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Assessing the Perceived Impacts of Ecotourism on the Adjacent Community: A Case of Meemure Area in Sri Lanka

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ABSTRACT

In the verdant landscapes of Meemure, Sri Lanka, ecotourism emerges as a vital source of economic sustenance for forest-dwelling communities. As custodians of these natural treasures, the local inhabitants play a pivotal role in fostering sustainable forest management practices. However, existing research in ecotourism often overlooks the perspectives of these rural communities, focusing instead on meeting the expectations of tourists and evaluating hospitality services. To bridge this gap, this study employs innovative causal models and mediation techniques to delve into the attitudes of forest villagers – the primary stakeholders – towards ecotourism activities in Meemure. Crucial insights were revealed by carefully examining the relationships between income opportunities from ecotourism, perceived ecotourism satisfaction, infrastructural challenges, and local situations. Findings affirm a positive correlation between ecotourism income and satisfaction, underscoring its potential for enhancing local well-being and economic growth. Additionally, the study reveals the detrimental effects of inadequate infrastructure on ecotourism satisfaction, highlighting the imperative of investment in local development. While challenging conventional notions, the research underscores ecotourism's pivotal role in mitigating adverse situations and fostering community resilience. It advocates for a holistic approach to ecotourism development, emphasizing sustainability, environmental stewardship, and cultural preservation. By fostering collaborative partnerships, sustainable ecotourism initiatives can pave the path toward harmonious coexistence with nature and enduring community prosperity.

KEYWORDS: Ecotourism, Meemure village, Rural communities, Structural equation modeling, Sustainable development

INTRODUCTION

Ecotourism has gained prominence as a sustainable development strategy that balances environmental conservation with economic growth. It promotes responsible travel to natural areas, aiming to conserve the environment and improve the well-being of local communities. As ecotourism grows, understanding its perceived impacts on adjacent communities becomes crucial (Kibria *et al.*, 2021). These impacts can be broadly categorized into economic, socio-cultural, and environmental dimensions.

Economically, ecotourism can generate income, create jobs, and improve local infrastructure. However, it may also lead to dependency on tourism and uneven distribution of benefits (Mbaiwa, 2005). Socio-culturally, ecotourism can foster cultural exchange and preserve local traditions, but it can also cause cultural commodification and social disruption (Weaver, 2002). Environmentally, while ecotourism promotes conservation efforts and sustainable practices, it can also contribute to environmental degradation if not properly managed.

Assessing these impacts from the perspective of residents provides valuable insights into the actual benefits and challenges they experience. It ensures that ecotourism development aligns with community needs and aspirations, identifies potential areas of conflict, and informs mitigation strategies to enhance positive outcomes and reduce negative effects (Stem *et al.*, 2003).

The remote village of Meemure, located in Sri Lanka's Knuckles Mountain Range, offers an ideal context for studying the perceived impacts of ecotourism on an adjacent community (Acquah *et al.*, 2017). Meemure is renowned for its unspoiled natural beauty, rich biodiversity, and traditional lifestyle, making it an attractive destination for ecotourists. As ecotourism in Meemure grows, it brings both opportunities and challenges to the local community (Acquah *et al.*, 2017). Economically, Meemure has seen benefits such as increased income from tourism-related activities and improved infrastructure. However, there are concerns about dependency on tourism and equitable distribution of economic benefits. Socio-culturally, ecotourism has facilitated cultural exchanges and highlighted the importance of preserving local traditions. Yet, there are worries about cultural erosion and changes in community dynamics. Environmentally, ecotourism has supported conservation efforts but also poses risks of environmental degradation due to increased tourist activity.

With this background, the overall objective of this research is to assess the perceived impacts of ecotourism on the community in Meemure by gathering insights from residents. Further the findings aim to provide recommendations for enhancing the positive impacts of ecotourism while mitigating its adverse effects, ensuring a sustainable and harmonious development path for Meemure.

METHODOLOGY

Theoretical Model and Hypothesis Formation

Figure 1 illustrates the conceptual framework, which was developed based on the literature reviews. A total of five hypotheses were defined to describe the relationship between variables.

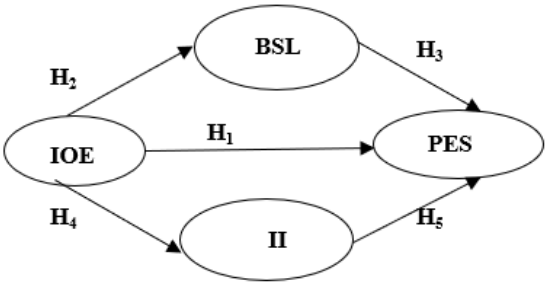

Figure 1. Conceptual framework

Note: IOE-Income Opportunities from Ecotourism; PES-Perceived Ecotourism Satisfaction; II-Insufficient Infrastructures; BSL-Bad Situation Experienced by local Inhabitants

H_1: Income opportunities from ecotourism activities are positively related to the ecotourism satisfaction levels of local inhabitants

H_2: Income opportunities from ecotourism activities are negatively related to the bad situations experienced by local inhabitants

H_3: Bad situations experienced by local inhabitants are negatively related to the ecotourism satisfaction levels

H_4: Income opportunities from ecotourism activities are negatively related to the insufficient infrastructure

H_5: Insufficient infrastructures are negatively related to the ecotourism satisfaction levels of local inhabitants.

Data Collection

Data were gathered through a pre-tested structured questionnaire. The socio-demographic characteristics of the respondents, such as age, gender, educational level, occupation, and monthly income, were assessed in Part one. Part two was primarily used to assess the four constructs proposed in the model. Sixteen indicators were used to evaluate four constructs. All indicators were measured using a seven-point Likert scale ranging from "strongly disagree" (1) to "strongly agree" (7). The data were collected in February and March, 2024. The 7-point Likert-type questionnaire form was designed in a way that all participants could easily understand and respond to it in 15-20 minutes. Households in Meemure Village were selected using systematic random sampling, targeting every 2nd household from a total of 150. We obtained 115 completed questionnaires, representing 77% of the village, ensuring a high response rate and data reliability.

Data Analysis

Extreme outliers were identified and removed to ensure data integrity. The data analysis was conducted using SPSS 26 and SmartPLS, chosen for their robust statistical capabilities and user-friendly interfaces. Two conceptually distinct models were used to analyze the collected data: the Measurement Model for reliability and validity analysis, and the Structural Equation Model for hypothesis testing (Ketchen, 2013).

RESULTS AND DISCUSSION

Demographic Characteristics

Among the 115 respondents, the majority (55.7%) were male. Age-wise, the population exhibited diversity, with significant proportions in the 35-49 age range (39.1%) and the 15-34 age range (21.7%). Educational levels varied, with a majority having secondary education (45.2%), followed by primary education (32.2%), and a smaller portion having higher education (7.0%). A notable percentage (15.7%) reported no formal schooling. Regarding occupation, respondents encompassed a range of roles, including farmers (26.1%), housewives (27.8%), self-employed individuals (31.3%), and others (14.8%). Regarding monthly income, a substantial portion earned between Rs.10,000-30,000 (46.1%), while 40.9% earned less than Rs.10,000.

Reliability Statistics

The reliability of the measurement scales was analyzed before testing the conceptual model (Table 1). Reliability measures the internal consistency of the constructs. The reliabilities of the scales in the measurement model are confirmed when the Cronbach alpha

Table 1. Results of reliability analysis

Scales and Items	No of Items	Cronbach's α
Income Opportunities from Ecotourism (IOE)	4	0.89
Perceived Ecotourism Satisfaction (PES)	3	0.96
Insufficient Infrastructure (II)	5	0.91
Bad Situation experienced by Local Inhabitants (BSL)	4	0.94

values are higher than 0.7 (Ketchen, 2013; Baydeniz et al., 2024). SPSS software was utilized to analyze reliability in terms of Cronbach alpha. The output provided insights indicating that the variables are correlated, and the data is suitable for factor analysis.

Structural Equation Modelling (SEM)

Structural Equation Modeling (SEM) was employed to examine the structural relationships among sixteen measured variables and four constructs. The measurement model and structural model are fundamental components of SEM. The measurement model assessed the validity of the constructs, while the structural model tested the significance of the hypotheses. Goodness of Fit indices were utilized to evaluate both the measurement and structural models. These indices determine how well sample data fits a distribution from a population with a normal distribution. Hu and Bentler (1999) concluded that when the CMIN/df value is less than three, the RMSEA value should be less than 0.08, and values of GFI, CFI, and TLI above 0.90 indicate a good fit for the model.

Measurement Model

The measurement model examines the relationship between the constructs and their measures. As reported in the study, there were four constructs: Income Opportunities from Ecotourism, Perceived Ecotourism Satisfaction, Insufficient Infrastructures, and Bad Situations Experienced by Local Inhabitants. The results revealed that the obtained chi-square value was 186.62, significant at the 0.05 probability level. The CMIN/df value, which represents the chi-square normalized by the degree of freedom, was 1.885, and the RMSEA (Root Mean Square Error of Approximation) was 0.068, indicating an acceptable model fit. The GFI (Goodness of Fit Index), CFI (Comparative Fit Index), and TLI (Tucker and Lewis Index) values were 0.903, 0.946, and 0.934, respectively. Therefore, the overall fitness of the measurement model meets the acceptance level of goodness of fit required to assess the structural model hypotheses. Confirmatory Factor Analysis (CFA) was conducted to test convergent validity. If a factor's Average Variance Extracted (AVE) value is above 0.5, that factor is said to have convergent validity. The square root values of each factor's Average Variance Extracted (AVE) were higher than its correlation coefficient with other factors, indicating that discriminant validity was achieved. According to the output of the measurement model, the Composite Reliability (CR) values ranged from 0.887 to 0.963, and the AVE values ranged from 0.665 to 0.895. The overall fitness achieved is sufficient for testing the conceptual model

Structural Model

The raw data of the survey variables retained from the Confirmatory Factor Analysis (CFA) were utilized as the database for the structural model analysis (Chen and Huang, 2013). This step was taken after confirming the overall good fit of the measurement model. Subsequently, the proposed causal relationships and hypotheses were tested via the structural model. Accordingly, structural paths were drawn between the four constructs and their variables. In the structural model, Income Opportunities from Ecotourism (IOE) can be identified as the exogenous (independent) variable, while Perceived Ecotourism Satisfaction (PES) represents the endogenous (dependent) variables (Figure 2).

Regarding the fitting indices for the structural model, the chi-square value was 191.32, which was statistically significant with 99 degrees of freedom (df). Additionally, the values of CMIN/df, RMSEA, NFI, CFI, and TLI were 1.93, 0.076, 0.99, 0.95, and 0.94, respectively. According to the standards of model fitting, the achieved output of this structural model demonstrates an overall good fit. The results of the hypothesis test are presented in Table 2. The outcomes indicate that four hypotheses are significant, while one is not. The results of the hypothesis tests in this study provide insights into the relationships between Income Opportunities from Ecotourism (IOE), Perceived Ecotourism Satisfaction (PES), Insufficient Infrastructures (II), and Bad Situations Experienced by Local Inhabitants (BSL).

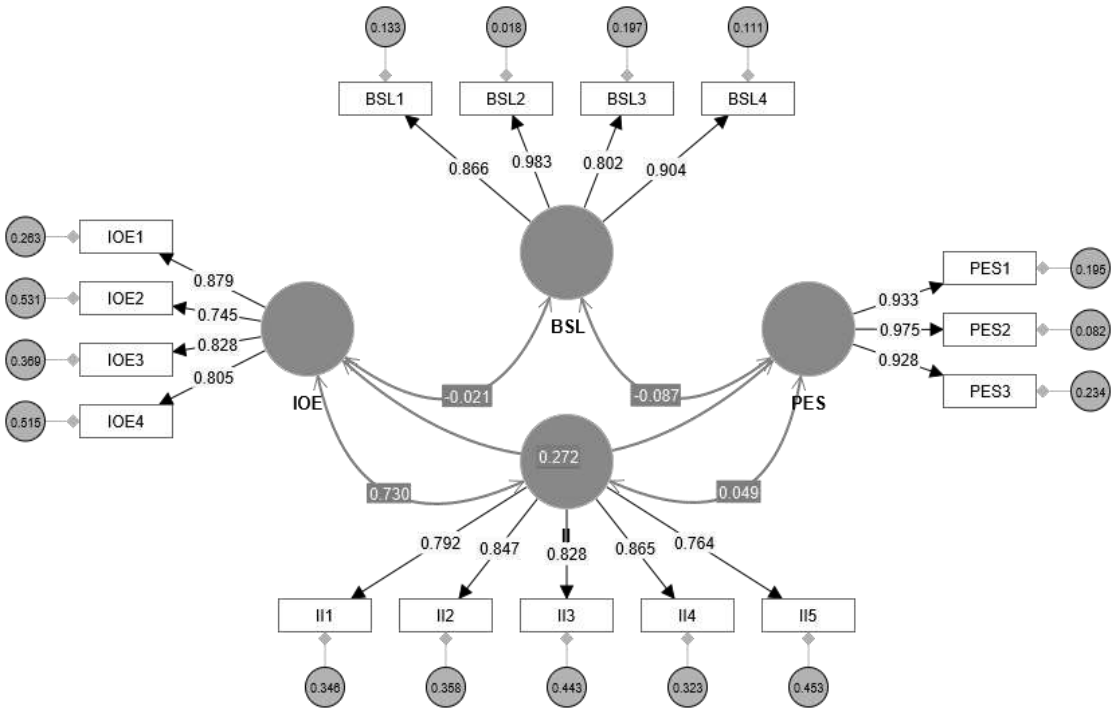

Figure 2. Complete Structural equation Model

Note: IOE-Income Opportunities from Ecotourism; PES-Perceived Ecotourism Satisfaction; II-Insufficient Infrastructures; BSL-Bad Situation Experienced by local Inhabitants

Table 2. Hypothesis test

Hypothesis	β	p-Value
IOE -> PES	0.26	0.00
IOE -> BSL	-0.06	0.04
BSL -> PES	-0.07	0.58
IOE -> II	-0.06	0.00
II -> PES	-0.23	0.04

The analysis reveals a positive and statistically significant relationship between Income Opportunities from Ecotourism (IOE) and Perceived Ecotourism Satisfaction (PES), with a β coefficient of 0.26 and a p-value of 0.000. This indicates that as income opportunities from ecotourism increase, perceived satisfaction with ecotourism also increases. Thus, enhancing income opportunities from ecotourism can significantly boost local perceptions of ecotourism satisfaction.

Our findings also show a statistically significant negative relationship between IOE and Bad Situations Experienced by Local Inhabitants (BSL), with a β coefficient of -0.063 and a p-value of 0.042. This suggests that increased income opportunities from ecotourism are associated with a reduction in adverse situations experienced by local inhabitants.

However, the hypothesis that BSL negatively affects PES is not supported by the data. Although the path coefficient is negative (β = -0.066), the p-value is 0.58, far above the 0.05 significance level. This non-significant relationship indicates that bad situations experienced by local inhabitants do not have a statistically discernible impact on their perceived satisfaction with ecotourism. Consequently, we reject the hypothesis that BSL negatively influences PES.

The relationship between IOE and Insufficient Infrastructures (II) is both negative and highly significant, with a β coefficient of -0.063 and a p-value of 0.000. This indicates that as income opportunities from ecotourism increase, the level of insufficient infrastructure decreases. The highly significant p-value confirms the strength of this relationship, supporting the hypothesis that IOE negatively influences II. This finding underscores the role of ecotourism income in improving local

infrastructure, thereby reducing infrastructural insufficiencies.

Finally, the hypothesis that II negatively affects PES is supported by the data, with a β coefficient of -0.23 and a p-value of 0.040. The negative coefficient suggests that higher levels of insufficient infrastructure are associated with lower perceived satisfaction with ecotourism. The p-value, being below 0.05, indicates a statistically significant relationship, thus supporting the hypothesis. This highlights the importance of adequate infrastructure in enhancing the satisfaction of those engaged in ecotourism.

CONCLUSIONS

This research underscores the multifaceted impact of ecotourism on rural communities, exemplified by the case of Meemure village in Sri Lanka. The study comprehensively examines the relationships between income opportunities from ecotourism, perceived ecotourism satisfaction, infrastructural challenges, and adverse local situations, yielding significant insights. The findings confirm a positive correlation between income opportunities from ecotourism and ecotourism satisfaction, indicating that ecotourism can enhance local well-being and economic prosperity. Additionally, the study highlights the adverse effects of insufficient infrastructure on ecotourism satisfaction, emphasizing the need for investment in local infrastructure to achieve sustainable development. Interestingly, the results challenge the conventional wisdom regarding the impact of adverse local situations on ecotourism satisfaction, suggesting that these factors may not significantly influence satisfaction in certain contexts. Despite this, the study also demonstrates the critical role of ecotourism in mitigating adverse situations by fostering economic opportunities and community development.

Moving forward, it is essential for policymakers and stakeholders to adopt a holistic approach to ecotourism development, prioritizing sustainability, environmental conservation, and cultural preservation. By fostering partnerships between government agencies, local communities, and private enterprises, sustainable and equitable ecotourism initiatives can be realized. This collaborative approach can pave the way for a future where communities thrive in harmony with their natural surroundings.

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Impact of Cross-disciplinary Collaboration and Funding Opportunities on Performance in Agri-tech Start-ups

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ABSTRACT

Agri-tech start-ups operating in the areas of agri-tech, food-tech, and farming as a service present a promising solution to address the issues of limited innovations and resources. These start-ups leverage new technologies to revolutionize agricultural processes and turn them into more efficient, sustainable, and secure solutions. The research aimed to investigate the synergistic effects of Cross-disciplinary collaboration and Funding opportunities on the performance of agri-tech start-ups in Sri Lanka. Utilizing the data acquired from employees of the agri-tech start-ups in Sri Lanka, the study performed a Regression Analysis to examine the relationship between these factors and Start-up performance. The finding revealed that the Cross-disciplinary collaboration, substantially in operational aspects, significantly influences the Start-up performance. Additionally, funding opportunities played a crucial role in enhancing Start-up performance. The Regression Model suggested that the increment in Cross-disciplinary collaboration or Funding opportunities led to a corresponding improvement in Start-up performance. Overall, this study highlighted the importance of encouraging Cross-disciplinary collaboration and expanding Funding opportunities to boost the performance of agri-tech start-ups in Sri Lanka. Promoting the collaboration between diverse stakeholders and facilitating access to funding, policymakers, and industry players can drive innovation and growth in the agri-tech sector, ultimately contributing to the advancement of agriculture and economic development in Sri Lanka.

KEYWORDS: Agri-tech Start-ups, Cross-disciplinary collaboration, Funding opportunities, Performance

INTRODUCTION

The agriculture sector in Sri Lanka employs 30% of the workforce, contributing seven percent to the Gross Domestic Product (GDP), which indicates it's cruciality to the economy. However, regardless of the importance, the sector also deals with challenges due to limited innovation and resources. Ranathunga *et al*. (2018) highlighted that to overcome the said challenges, appropriate, latest technologies should be introduced and communicated among all agricultural stakeholders. That is how the agri-tech start-ups can support the development of the sector.

According to Ries (2011), start-up companies or pioneering companies are newly established companies and are in the research and development phase to find the most appropriate market that has been planned before the business is executed. Start-ups working in the agriculture technology sector are known as agri-tech start-ups. They are working on three working spaces; Agri-tech, Food-tech, and FAAS (Farming as a service) (Vijayan and Shivkumar, 2020).

As noted by Vijayan and Shivkumar (2020), these start-ups deal with new technologies, innovations, and capabilities that change how food and farm products are grown, harvested, packaged, stored, transported, processed, and sold, making the agricultural process from field to the end user more efficient, sustainable and safe.

The literature suggests that planning factors, competency factors, source of funding factors, business environment factors, educational factors, family factors, and technological factors are crucial to the success of start-ups (Gunawan, 2017). This study focused on competency and source of funding factors where competency factors were represented by cross-disciplinary collaboration and source of funding factors were represented by funding opportunities.

This study addressed this critical gap in identifying the synergistic effects of three key support mechanisms: Cross-disciplinary collaboration, Funding opportunities, and Start-up performance.

Therefore, the objectives of the study were to; (1) determine the current level of and different types of discipline collaboration among agri-tech start-ups in Sri Lanka, (2) investigate how these different levels/types of discipline collaboration impact the performance of agri-tech start-ups, (3) explore the existing funding opportunities available for agri-tech start-ups in Sri Lanka and (4) investigate how these different funding sources contribute to the performance of agri-tech start-ups in Sri Lanka.

METHODOLOGY

Theoretical Framework

The study two independent variables (i.e. Cross-disciplinary collaboration and Funding opportunities) and investigated their influence on start-up performance (Figure 1). Accordingly, the following hypotheses were developed:

H_1: There is a significant and positive relationship between Cross-disciplinary collaboration and Start-up performance.

H_2: There is a significant and positive relationship between Funding opportunities and Start-up performance.

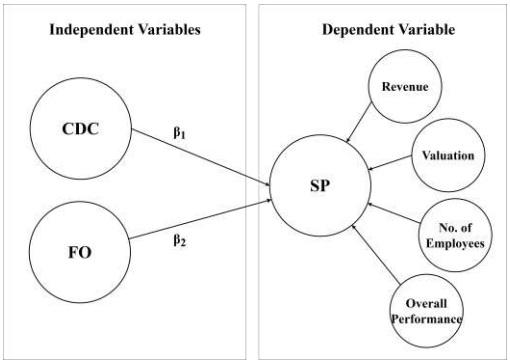

Figure 1. Theoretical framework that shows the relationship between dependent and independent variables.

CDC- Cross-disciplinary collaboration, FO- Funding opportunities, SP- Start-up performance.

Survey Design

The survey was crafted to gather comprehensive insights into factors influencing the performance of agri-tech start-ups in Sri Lanka. The questionnaire comprised four main categories, each tailored to extract specific information vital for the research objectives. The categories included: (1) General information- captured the details about socio-demographics data about the start-ups, (2) Cross-disciplinary collaboration information- focused on understanding the data mainly through a Likert scale question statements, (3) Funding opportunities- was designed to gather data through Likert scale type questions and (4) Information about the performance of the start-ups were measured mainly using Likert scale type questions focused on Annual revenue change, Valuation change, Number of employees change and the Overall performance.

Data Collection

Based on research into the latest agri accelerators and LinkedIn, 50 agri-tech start-ups were selected as the sampling frame of the study. The employees in the start-ups were identified as the sample of the research.

Data was collected through a structured online survey questionnaire format to ensure efficient data collection and maintain consistency in responses. Prior to the main survey, a pilot test was conducted with a small sample of five co-founders of start-ups to validate the questionnaire, and necessary revisions were made based on the feedback received.

After refining and improving the questionnaire, the main survey was conducted with 111 employees currently working in the start-ups, ranging from the executive level to the general office workers. Convenience sampling and snowball sampling were employed as the sampling techniques, and it involved contacting the respected company employees personally and requesting the CEOs to link their company employees to the research.

Data Analysis

The study adopted an Ordinary Least Square (OLS) regression analysis to examine the relationship between the independent variables (i.e. Cross-disciplinary collaboration, Funding opportunities) and the start-up performance. The analysis was performed using the Statistical Package for the Social Sciences (SPSS) software.

The regression equation can be stated as follows (Equation 1);

$$Y= \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \varepsilon \ldots\ldots (1)$$

Where,

Y = Dependent Variable, β_0 = intercept, β_1, $\beta_{2\ldots}$, βn = Coefficients associated with the independent variables, X_1, $X_{2\ldots}$, X_n are independent variables, and ε = Error term.

According to Equation 1, the derived regression analysis equation (Equation 2) can be expressed as follows.

$$\text{Start-up performance} = \beta_0 + \beta_1 \times \text{Cross-disciplinary collaboration} + \beta_2 \times \text{Funding opportunities} + \varepsilon \ldots\ldots (2)$$

The data collected from the survey were analyzed using quantitative data analysis approaches to check the theoretical model constructed. The demographic data were descriptively analyzed using Excel software. Inferential measures were employed using the SPSS software.

RESULTS AND DISCUSSION

Summary of Socio-demographic Factors

Descriptive statistical tools were used to summarize socio-demographic characteristics

of the respondents. The results of the descriptive analysis are depicted in Table 1.

Table 1. Demographic characteristics

Parameters	Category	Percentage (%)
Industry categories	Agri-data analytics and decision support	16.92
	Agribusiness/ e-commerce /marketplace	15.38
	Smart farming (IoT-Internet of Things)	13.85
	Agri-fintech	13.85
	Precision agriculture	12.31
	Sustainable farming	9.23
	Agri biotechnology	6.15
	Farm automation and robotics	6.15
	Vertical farming and controlled environment agriculture	4.62
	Agri production	1.54
Target customers	Global	52.94
	Domestic	47.06
Company size	1-10 employees	61.76
	11-20 employees	26.47
	21-30 employees	5.88
	30+ employees	5.88
Employee prior start-up experience	Have	46.85
	Do not have	53.15
Disciplines in the start-up	AFL, BM and ET	44.12
	BM and ET	17.65
	AFL and BM	14.71
	AFL and ET	8.82
	AFL, BM, ET and LE	8.82
	AFL, BM and LE	2.94
	AFL, BM, ET and RAM	2.94
Current funding stage	Pre-seed/idea stage	47.06
	Seed stage	41.18
	Series A	11.76
Funding explored	Explored	70.59
	Have not explored	29.41

AFL: Agriculture, food science or life sciences, BM: Business management, ET: Engineering, and technology, LE: Legal, RM: Research, and marketing.

The founding years of the companies varied from 2013 to 2017. The top five industry categories of agri-tech start-ups were Agri-data analytics and decision support, Agribusiness/e-commerce/marketplace, Agri-fintech, Smart farming (i.e. IoT - Internet of Things), and Precision agriculture.

Fifty-three percent of total companies targeted global customers whereas 47.06% of companies targeted domestic customers. Sixty-two percent of companies had 1-10 employees while the remaining 38.24% had 11 or more employees. In general, there are 1-4 founders in a company

When considering the employees, 53.14% do not have prior experience in start-up, while 46.85% do. In terms of the companies, 44% have teams focused on agriculture, food science or life sciences, business and management, engineering, and technology.

Respectively 47.06% of the companies are in the pre-seed/idea stage, 41.18% are in the seed stage and 11.76% are in series A (i.e. first institutional round of funding). Moreover, the majority of companies (70.59%) have explored funding opportunities from angel investors, grants, venture capital, and crowdfunding (Table 1).

Results of the Reliability Analysis

To ensure the reliability of the Likert scale data collected Cronbach's alpha test was carried out. According to Hair *et al*. (2013), Cronbach's alpha between 0.6 and 0.8 is considered acceptable for reliability. To measure the validity; Kaiser-Meyer-Olkin (KMO), Bartlett's Sphericity, and Average Variance Explained (AVE) tests were conducted (Table 2).

Table 2. Reliability and validity test

Variable	Cronbach's alpha	KMO	AVE
CDC	0.820	0.772	52.18%
FO	0.938	0.905	73.95%
SP	0.880	0.900	73.61%

KMO-Kaiser-Meyer-Olkin test, AVE- Average Variance Explained, CDC: Cross-disciplinary collaboration, FO: Funding opportunities, SP: Start-up performance.

According to the results, the CDC, FO, and SP variables have Cronbach's alpha values higher than 0.6 which indicates acceptable levels of reliability. The generally accepted KMO test value is above 0.50. The CDC, FO, and SP variables all show higher KMO values, indicating good sampling adequacy for factor analysis. An AVE value above 50% is typically considered acceptable. The AVE values for CDC, FO, and SP are 52.18%, 73.95%, and 73.61%, respectively, which are within the acceptable range.

Principal Component Analysis (PCA)

Principal component analysis (PCA) was conducted to summarize the variables to a manageable number and to identify the variables for the model. The Varimax-rotated component matrix is depicted in Table 3.

The PCA extracted four components, which collectively explained 73.967% of the variance. The first component, extracted items explaining the Funding opportunities, hence named "Funding opportunities impact". The second factor, which grouped the questions related to Start-up performance was named the "Start-up performance".

Six variables were extracted under the third and fourth factors which compositely represent the cross-disciplinary collaboration (CDC) items.

As the variables loaded into components three and four cannot be cross-loaded, two separate components were created and named "CDC impact in operations", and "CDC impact in teams".

The four components extracted are then used to refine the theoretical model proposed in Figure 1. Thereby, the new model consisted of three independent variables namely; cross-disciplinary collaboration impact in operations (CDC_O), cross-disciplinary collaboration impact in teams (CDC_T), and funding opportunities (FO), and one dependent variable start-up performance (SP) which comprised four measurements (Figure 2).

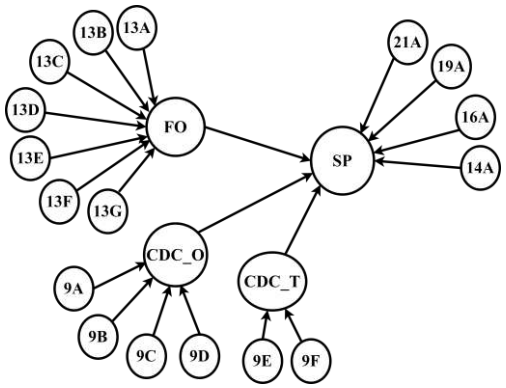

Figure 2. New theoretical framework constructed using the factor analysis.
CDC_O: Cross-disciplinary collaboration in Operations, CDC_T: Cross-disciplinary collaboration in teams FO: Funding opportunities, SP- Start-up performance.

Ordinary Least Square Regression

As the first step of the regression, the normality of the dependent variable was examined using the Shapiro-Wilk Test. Since the probability value (p) associated with the Shapiro-Wilk Test (p=0.12) was greater than the conventional significance level of 0.05, the null hypothesis is accepted. Therefore, the assumption of normality for the dependent variable can be concluded.

The coefficient of Multiple Correlation which is R, estimates the strength and direction of the linear relationship between the independent and dependent variables. In this case, the R-value is 0.0668, indicating a moderately strong positive correlation between the independent and the dependent variables.

Table 3. Rotated Component Matrix

Rotated component matrix					
	ID	**1**	**2**	**3**	**4**
High flexibility in negotiating terms and conditions	13E	.825			
High overall satisfaction in fundraising	13G	.810			
Easy to secure funding opportunities	13B	.802			
Satisfactory funding terms and conditions	13F	.798			
Easy to find funding opportunities	13A	.782			
Low competition to access funding	13D	.762			
Easily met eligibility criteria	13C	.725			
Change in number of employees 2023	16A		.810		
Overall performance in 2023	21A		.797		
Valuation changes in 2023	19A		.762		
Annual revenue change in 2023	14A		.718		
Increment of innovations/ideas	9A			.794	
Able to acquire more customers	9C			.789	
Able to find more funding opportunities	9D			.683	
Able to access to the new resources/ opportunities	9B			.622	
Easy decision making	9E			.262	.854
Easy to coordinate the team members	9F			.160	.825

Extraction method: Principal component analysis, 1: Funding opportunities impact, 2: Start-up performance, 3: Cross-disciplinary collaboration impact in operations, 4: Cross-disciplinary collaboration impact in teams.

The R-squared value is 0.446, indicating that 44.6% of the variance in the dependent variable (i.e. Start-up performance) is explained by the independent variables.

The standard error of the model is 0.4945, which reflects the model prediction accuracy. The Durbin-Watson statistic is a test for dependence between residuals or autocorrelation. In the model, the value is 1.790, which suggests a lack of substantial autocorrelation.

The F-value of the regression model is 28.720, while the probability value is <0.001 indicating that the model significantly explains variation in the dependent variable. The results of the Regression Analysis are presented in Table 4.

Table 4. Results of the Regression Analysis

Model	Unstandardized B	Probability
Constant	1.702	<0.001
CDC_O	0.192	0.038
CDC_T	0.005	0.943
FO	0.391	<.001

CDC_O: Cross-disciplinary collaboration in operations, CDC_T: Cross-disciplinary collaboration in teams, FO: Funding opportunities.

The results suggest that the CDC in operations (probability = 0.038<0.05), is significantly and positively related to the Start-up performance. However, CDC in teams (probability = 0.943>0.05), showed no significant relationship to the Start-up performance.

Interestingly, Funding opportunities (probability <0.001<0.05), also showed a significant and positive to the Start-up performance. The regression model can be formed as follows (Equation 3):

Start-up performance = 1.702 + 0.192×Cross-disciplinary collaboration in operations + 0.391× Funding opportunities …… (3)

Based on this model, if all the other variables are kept constant and Cross-disciplinary collaboration is increased by one unit, Start-up performance will increase by 0.192 units. In terms of Funding opportunities when it increases by one unit while other variables are constant, Start-up performance is expected to be increased by 0.391 units.

CONCLUSION

As stated in the equation model, cross-disciplinary collaborations, especially in operations, have a positive impact on the start-up performance in agri-tech start-ups. This indicates importance of different disciplines working together in the operations of the start-ups. Funding opportunities also demonstrated a positive impact on start-up performance.

To enhance the start-up performance in the agri-tech industry in Sri Lanka, relevant parties can support start-ups by increasing the chances of Cross-disciplinary collaboration. This can be achieved by introducing people from agriculture, food science or life sciences, business and management, engineering and technology, legal, research, and marketing disciplines.

As the research examined, grants, crowdsourcing, angel investing, and venture capital are the current funding options accessible for agri-tech start-ups in Sri Lanka. Additionally, by expanding funding opportunities, more start-ups will be able to explore these resources and improve their performance.

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Navigating Agricultural Uncertainties: Risk Sources and Management Strategies Among Maize Farmers in Monaragala District, Sri Lanka

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ABSTRACT

Agriculture plays a pivotal role in the developed and developing countries of the world. Agricultural activities are subjected to a variety of risks and uncertainties. Risk can be defined as the probability of a possible outcome that is known. This study explores the farmers' perceptions of various sources of risks encountered by them during their cultivation. There are various management tools available for farmers to help prevent risk. Therefore, it was also intended to explore the various risk management strategies that are already being adopted by the farmers. The primary data was gathered from maize farmers in Monaragala district using a structured questionnaire. Maize farmers (n=303) were selected as the sample of this study based on a multi-stage sampling technique. Descriptive statistics and Exploratory factor analysis were used to process the data. Exploratory factor analysis was employed to identify and summarize farmers' perceptions of sources of risk and the relevant management strategies adopted. For risk sources; environmental (natural) risk, input-related risks, financial and regulatory risk, farming-related risks, and operational risks were perceived as the most important sources of risk in the studied area. For management strategies; financial risk management strategies, operational risk management strategies, strategic risk management strategies, knowledge-related risk management strategies, human resource risk management strategies, and marketing risk management strategies were the most pivotal to mitigate risks. Accordingly, this exploration into farmers' risk perceptions and risk management strategies could provide important inputs to the farm decision-makers who wish to uplift this important crop sector.

KEYWORDS: Maize farmers, Risk management strategies, Risk perception, Risk sources

INTRODUCTION

Agriculture plays a pivotal role in the developed and developing countries of the world. Likewise, in the Sri Lankan context, the agricultural sector makes up a significant portion of the country's economy. The agriculture sector comprises several different crop sectors including field crops, oil crops, fruit and vegetables, and root and tuber crops. Maize (*Zea mays*) is one of the main field crops grown in Sri Lanka which greatly contributes to the overall crop production of agriculture in Sri Lanka and in turn the economy of Sri Lanka. Maize is a commonly found food crop in the diet of most of the people in Sri Lanka, especially in rural areas. A large proportion of maize is grown and consumed in Monaragala, Polonnaruwa, Anuradhapura, and Ampara districts.

The uncertainty concerning an outcome that involves some loss that negatively affects an individual's well-being is normally associated with the concept of risk. According to Ullah *et al*., (2016), uncertainty is imperfect knowledge and risk is exposure to uncertain unfavorable economic consequences. In practice, both concepts are very much related and used interchangeably.

Agriculture is considered an inherently risky endeavor where agricultural activities are subjected to a variety of risks and uncertainties. Similarly, maize farmers are also at a high level of risk due to a number of factors such as; Seasonal changes in demand, Unexpected variability in yields, Insufficient storage facility, Lack of market information, Inadequate infrastructure, Debt situation, Cost of fuel prices, Variability in input prices, Lack of farming-related knowledge, Climate change, Government influences (*i.e*. Tax, Subsidies, and Allowances), and Animal impact (Ullah *et al*., 2016; Ahsan, 2011). Maize farmers like most other people, also place greater weight on potential negative outcomes of risk and are generally willing to sacrifice potential income to avoid a risk or uncertainty (Ahsan, 2011).

By looking at the number of sources of risks encountered by these farmers, it is important to explore whether and how they manage the risks they face. However, regardless of the importance of maize as a field crop as well as an essential ingredient in animal feed production, the attention received from previous scholars is close to none. It was difficult to locate much previous literature focused on risks and risk-related aspects of maize production in the Sri Lankan context. Therefore, based on the above background, the objectives of this study were to explore and identify the risk factors contributing to the reduction of maize yield particularly in the Monaragala district, one of the leading maize-

growing areas in the country. Further, it is also intended to investigate the various risk management strategies that are already adopted by the farmers. Insight into the risk and corresponding management strategies in maize farming is expected to provide useful information to policymakers which can be used to design policies and measures to help farmers to manage their risk more effectively.

METHODOLOGY

Study Area and Data

The study was carried out in five Divisional Secretariats in Monaragala district from February 2024 to April 2024. The approach of multi-stage random sampling was used to select the respondents. The researcher administered a standardized questionnaire to gather primary data. The questionnaire was pretested and validated using a pilot survey (n=15). A sample of 303 maize farmers in Monaragala district participated in the main survey.

Measures

The questionnaire was divided into six sections i.e.: farmers' socio-demographic characteristics; farming information; Storage capacity and market information; Perceived sources of risks; and Risk management strategies. Eleven variables were employed to examine the farmers' perception of risk sources measured on a five-point Likert-scale ranging from "Strongly Disagree (1)" to "Strongly Agree (5)". Farming information was gathered on farm size, production cost, total maize production per season, and gross revenue. Four variables were used to measure storage capacity and market information. Twenty-one risk management strategies were identified based on the literature and the data were collected on the frequency of adoption (Girma, *et al*., 2023; Shadbolt and Olubode-Awosola 2013). The adoption data were also gathered on a five-point Likert-scale ranging from "Very rarely adopted (1)" to "More frequently adopted (5)".

Data Analysis

Statistical Package for the Social Sciences (SPSS) statistical software was used to analyze the data. Socio-demographic characteristics of farmers and farming information were analyzed using descriptive statistical tools. The internal consistency of Likert-scale items was measured by using Cronbach's alpha value (Cronbach, 1951).

Exploratory Factor Analyses (EFA) were separately carried out to summarize the data gathered on perceived risk sources and the adoption of risk management strategies. Factor loading of 0.4 and above is regarded as significant for the sample of 303 respondents (Girma, *et al*., 2023). Factor loading depicts the strengths of the relationships between the items and the factors.

RESULTS AND DISCUSSION

Socio-demographic Profile of Respondents

As illustrated in Table 1, the socio-demographic factors of the sample were summarized using descriptive analysis. Accordingly, 77 % of respondents were male farmers while 23 % were female farmers (Table 1). All respondents were over the age of 20 years, but 83.44 % of farmers were between the ages of 20 and 60 and only 16.55 % were over the age of 60. The majority of the respondents (97.7 %) participated in activities for Agricultural Farm Extension. Among the respondents, 11.5 % of farmers have more than 30 years of maize farming experience compared to 73.3 % who have between 10 to 30 years of experience in maize farming. The majority of the respondents completed their education up to Ordinary Level (48 %). The percentage of farmers with higher education was only 1.32 % (Table 1).

Table 1. Descriptive summary

Variable	Category	Percentage (%)
Gender	Male	77
	Female	23
Age	20-40 years	34.6
	40-60 years	52.8
	Above 60 years	12.2
Education	No schooling	3
	Up to grade 5	17.2
	Grade 5-10	25.4
	Up to O/L	47.9
	Up to A/L	5.3
	Higher education	1.3
Experience in growing maize (Years)	0-10 years	15.2
	10-20 year	34.7
	20-30 year	38.6
	30-40 year	8.9
	Above 40 years	2.6

Descriptive Statistics of Farming Information

Farm investment, farm size, seasonal maize production, production cost, seasonal gross revenue, production, membership in farmer groups and type of farmers group, and application of technology in irrigation are the main variables considered under farming information. More than 50 % of maize farmers made investments in their farms using both personal capital and third-party capital while 35.5 % used only personal capital. In maize cultivation, 99 % of farmers followed the

traditional method. Interestingly, instead of adhering to radio or television as sources of farming information and help from agriculture instructors, farmers used their own experience and climate-related knowledge when growing the farmland. All respondents used traditional methods for irrigation technology (i.e. rainwater).

Storage Capacity and Market Information

Sixty-two per cent of maize farmers directly obtained market information from the market itself. Only 1 % of them had used indirect sources such as television, radio, or the Internet. After the cultivation, farmers stored their harvested maize in maize sheds. However, the majority of the farmers haven't had enough storage capacity (95.7 %). Only 4.3 % of farmers have enough storage capacity to store their harvest (Table 2).

Table 2. Summary of storage capacity and market information

Variable	Category	Percentage (%)
Access to market information	Take market information	99
	Don't take market information	1
Sources of obtaining market information	Direct (from the market)	62.3
	Indirect (Television/ Radio/ Internet)	1.7
	Other sources	36.1
Storage capacity	With enough storage	4.3
	Without enough storage	95.7

Reliability Analysis

Reliability was calculated by using Cronbach's alpha measuring the internal consistency of the Likert-scale variables. (Hair *et al*., 2021). According to Girma *et al*., (2023), sample adequacy test results showed a Kaiser-Meyer-Olkin (KMO) value of 0.808 and Bartlett's test value ($\chi 2 = 1773.594$, *probability* < 0.000), which implied that sufficient and reliable factors were produced.

In this study, KMO value and Bartlett's test value were within acceptable range. Hence, the data appeared suitable for further statistical analysis. Thereby, the next step of the analysis was the Exploratory Factor Analysis (EFA).

Exploratory Factor Analysis (EFA)

EFAs carried out for two risk-related variables namely, sources of risk and risk management strategies. The Varimax rotated component matrices are presented in Table 3, and Table 4 respectively. The first EFA conducted for the sources of risks extracted five factors that explained more than 63 % of the cumulative variance. Among the 11 sources of risks used in the analysis, three sources were extracted under the first factor explaining the majority of the variance. Based on the composition of the variables of the first factor, it can be identified as "Environmental (Natural) Risks". Following the same procedure, the five factors were named; Environmental (Natural) risks, Input-related risks, Financial & regulatory risks, Farming-related risks, and Operational risks.

The literature also supported this summarization where previous scholars found that maize farming is mostly influenced by weather conditions (Adnan *et al*., 2021). Further, this research found that maize farmers are more vulnerable to the effects of environmental (natural) risk. Likewise, seasonal changes in demand and unexpected variability in yield have insignificant positive impacts on maize farmers' decision-making process regarding the adoption of environmental risk. Following the same procedure as above, the second factor was renamed input-related risk. Cost of fuel prices and lack of farming-related knowledge have impacted maize farming (Table 3).

Apart from the above two categories of sources of risks, Financial & regulatory risks, Farming-related risks, and Operational risks also explained a considerable amount of variance. This highlights that farmers tend to perceive these sources of risks at a lesser level of importance in comparison to environmental and input-related risks (Table 3).

The data gathered on the adoption of risk management strategies were then considered in the second EFA (Table 4). The Varimax Rotation was utilized as the rotation technique while Principal Components were used as the extraction method. The analysis extracted six factors that cumulatively explain 58 % of the variance in the data. The first factor was called financial risk management strategies, the second was Operational risk management strategies, the third was Strategic risk management, the fourth was Knowledge-related risk management strategies, the fifth was human resource risk management strategies, and the sixth was Marketing and natural risk management strategies (Table 4).

Table 3. Rotated component matrix for risk sources

No	Risk source	1	2	3	4	5
1	Seasonal changes in demand	0.767				
2	Unexpected variability in yields	0.758				
10	Climate change	0.595				
7	Cost of fuel prices		0.815			
9	Lack of farming-related knowledge		0.786			
11	Government influences (TAX, Subsidies, Allowances)			-0.808		
4	Lack of capital			0.688		
5	Inadequate infrastructure				0.688	
12	Animal impact (Elephant, Monkey, Pig, Bird)				0.541	
6	Effect of creditors				-0.499	
3	Insufficient storage facility					0.838
8	Variability in input prices					0.511

Note: 1-Environmental (Natural) risks, 2-Input-related risks, 3-Financial & Regulatory risks, 4-Farming-related risks, 5-Operational risks

Table 4. Rotated component matrix for the adoption of risk management strategies

No	Risk management strategy	1	2	3	4	5	6
6	Managing debt	-0.839					
7	Keeping debt low	-0.819					
17	Enter into contracts/ agreements with raw material suppliers	0.754					
8	Purchasing inputs in bulk (from wholesale markets)	0.702					
19	Using futures markets	0.450					
4	Keeping raw material reserves	0.440					
13	Monitoring technology changes		0.766				
12	Monitoring market trends		0.748				
5	Planning resource allocation		0.458				
2	Having another regular source of income (e.g.: taking up a part-time job, other investments, fixed deposits		0.396				
3	Keeping cash reserves or assets that can be easily converted into cash		0.392				
21	Assessing the strengths, weaknesses, threats and opportunities for the farm			0.837			
20	Planning capital spending			0.786			
10	Entrusting key decision-making to experts				0.797		
11	Participating in relevant workshops organized by AI officers to improve knowledge				0.556		
18	Enter into contracts/agreements with buyers				0.421		
15	Spreading sales					0.756	
9	Involving family members in the farm					0.650	
16	Sourcing expert knowledge (e.g.: AI officers)					0.381	
14	Monitoring competitor activities						0.714
1	Insurance against hazard risks						0.587

Note: 1- Financial Risk Management Strategies, 2- Operational Risk Management Strategies, 3- Strategic Risk Management Strategies, 4- Knowledge-related Risk Management Strategies, 5- HR Risk Management Strategies, 6- Marketing and Natural Risk Management Strategies

According to the results of the EFA, the majority of the strategies extracted under the first component were those used to manage risks associated with farming. Likewise, the second factor has a significant contribution to managing risks associated maize farming (i.e. operations). These six categories are used by maize farmers in the Monaragala district to manage the risks they face (Table 4).

CONCLUSIONS

This study sought to identify the perceived sources of risks of maize farmers in Monaragala district and to determine the various risk management strategies used by these farmers.

The results highlighted the association of socioeconomic factors and the source of risk of farmers regarding their decisions of risk management strategies. According to the results, environmental or natural risks were the most perceived source of risk for these farmers including climate change, unexpected variabilities in demand, and seasonal changes. Apart from these farmers perceived farming and operational risks and financial risks also to be significant. However, in contrast, farmers placed a high level of importance on managing their risks by adopting financial risk management strategies including managing their debts. It was also interesting to see that have adopted farm planning, knowledge management, and human resource-related risk management strategies in managing the risks they face.

The findings of this study are quite significant as it has touched on an under-research area in agricultural crop production in Sri Lanka. Even if maize is a significant contributor to the country's economy the attention paid to the sector was considerably low. Thereby, the exploration into farmers' risk perceptions and risk management strategies could provide important inputs to the farm decision-makers who wish to uplift this important crop sector. Education and training programs on financial management and marketing could benefit these farmers as they place high importance on such management strategies.

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Technical Efficiencies and Technology Gap Ratios of Asian Agricultural Production: A Stochastic Meta-Frontier Analysis

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ABSTRACT

This study examines the agricultural production efficiency of 28 Asian countries from 1992 to 2021, categorized by their income levels. The descriptive statistics revealed significant variation in production values, land extent, labor, and input usage across these countries. The analysis utilized stochastic production frontiers and Meta-frontier estimations to identify differences in production technologies among high-income, upper middle-income, and lower middle-income groups. The results indicated that the average TE for the Asian agricultural sector is 0.54, suggesting that there is a potential for a 46% improvement in output if all countries operated at maximum efficiency. Upper middle-income countries exhibited the highest average TE of 0.82, indicating that they are the most efficient in their use of agricultural inputs relative to their group-specific production frontiers. Technology gap ratios further highlighted the disparities in potential output among the different income groups. High-income countries produce 52% of their potential output, upper middle-income countries achieve 62%, and lower middle-income countries reach 49%. This study highlighted the need for targeted interventions to enhance technical efficiency, particularly in lower middle-income countries.

KEYWORDS: Asian agriculture, Stochastic meta-frontier, Technical efficiency, Technology gap ratio

INTRODUCTION

Asia is the most populous continent in the world with 60% from total population (National Geographic Society, 2023). As the world's largest regional economy (Tonby *et al*., 2019), Asia has the potential to shape up the globalization with its diversified economic sources. Among those sources, agriculture plays a vital role in Asian economy as one-third of employees in Asia are working in agriculture. More than 70% of Asian people live in rural areas and they are engaging in the agriculture to reduce hunger, achieve food security and improve nutrition (Asian Development Bank, 2021). Even though there are economic, social and political differences among the Asian countries, agriculture is still a major factor to alleviate poverty. Rural people in Asian countries are highly depending on agriculture for their livelihood. In the last 50 years, agriculture has significantly contributed to the Asia's development and structural transformation. Asian agriculture has become a leading influencer to the global agriculture markets by exporting and importing large quantities of agricultural products (Rosegrant *et al*., 2007). Even though agriculture is the largest employer in Asian region, it is not the largest sector in any Asian country by gross domestic product (GDP) (Briones and Felipe, 2013) which means there is a potential to increase the output and GDP percentage in an efficient way. There are many challenges and obstacles to the Asian agriculture such as changing consumer demand with increasing population, input price fluctuations, environmental impacts from unsustainable farm practices and the biggest challenge is climate change and extreme weather conditions (Asian Development Bank, 2021).

There are many studies related to technical efficiency (TE) in Asian agriculture, however most of them have done for a one particular Asian region at a time. Several studies have been carried out on the south Asian agriculture (Liu *et al.*, 2020; Bibi *et al.*, 2021) and some studies focused on East Asian agriculture (Luh *et al.*, 2008; Le *et al.*, 2019). In addition, there are ample number of studies related to the TE in agriculture by individual countries. Liu and Zhuang (2000) have done a study to identify the determinants of TE in Chinese agriculture. Unggul *et al.* (2015) have done an analysis of TE in rice cultivation in Indonesia.

This study is aimed to fill the gap in previous studies by estimating TE for 28 Asian countries with three main categories as it represents the whole Asian region. Although there are sufficient studies on TE, studies about meta-frontier analysis and technology gaps in agriculture are limited. Fei and Lin (2017) have done a meta-frontier modeling for Chinese agriculture sector to identify the technology gaps. Gero (2020) have done a study to estimate and compare TEs in regions which is similar to the objectives of our study but for the African agriculture. Liu *et al*., 2018 have done a meta-frontier analysis to estimate TE by using 12 top agriculture producing countries in Asia.

The necessity of a meta-frontier analysis to whole Asia along with the technology gap ratios (TGR) was identified by referring previous studies. This study focused on filling the gap in past literature by estimating technical efficiencies of Asian countries under three categories along with the meta-frontier. Objectives of this study are to estimate group-specific TE scores, technical efficiency scores related to the meta-frontier and compare efficiencies using TGRs.

METHODOLOGY

Data Sources

Data for the empirical analysis were sourced from The Food and Agriculture Organization Statistical Database (FAOSTAT) and World Bank official website. Country classification was obtained from the World Bank.

Stochastic Meta-frontier Model

According to Farell (1957), there are three forms of efficiency, namely technical, allocative and economic efficiencies. TE is the ability of a firm to produce maximum output from a given level of inputs. There are several approaches for estimating TE as data envelopment analysis, stochastic production frontier analysis, ordinary least square and total factor productivity indices using price-based index numbers (Sreenivasa Murthy et al., 2009). Among these methods, data envelopment analysis and stochastic production frontier analysis are the most common approaches. This study utilized the stochastic production frontier model since it is a parametric approach which separately identifies statistical noise and technical inefficiency. This econometric approach allows statistical testing of hypotheses and construct confidence intervals (Hjalmarssan *et al*., 1996). Looking beyond just stochastic production frontiers, the technology gap and random error offer more insights in comparing different groups. The technology gap is particularly crucial in understanding how well firms in one group can compete with those in different groups within the industry. It gives an estimate of the technology difference between groups and the industry as a whole. Using a stochastic meta-frontier model for TE analysis provides a clearer picture of how TE scores can be compared across various groups (Pujari, 2005).

This study utilized the Stochastic meta-frontier model and it employed the two-step stochastic frontier approach introduced by Haung *et al*. (2014) to estimate group-specific frontiers along with the meta-frontier, TE scores and TGRs.

1. Stochastic frontier model for the *j*th group is,

$$Y_{it(j)} = f_t^j\left(X_{it(j)}\right)e^{V_{it(j)}-U_{it(j)}} \cdots\cdots\cdots (1)$$

Where:
$Y_{it(j)}$: Output for the i^{th} country in the t^{th} time period for the j^{th} group
$X_{it(j)}$: A vector of values of functions of the inputs used by the i^{th} country in the t^{th} time period for the j^{th} group
$V_{it(j)}$: Statistical noise
$U_{it(j)}$: Technical inefficiency

2. Meta-frontier production function for the countries in all groups in the industry ($f_t^M\left(X_{jit}\right)$) is,

$$f_t^M\left(X_{jit}\right) = \frac{f_t^j(X_{jit})}{e^{-U_{jit}^M}} \cdots\cdots\cdots (2)$$

3. Technical efficiency relative to the stochastic frontier for the j^{th} group (TE_{it}^j) is,

$$TE_{it}^j = \frac{Y_{it(j)}}{f_t^j(X_{jit})e^{V_{jit}}} = e^{-U_{it(j)}} \cdots\cdots\cdots (3)$$

4. Technical efficiency with respect to the meta-frontier production technology (MTE_{jit}) is,

$$MTE_{jit} = \frac{Y_{jit}}{f_t^M(X_{jit})e^{V_{jit}}} \cdots\cdots\cdots (4)$$

Technology gap ratio (TGR) is the ratio of output given by group specific frontiers to the output given by stochastic meta-frontier which is the potential output in the industry. It has values between zero and one. This gives the potential of each group to achieve the maximum TE in agricultural production. This ratio is given by,

$$TGR_{jit} = \frac{MTE_{jit}}{TE_{it}^j} \cdots\cdots\cdots (5)$$

Empirical Application

Using FAOSTAT data, model was estimated for 28 countries for a 20-year period from 1992 to 2021. Countries were divided into three groups as high-income, upper middle and lower middle-income countries. There is a single output to represent agricultural production (Y_{it}) defined as gross production value in USD million and multiple factors of production; land used in ha, number of employees occupied in agriculture, total of N, P, K fertilizer used in tons and pesticides used in tons. Since the outcome variable is in monetary terms, it was deflated using the GDP

deflator. Cobb Douglas production function form was used to estimate the group specific frontiers and meta-frontier. The estimation equation is,

$$ln\, Y_{it} = \beta_0 + \beta_1\, ln\, land_{it} + \beta_2\, ln\, labor_{it} + \beta_3\, ln\, fert_{it} + \beta_4\, ln\, pest_{it} + V_{it} - U_{it} \cdots\cdots \quad (6)$$

First TE scores for each group were estimated after estimating group-specific frontiers. Then TEs related to the meta-frontier was estimated. Lastly TGRs were calculated.

Statistical Analysis

Stochastic meta-frontier model estimated using STATA version 15.

RESULTS AND DISCUSSION

Estimates of group specific production frontiers and meta-frontier are given in Table 1.

Table 1: Results of stochastic production frontiers and meta-frontier estimation

Variable	Coefficient	P -value
Group 1: High-Income Countries		
Constant	-2.201	0.850
*ln*l	-0.096	0.000*
*ln*k	0.024	0.588
*ln*f	0.658	0.000*
*ln*p	0.252	0.000*
Year	-0.018	0.887
Log likelihood	-252.9	
Group 2: Upper-Middle Income Countries		
Constant	8.998	0.122
*ln*l	0.272	0.000*
*ln*k	0.249	0.000*
*ln*f	0.484	0.000*
*ln*p	-0.033	0.026*
Year	-0.008	0.002
Log likelihood	-66.19	
Group 3: Lower-Middle Income Countries		
Constant	-4.862	0.483
*ln*l	0.113	0.000*
*ln*k	0.252	0.000*
*ln*f	0.236	0.000*
*ln*p	0.189	0.000*
Year	0.000	0.968
Log likelihood	-256	
Metafrontier:		
Constant	5.046	0.021
*ln*l	0.068	0.000*
*ln*k	0.172	0.000*
*ln*f	0.340	0.000*
*ln*p	0.207	0.000*
Year	-0.004	0.000
Log likelihood	-458.7	

**P<0.05, l:land, k:labor, f:fertilizer, p:pesticides*

Stochastic production frontiers for each group were estimated assuming all the countries in one particular group utilize same production technology relevant to that group. Log likelihood estimates given in Table 1 prove that countries in different groups are not utilizing the same production technologies since those estimates are different for each group. All the parameters estimated for all three categories are significant at 5% error level except labor in group 1. In both upper middle and lower middle-income countries in Asia, when factors of production usage increases, the gross production value in agriculture also rises, as evidenced by the positive and significant coefficients of input variables in these groups. Despite allocating more land to agriculture in high-income Asian countries, the gross agriculture production value is lower contrary to the expectation. Also, in upper middle-income countries, when pesticide usage increases, gross agricultural production value falls which indicates by negative sign of the coefficient.

Table 2 shows that TE scores, meta technical efficiency (MTE) scores and TGRs for all three groups considered.

Table 2: Summary statistics of efficiency measures and technology gap ratios

	Mean	Std.Dev	Min.	Max.
Group 1				
TE	0.68	0.12	0.28	0.91
MTE	0.34	0.07	0.20	0.56
TGR	0.52	0.13	0.27	0.95
Group 2				
TE	0.82	0.07	0.50	0.78
MTE	0.51	0.03	0.42	0.58
TGR	0.62	0.09	0.27	0.99
Group 3				
TE	0.63	0.09	0.47	0.95
MTE	0.31	0.10	0.13	0.84
TGR	0.49	0.13	0.16	0.97
Overall				
TE	0.54	0.27	0.13	0.95

Descriptive statistics of variables used in the production function are presented in Table 3. In this study, overall, TE for whole Asian region (sample of 28 countries) was around 0.54 which ranges from 0.27 to 0.95. That means average Asian agricultural sector produce 54% of maximum possible output at a given level of inputs and it has the potential efficiency to be achieved. All producers in Asia can enhance their output by around 46% or they can produce the same amount of output by using a smaller number of inputs if they become technically efficient. Among all three groups, the highest average TE which is 0.82 belongs to group 2 which is upper middle-income category. Group

Table 3. Descriptive statistics of output and input variables used in production function

Variable	Mean	Standard Deviation	Minimum	Maximum
Output	40078.9	689256.7	0.2479	$1.22x10^7$
Land extent (ha)	$4.86x10^7$	$1.04x10^8$	10300	$5.30x10^8$
Labor (persons)	$2.30x10^7$	$6.63x10^7$	1046	$3.90x10^8$
Fertilizers (ton)	2,832,847	8,501,955	100	$5.50x10^7$
Pesticides (ton)	55198.16	251176.8	2	$1.8x10^6$

1 which is high-income category had the second highest TE score which is 0.68. The lower middle-income category which is group 3 had the least TE score which is 0.63. TE is calculated relevant to best production in the dataset. Hence, this result implies that countries in upper middle-income category have the highest TE relative to their group specific frontiers and lower middle-income countries have the least.

The average TGRs are 0.52, 0.62, 0.49 for group 1, 2 and 3 respectively. This implies that high-income countries produce only about 52% of the potential output on average given the technology available to Asia as a whole. Upper middle-income countries produce about 62% of potential output and lower middle-income countries produce around 49% of potential output. Countries in upper middle-income category obtained the highest MTE. This is reflected in their achievement of the highest TE scores relative to the group specific frontiers. This may be due to the presence of countries such as China, Thailand, Indonesia, Malaysia and Georgia, where agricultural production is much developed. According to Dawe (2015), China, Indonesia, Malaysia and Thailand have adopted to mechanization, diversified crop production, climate change resistant cropping methods, farm size expansion in order to sustain their agricultural production.

CONCLUSIONS

Using meta-frontier analysis, this study has provided a comprehensive analysis of agricultural production efficiency across different income groups in Asia from 1992 to 2021. Findings from the stochastic production frontier analysis and meta-frontier estimation highlight significant differences in production technologies and efficiencies among high-income, upper middle-income, and lower middle-income countries. The TGRs further highlight the differences in potential output across the different income groups. High-income countries produce 66% of their potential output, upper middle-income countries achieve 92%, and lower middle-income countries reach 66%. Overall, the study emphasizes the need for targeted interventions to enhance TE in the agricultural sector, particularly in lower middle-income countries in the Asian region.

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Value Chain Analysis of Food Fish in the Village Tank Cascade System (VTCs) of North Central Province, in Sri Lanka

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ABSTRACT

Sri Lanka's North Central Province harbors a unique network of interconnected Village Tank Cascade systems (VTCs). These historically significant systems provide water for agriculture and have the potential to contribute to local food security through fish production. This research investigates the food fish value chain within the VTCs of the North Central Province. The analysis explores key actors, stages, and challenges within the chain, aiming to identify opportunities for improvement. The study sheds light on the role VTCs plays in supporting food fish production and livelihoods in the region. Value chain analysis was done qualitatively, in order to map the existing value chain for food fish and to identify main actors, channels and constraints along value chains. Additionally, value addition and gross profit margin were calculated in order to identify the profit gain by each actor for the value they add. Bellankadawala VTCs was selected. A total of 40 participants were drawn purposively, and interviewed through face-to-face interviews and telephone conversations using open ended semi structured questionnaires in order to gather primary data needed. Fishermen, as the primary actors in the value chain, added substantial value and achieved the highest gross profit margins by selling directly to consumers, followed by wholesalers who enhanced value through bulk purchasing and transportation, and retailers who further contributed through direct consumer interaction. This study suggests subsidizing raw materials, forming a Fishermen's Union, enhancing safety and equipment.

KEYWORDS: Food fish, Value chain, Village Tank Cascade System

INTRODUCTION

Sri Lanka is world renowned for its ancient water civilization and the development and evolution of the country's irrigation systems is well documented. Among them, Village Tank Cascade systems (VTCs) are more important. They exist in the country with their unique environment consisting of lakes, paddies and passages of surface water movement (Dharmasena, 2020). Also, VTCs are one of the oldest and most advanced man-made agricultural irrigation systems that provide various services to the community (Mahatantila *et al*., 2008). They are relatively resource-efficient systems and their resources are divided among many income-generating activities such as crop cultivation, livestock farming, freshwater fishing and lotus harvesting. In addition, they use water for household purposes as well (Melles and Perera, 2020). Traditionally, fishing in VTCs was practiced as the extraction of naturally recruited stock on a subsistence basis aimed at fulfilling household protein requirements. The absence of reliable refrigeration facilities, along with an underdeveloped marketing that involved bicycle or motorbike vendors for distributing fish to households on a door-to-door basis has resulted in consuming harvested fish from tanks locally, within a range of 30–40 km from production areas (Murray and Little, 2022).

Food fish in cascade systems represent a sustainable livelihood opportunity for local communities (Geekiyanage and Pushpakumara, 2013). These freshwater habitats support a variety of fish species and provide a significant source of income, employment and cultural heritage. However, to ensure the sustainability of this resource, careful management is required to address challenges such as overfishing and illegal fishing.

By promoting sustainable fishing practices and community participation, cascade systems can maintain the economic and cultural importance of food fish while protecting the long-term health of ecosystems (Amarasinghe and De Silva, 1999). By clarifying key actors, behaviors and value additions in the food fish sector of VTCs, this study provides valuable insights for policy makers, practitioners and community stakeholders seeking to optimize the socio-economic benefits of these systems while minimizing environmental impacts. Furthermore, the VTCs emphasize the importance of adopting a holistic and integrated approach to rural development that integrates sustainable value addition opportunities in the food fish value chain, technological innovation, institutional capacity building and community empowerment.

By developing interactions between traditional knowledge systems and modern approaches to sustainable development, VTCs can continue to serve as an engine of rural prosperity and resilience for future generations. However, the food fish value chain in VTCs is poorly researched in Sri Lanka. Furthermore, this study aims to contribute to the understanding of the socio-economic dynamics within VTCs. The primary objective of this research is to map the value chain of the food fish sector in the VTCs. The study focuses on estimating the value additions and exploring possible sustainable value addition opportunities in the sector.

METHODOLOGY

Research Site Selection

The study area was Bellankadawala VTCs, part of the Horivila cascade system in Palugaswewa Divisional Secretariat, Anuradhapura District, North Central Province. This area was selected for its strategic importance within the cascade system, its historical relevance and its role in contemporary agricultural practices. The research has focused on three important lakes in this system: Thumbikulama, Bellankadawala and Horivila**.**

Research Design

The study adopted mixed methods research design to provide a comprehensive understanding of the food fish value chain in VTCs in the North Central Province of Sri Lanka. This approach combines qualitative and quantitative methods to identify barriers, suggestions and opportunities in the fisheries value chain within VTCs.

Sampling

A two-stage sampling is conducted to select actors for data collection. In the first phase, primary sampling units were identified from the GN *(Grama Niladari*) sector. In the second phase, 40 actors were identified: (Fishermen, n=20; Retailers, n=15; Wholesalers, n=5)

Data Collection

Primary data was collected from all actors in the value chain including fishermen, wholesalers and retailers. Data comprised of cost of inputs, production volume, revenue generated, barriers in the industry, suggestions and opportunities at each level. Individual and focus group interviews were conducted using semi-structured questionnaires expressly designed for each level of actors in the chain.

Data Analysis

Computations were made to examine value additions and gross profit margin at each stage of the value chain. Analyzed opportunities, challenges, and areas for improvement to identify gaps in the value chain at each actor's level. To facilitate this, a SWOT analysis was conducted for the food fish industry. Value addition was calculated using the equation 1 (Samarawickrama *et al*., 2023).

$$VA = P - \frac{TVC}{Q} \quad \text{..... (1)}$$

Whereas,

VA= Value added (Rs.)
P= Selling price of a unit (Rs.)
TVC = Total variable cost (Rs.)
Q = Quantity produced(kg)

The gross profit margin of each actor along the chain was also computed using equation 2

$$GPM = \frac{TR-TVC}{TR} \times 100 \quad \text{..... (2)}$$

Whereas,

GPM = Gross profit margin (%)
TVC=Total variable cost (Rs.)
TR=Total revenue (Rs.)

RESULTS AND DISCUSSION

Value Chain Map (VCM)

The Value Chain Map (VCM) depicted in Figure 1 illustrates the comprehensive pathways through the cascade from food fish production to consumption. Six distinct channels within the cascade system have been identified, each delineating different paths of fish flow. Channel 01: Fishermen-consumer. Channel 02: Fishermen-Village Shops-Village Consumer. Channel 03: Fishermen-Retailer-Consumer. Channel 04: Fishermen-Wholesaler-Retailer-Consumer. Channel 05: Fish Famer-Wholesaler-Retailer-Hotel. Channel 06: Fishermen-Wholesaler-Consumer. Channel 01 highlights a direct connection between fishermen and consumers, showcasing a localized exchange of food fish near the lake. Channels 03 and 04 introduce intermediaries such as wholesalers and retailers into the chain, broadening the distribution network to include wider consumer bases. In addition, some retailers offer a special product called fish fingle made by removing all the bones, to cater to different consumer tastes and needs.

The value chain map for food fish in a cascade system delineates the intricate flow of activities and value addition processes from fish harvesting to consumer consumption. Beginning with fish harvesting, often employing traditional methods such as netting the process moves into encompassing cleaning, gutting, to ensure quality standards. Many farmers engaged in this as their primary source of income, while some had agriculture as a secondary occupation. They often invested their resources, though some received boats from the Agriculture Department. Others took loans to purchase boats.

August and July were the peak seasons, and they used the surplus for dry fish production. After production, the distribution and marketing channels then come into play, encompassing wholesale markets, retail outlets, hotels, and direct sales to consumers.

The final stage culminates in consumer consumption, shaped by various factors including culinary preferences, cultural traditions, and dietary habits. Throughout this chain, supporting services and infrastructure such as transportation, cold storage facilities, and regulatory frameworks play crucial roles in facilitating smooth operations.

Key actors involved span from fishers and processors to wholesalers, retailers and consumers, each contributing to the dynamics of the value chain through supply chain linkages**.**

The value chain for food fish in cascade systems encompasses five fundamental processes, each contributing distinct roles to ensure the efficient flow of fish products to the market. Firstly, the production phase involves traditional fishing methods utilizing boats, tubes, and nets to harvest fish from the lakes.

Secondly, the processing stage sees processors receiving fish and undertaking various tasks such as cleaning and sorting, to prepare fish for the market. Thirdly, transportation plays a critical role in maintaining the freshness of perishable fish products during transit from processors to wholesalers or retailers. Fourthly, wholesalers operate as key intermediaries, purchasing fish in bulk from processors and distributing them in smaller quantities to retailers and hotels, thereby facilitating the integration of logistics and distribution. Finally, retailers serve as the last link in the value chain, directly selling fish to consumers, either procured from wholesalers, fishermen. Utilizing traditional methods for fish capture and ice storage, retailers ensure the quality and freshness of fish products before reaching consumers. Criteria such as shiny skin, bright eyes, slippery texture, and freshness indicators guide consumers in selecting high-quality fish products, which can be stored in ice boxes for up to two days to maintain optimal freshness.

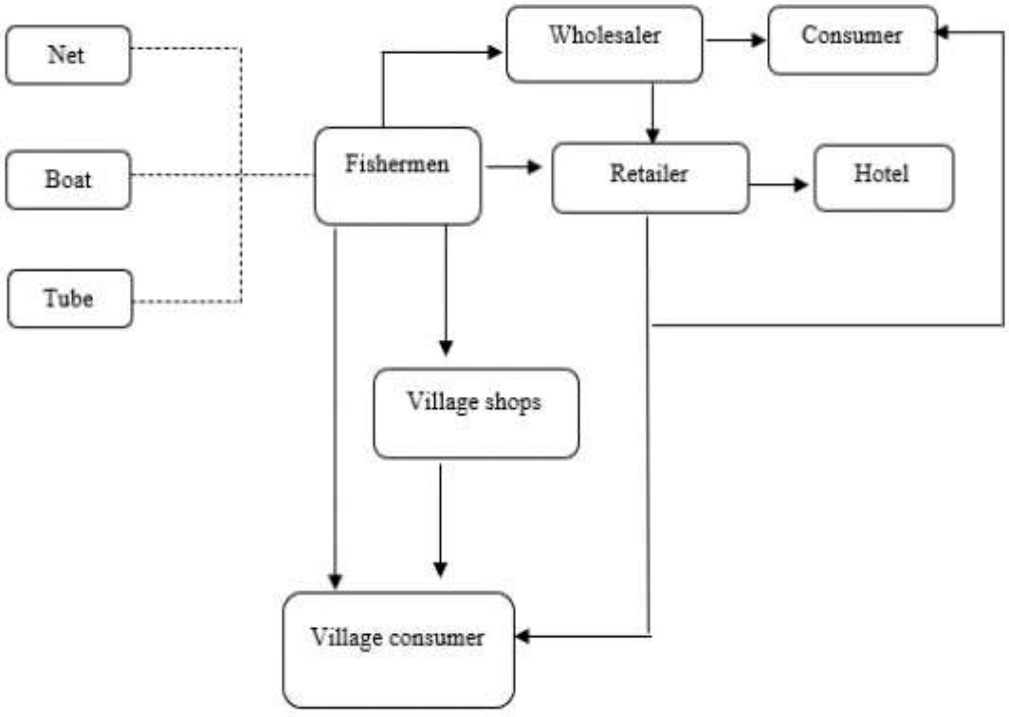

Figure 1. Value Chain Map (Incorporated within this value chain map are six channels)

Value Additions and Profitability

Different actors involved in the food fish value chain contribute to different levels of value addition, each retaining different proportions of gross profit margins. As shown in Table 1, the calculations reveal unique figures that reflect the amount of value added at each stage and the corresponding percentage of gross profit margins retained by the actors.

Table 1. Calculations of value addition and gross profit margin

Actor	AVA(Rs/kg)	AGPM (%)
Fishrmen	315.15	63.69
Wholesaler	266.66	44.44
Retailer	83.19	31.97

AVA-Average value addition, AGPM-Average Gross Profit Margin

Fishermen

As the initial actors of the value chain, fishermen added an average value of Rs 315.15 per kg from their catch and sold the fish to the next actor. As a result of such value addition, their average gross profit was 63.69%. They showed the highest value addition and gross profit margin among other actors. There were two types of farmers: those who sold 100% of their fish directly to consumers, and others who sold 20% to retailers and 80% directly to village consumers. The farmers also cleaned, sorted, and cut the fish into fillets before selling. They invested in high initial costs for their inputs, such as the boat and net, but their variable costs were low.

Wholesalers

Wholesalers added an average of Rs. 266.66 per kg in value, resulting in a 44.44% average gross profit margin. Most wholesalers approached the fishermen to purchase in bulk. The value additions at this level included the costs of transportation and storage facilities that they maintained.

Retailers

Retailers added an average value of Rs 83.19 per kg, with a gross profit margin of 31.97%. There were mainly two kinds of retailers: those who sold 100% of their output to consumers, and those who sold 60% to consumers and 40% to hotels. Typically, retailers visited fishermen to purchase their products, though occasionally, fishermen came to them to sell their products. Retailers sold the fish at their locations in the village, and some used bikes for transportation. This direct interaction with consumers and control over pricing enabled retailers to capture significant profits within the value chain.

Constraints, Solutions and Opportunities

The fishing community is currently facing numerous challenges that are impacting their productivity and livelihood. Insufficient inputs and a decrease in yield are primary concerns. Additionally, the destruction of nets due to crocodile threats is causing significant losses. The lack of a boat has increased fishing time, making it more difficult to meet the demand for fish. This gap between supply and demand is a critical issue.

To address these challenges, several feasible solutions have been proposed. Supplying raw materials at subsidized prices can help reduce costs for fishermen. The formation of a Fishermen's Union would provide a platform for collective bargaining, better representation, and mutual support among the fishermen. Increasing the fish population through sustainable practices and restocking efforts can help boost yields. Cleaning the tank is crucial to ensure a healthy aquatic environment, which in turn supports fish populations.

Additionally, taking necessary steps to enhance safety measures and provide better equipment can help mitigate the risks posed by crocodile threats and improve overall efficiency. Furthermore, with proper facilities, the fishing community can significantly expand their value chain. By investing in better storage, processing, and transportation facilities, they can improve the quality and shelf-life of their products, access new markets, and increase their profitability.

Facilities for fish processing and packaging can add value to their raw catch, while better transportation means can ensure that their products reach markets faster and in better condition. Expansion of this value chain will not only improve their economic resilience, but also create additional employment opportunities in the community.

These joint efforts are essential to increase the sustainability and productivity of fishing communities, enabling them to meet demand and sustain their livelihoods in the long term, expanding their market access and increasing their overall economic impact. Providing education and training on modern fishing techniques and sustainable practices can help fishermen catch more fish while preserving the environment. Offering access to microfinance and insurance can help fishermen invest in better equipment and protect against losses. Creating cooperatives can allow fishermen to share resources and work

together more effectively. Engaging with local and national governments to develop supportive policies can also make a big difference.

Furthermore, improving community infrastructure, such as building better roads and creating reliable power sources, can enhance the efficiency of the fishing industry. Encouraging tourism related to fishing activities can also provide an additional source of income. Promoting the consumption of local fish can help create a stable market for fishermen's products.

Supporting women and youth in the fishing community can also create new opportunities for income and growth. Women can be involved in processing and selling fish, while youth can bring new ideas and energy to the industry. Providing training in business skills can help fishermen and their families diversify their income sources and become more resilient to economic changes.

Creating awareness about the importance of sustainable fishing practices can help protect the environment and ensure that fish populations remain healthy. Organizing community events and workshops can engage fishermen and other stakeholders in discussions about best practices and new opportunities. Lastly, improving communication and collaboration among fishermen can lead to better sharing of resources and knowledge. By working together, fishermen can overcome challenges and build a stronger, more resilient community. These efforts will ensure that the fishing industry can meet demand, sustain livelihoods, and have a positive economic impact for many years to come.

CONCLUSIONS

The results indicate that fishermen play a crucial role as the initial actors in the value chain, adding significant value to their catch and achieving the highest gross profit margins among all actors. They demonstrate versatility by selling directly to consumers. Wholesalers follow, adding value through bulk purchasing and transportation services. Lastly, retailers contribute to the chain by further adding value through their direct interaction with consumers, though their profit margins are lower compared to fishermen. Overall, these findings underscore the dynamic nature of the fish value chain and highlight opportunities for enhancing profitability at each stage.

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Challenges Facing Floriculture Exporters in the Western Province, Sri Lanka

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ABSTRACT

Sri Lanka's floriculture industry, particularly in the Western Province, holds significant export potential. However, despite global industry growth, Sri Lankan exporters face challenges that limit their ability to fully capitalize on this opportunity. This research investigates the export barriers faced by floriculture exporters in Western Province, Sri Lanka. The studies done by the previous scholars have only identified broad industry challenges. Then, there is a thriving need for a recent comprehensive study in the Sri Lankan context. This research gap inhibits the development of targeted strategies to address these obstacles and unlock the Sri Lankan floriculture industry's full export potential. This study employs a quantitative approach, utilizing a structured questionnaire based on Likert scale statements to gather primary data from registered floriculture exporters in Sri Lanka's Western Province. The data were collected through a combination of online and telephone surveys and descriptive analysis was done using SPSS version 21. It aimed not only to explore these obstacles but also to investigate the strategies currently employed by these firms to manage, mitigate, or eliminate them. Ultimately, the research sought to identify an ideal mix of strategies that can effectively overcome the identified challenges and contribute to a more robust floriculture export sector in the Western Province. The results highlighted that profit increase and business expansion as top export motivators. Financial, logistic and transportation, political and government barriers, and customer barriers are the biggest challenges faced by the exporters. The most common mitigation strategies include market research, financial planning, logistic management, and employee training. This study aims to provide valuable insights for policymakers, industry stakeholders, and future research endeavors.

KEYWORDS: Challenges, Exportation, Floriculture industry, Mitigation strategies, Perceptions

INTRODUCTION

Floriculture in Sri Lanka started as an industry in 1970 (Danasekara, 2005). It contributes to the Sri Lankan economy significantly by generating foreign exchange and contributing to agricultural diversification (Abesekera and Wijesundara, 2014). The favorable climate present in the Western Province of Sri Lanka is the key factor for floriculture production boosting exporters and skilled growers (FAO, 2018). The global floriculture industry is experiencing significant growth with exports reaching an estimated US$ 14.66 in 2022 (EDB, 2022) while Sri Lanka boasts a strong position as the world's fourth largest foliage exporter. Despite this, Sri Lankan floriculture exporters, particularly those in the Western Province, face challenges that prevent their ability to capitalize on this opportunity fully. A study carried out by the Central Bank of Sri Lanka in 2022 identified broad industry challenges including limited cold chain infrastructure, high air freight costs, and stringent phytosanitary regulations.

A comprehensive and recent study specifically focusing on the challenges encountered by the floriculture exporters in Sri Lanka is currently lacking. Therefore, it is important to conduct a comprehensive exploration to understand the specific challenges and obstacles faced by Western Province exporters to develop and implement the most successful and efficient strategies to help unlock these obstacles from the path and reveal the industry's full export potential. This study focuses on challenges faced by the floriculture exporters in the Western Province, aiming to identify the obstacles that prevent Sri Lanka from fully identifying its potential in the international floriculture market.

Therefore, this research aims to address this critical gap by exploring the challenges faced by floriculture sector exporters in the Western Province, exploring the strategies adopted to manage, mitigate, or eliminate the challenges encountered by these firms, and identifying the ideal mix of strategies for overcoming identified challenges. By addressing these objectives, this research study aims to contribute to the sustainable development of the Sri Lankan floriculture industry and support increased export revenue for floriculture businesses in the Western Province.

METHODOLOGY

Study Area and Data

This study targeted the population of all registered floriculture exporters in the Western Province of Sri Lanka (n = 51). Western

Province of Sri Lanka was selected, due to their high population and the presence of a higher number of growers attributed to the availability of infrastructure facilities for exporting and a readily available local market. The Export Development Board provided a complete list of these companies. Since the population size is relatively small, the findings can be considered more generalizable to the Western Province's floriculture export industry.

Data Collection

A structured questionnaire was used to collect primary data through a combination of online and telephone surveys. To ensure the questionnaire's clarity and effectiveness, a pilot survey was conducted with a sample of 10 registered floriculture exporters. The questionnaire consisted of three main sections namely: (a) Demographic factors: gathered information about the registered export companies in Sri Lanka, including company size, years of experience, export type product, employee type, and why enterprise owners are motivated to export; (b) Exporter challenges: identified the challenges faced by floriculture exporters. Drawing upon previous literature reviews, seven key challenges were identified; (c) Mitigation strategies: explored the strategies adopted by floriculture exporters to manage, mitigate, or eliminate the identified challenges. Based on the literature review, twelve potential mitigation strategies were included.

The export barriers and mitigation strategies questions were straightforward and used five-point Likert scale items to gather the responses (Churchill and Iacobucci, 2006). The perceived severity of export barriers was measured using a Likert scale ranging from Strongly Disagree (1) to Strongly Agree (5). The perceived effectiveness of these strategies was measured using a similar Likert scale ranging from Very Ineffective (1) to Very Effective (5).

Data Analysis

To ensure the reliability of the questionnaire, Cronbach's alpha (Cronbach, 1951) was employed. Descriptive statistics were then utilized to analyze the demographic factors, export barriers, and mitigation strategies reported by the participating enterprises. Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 21.

RESULTS AND DISCUSSION

Data were collected through a structured questionnaire administered to a sample of 51 registered exporters, with a 100% response rate.

Reliability Analysis

Cronbach's alpha coefficient was employed to assess the internal consistency of the Likert scale variables used in the questionnaire. A Cronbach's alpha value between 0.6 and 0.8 is generally considered acceptable for establishing internal consistency (Hair *et al*., 2013).

In this study, Cronbach's alpha was calculated separately for the two sections of the questionnaire: export barriers and mitigation strategies. Both sections yielded satisfactory results. The Cronbach's alpha coefficient for the export barriers section was 0.921, and for the mitigation strategies section, it was 0.931. These values fall within the acceptable range, indicating strong internal consistency for the Likert scale measures within the questionnaire.

Demographics of Respondents

The participating companies were located primarily in Colombo (39.2%) and Gampaha (60.8%) Districts. In terms of education level, the majority of respondents had a degree (74.5%), with some possessing postgraduate qualifications (19.6%). Export experience varied, with 35.3% having over 15 years, 37.3% between 15-25 years, and the remaining in categories below 15 years. Most companies were classified as Small and Medium Enterprises (54.9%), followed by Medium Size Enterprises (31.4%) and Micro (7.8%). The predominant employment type was permanent staff (78.4%), with a smaller portion utilizing temporary/contract workers (15.7%). Regarding product focus, nearly half (43.1%) exported both indoor plants and cut flowers, while the remainder focused on one category (Indoor plants and Landscape plants: 39.2%, cut flowers: 17.6%). Ownership structures primarily consisted of companies (64.7%), followed by sole proprietorships (29.4%) and partnerships (5.9%). The gender distribution of respondents was predominantly male (80.4%) (Figure 1).

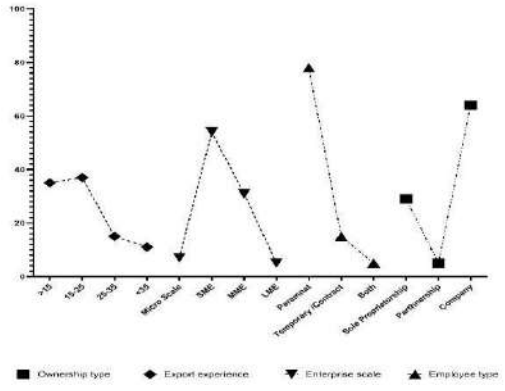

Figure 1. Demographic Summary

Export Motivations

Driven by a desire for growth and profitability, floriculture exporters in the Western Province participate in the international market for a variety of reasons. The primary motivations include increasing profits (30.2%) and expanding their businesses (22.5%). Building brand recognition (10.1%) and earning additional benefits (19.4%) are also significant drivers. Interestingly, a strong entrepreneurial motivation (17.8%) plays a role in motivating these exporters to venture into the global arena.

Export Barriers

The perceived severity of export barriers was assessed using a Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The most significant challenges, with mean scores exceeding 4.0, were: High export taxes (mean = 4.08), Policy instability (mean = 4.18), and high cost of export-related activities (mean =4.06).

Other notable concerns included complex documentation (3.55), meeting quality standards (3.51), and time-consuming customs procedures (3.33). Interestingly, challenges related to technological advancements (3.31) and skilled labor shortage (3.29) were perceived as less severe (Figure 2).

The literature survey supported the categorization of export barriers into seven key areas. The mean scores were analyzed under each category. Political and Government Barriers emerged as the most concerning category (mean score = 3.97), highlighting challenges like high export taxes, policy instability, and insufficient financial support programs by the government. Financial Barriers (mean score = 3.62) were also significant, indicating financial constraints faced by exporters.

Procedural Barriers (mean score = 3.44) were perceived as less problematic, encompassing challenges like complex documentation and regulatory changes. Logistics and Transportation Barriers (mean score = 3.38) included concerns about limited transport options, disruptions, and poor infrastructure. Customer Barriers (mean score = 3.27) focused on building trust, negotiating contracts, and meeting quality standards. Technology and Information Barriers (mean score = 3.33) with limited market research, lack of technological advancements, and the lack of reliable data on competitors and pricing strategies. Finally, Human Resource Barriers (mean score = 3.21) indicated the least impact barrier, including skill labor shortages, employee retention, and communication challenges which were less severe issues compared to other categories.

Statement Mean Value represents the average score assigned by participants to a specific barrier, with higher scores indicating a greater perceived severity. Rank (Based on Mean Value) shows the relative ranking of each barrier based on the mean score, with seven being the most severe and one being the least severe.

Financial limitations were highlighted as the most concerning issue, with high-rank mean scores (5.02) and mean (3.62) highlighting this challenge. Logistics and transportation also pose significant hurdles (rank: 4.86, mean: 3.38) due to limited options and infrastructure limitations. Customer relations present another challenge (rank: 4.68, mean: 3.27), with building trust and meeting quality standards

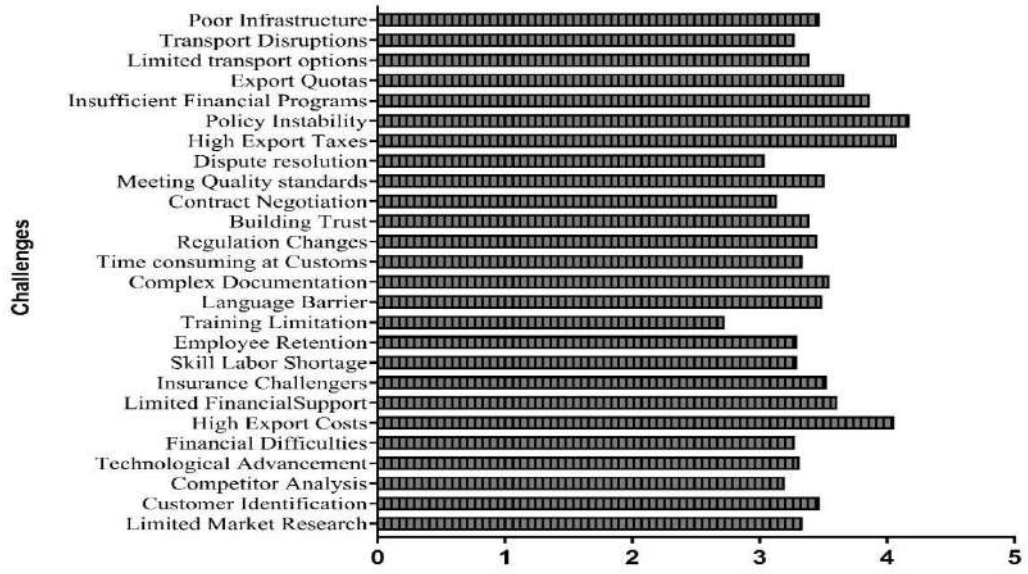

Figure 2. Perception of Export Barriers

being key concerns. While political and government barriers (rank: 4.44, mean: 3.96) are present, they are perceived as less severe than financial and logistical issues. Overall, financial constraints, logistics issues, customer barriers, and political and government barriers are the greatest challenges for Sri Lankan floriculture exporters in the Western Province.

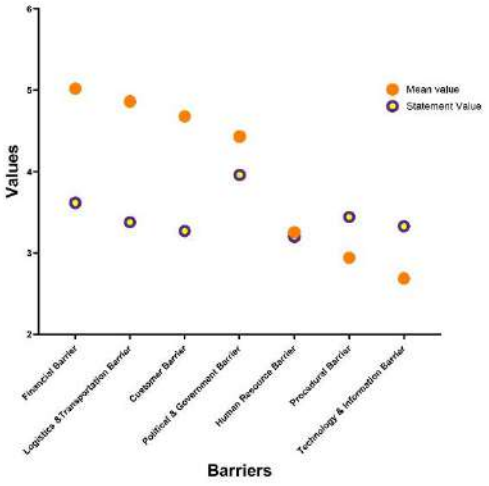

Figure 3. Relative importance vs. average perceived severity of export barriers *(Ranking Mean value vs Likert scale Statement mean values)*

(Figure 3).

Export Mitigation Strategies

The survey explored the mitigation strategies adopted by floriculture exporters through using a Yes/No scale question type. It revealed a high adoption rate (over 90%) for strategies such as Building strong relationships with buyers (92.2%) alongside maintaining high-quality control (92.2%). Interestingly, a strong emphasis is placed on technology adoption (92.2%) and incorporating sustainable practices (92.2%) into their operations. Investing in human resources through employee training (90.2%) was also a key focus. Financial planning (88.2%) to ensure financial stability and market research (84.3%) to identify profitable markets (Figure 4a).

Effectiveness of Mitigation Strategies

The perceived effectiveness of these strategies was measured using a similar Likert scale (1 = Very Ineffective, 5 = Very Effective). All strategies achieved mean scores above 3.5, indicating a generally positive perception of their effectiveness. The strategies with the highest mean scores were: Quality Control (4.35), Logistics Management (4.23), Technology Adoption (4.24), Sustainability (4.22), Employee Training (4.12), Buyer Relations Building (4.09) (Figure 4b).

The results of this study reveal that floriculture exporters in Sri Lanka's Western Province face various export barriers. The most significant challenges are related to, financial constraints, logistical limitations, and government policies. However, exporters appear to be actively mitigating these challenges through various strategies, with a focus on Quality control, technology adaptation, logistics management, Employee Training, Buyer Relationship Building, market research, and financial planning. These strategies are perceived as generally effective in overcoming export barriers and achieving business goals.

The results highlight a range of export barriers impacting floriculture exporters, with varying levels of perceived severity based on both mean values gained by the Likert scale statements of each seven areas and ranking mean values of seven areas. Financial barriers emerged as a significant concern, reflected in the highest mean value and a relatively high-ranking mean. This suggests that exporters

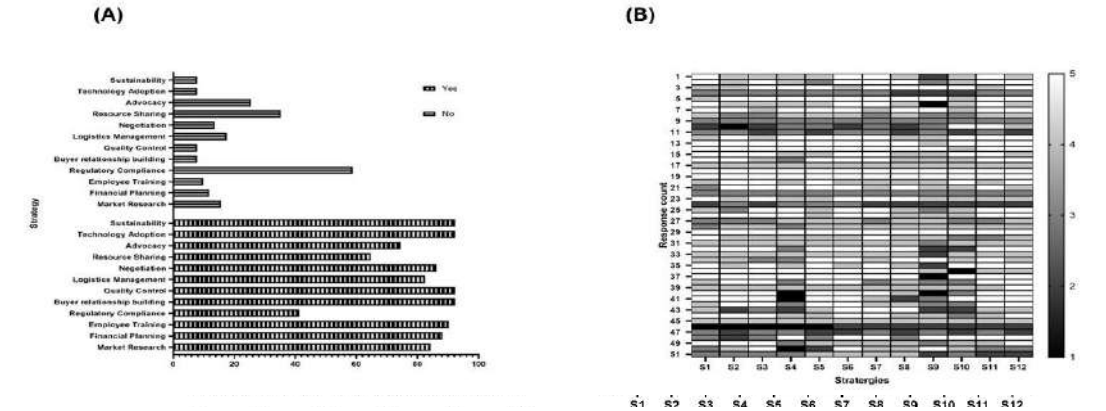

Figure 4. Percentages and Effectiveness of mitigation strategies that can be used to overcome the export barriers: *(A) Percentages of both implemented and unimplemented mitigation strategies, (B) Effectiveness of mitigation strategies. Yes= Strategy implemented percentage; No= Strategy not implemented percentage; S1 to S5 mentioned as same in Figure 4a.*

struggle with financial difficulties, including high export costs for certifications, logistics, insurance coverage, etc. and limited financial support programs for export enthusiasts in the floriculture industry. According to the results logistics and transportation barriers are the considerable second barrier. Limited reliable and affordable transport options and poor infrastructure, transport disruptions contribute to these difficulties.

To tackle these issues, financial solutions should prioritize market research and competitor analysis to identify profitable markets and optimize pricing. Additionally, collaboration between exporters and government agencies is crucial to explore financial aid programs and potentially lower export taxes.

For logistical and transportation challenges, exporters might consider and utilize bargaining power to negotiate better rates and secure reliable transportation options. Furthermore, improvements in infrastructure development could be advocated through industry associations.

Policymakers can use the findings to tailor support for floriculture exporters in Sri Lanka's Western Province, like financial aid, infrastructure upgrades, or smoother export processes. Industry groups can develop training programs to address skill gaps and technology limitations. This research provides a foundation for future studies that conduct comparative studies with other floriculture production regions in Sri Lanka or other countries to identify similarities and differences in export barriers and mitigation strategies.

CONCLUSIONS.

In conclusion, the study reveals the top five primary challenges as financial, logistics and transportation, customer, political and government, and procedural barriers. As mitigation strategies market research and competitor analysis, financial planning, logistic management, and industry advocacy for infrastructure development and quality control can be given. Market research and government collaboration with logistical strategies like collective bargaining and industry advocacy, technology adoption for efficiency improvements, and collaboration with research institutions or technology providers can be identified as the ideal mix of strategies for overcoming these challenges.

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Determinants of Sri Lankan Coffee Trade: A Gravity Model Analysis

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ABSTRACT

Coffee trade holds a special place in Sri Lanka's agricultural heritage and economic development with great potential for improvement. This study therefore explores Sri Lanka's bilateral coffee trade potential and investigates the determinants of coffee trade to key import destinations. Data were collected from trade related sources for the period 2014 to 2022. Gravity model was employed with country and time fixed effects accounting for endogeneity. Results identified key factors influencing bilateral trade volumes. Import GDP and distance are significant determinants, with higher GDP in importing countries positively affecting trade volumes and distances negatively influencing trade. Import country GDP showed an inverse relationship emphasizing the importance of other factors in boosting trade to these destinations. Additionally, the study highlights the roles of historical ties and regional trade agreements in facilitating trade. Fixed effects models further reveal complex interactions between domestic consumption and trade barriers. These findings provide actionable insights for enhancing Sri Lanka's coffee export strategies by targeting economically robust markets, logistics improvement and leveraging trade relationships.

KEYWORDS: Bilateral Coffee trade, Exports, Gravity model, Imports, Sri Lanka

INTRODUCTION

Coffee is one of the most popular beverages and the most traded commodities all over the world. Its dollar value exchanged internationally is second only to crude oil, demonstrating its economic significance. Every day, over 2.25 billion cups of coffee are consumed and the annual growth rate of global coffee consumption is 1.3%, (International Coffee Organization ,2022) demonstrating the beverage's pervasiveness and cultural relevance in a wide range of countries. Coffee has a significant impact on the GDP, employment rates, and social structures of many developing nations.

Coffee holds a special place in Sri Lanka's agricultural heritage and economic development. Sri Lanka has a rich history of coffee cultivation, dating back to the 17th century when the Dutch introduced coffee plants to the island. However, the coffee industry faced setbacks during the British colonial period due to the devastation caused by coffee leaf rust. But, in recent years, there has been a renewed interest in coffee cultivation, driven by factors such as rising global demand for specialty coffee and efforts to diversify Sri Lanka's agricultural exports. Sri Lanka's coffee exports have increased in recent years, growing 84 percent from 2017 to reach nearly USD 355,000 by 2019. In 2023, Sri Lanka exported coffee and related products primarily to the Maldives (18.5%), the United Arab Emirates (12.9%), and the USA (10%), among other countries. The export structure was dominated by coffee husks and skins, and coffee substitutes (35%), followed by various forms of roasted and unroasted coffee. On the import side, Sri Lanka's purchases of these products totalled 558 thousand USD, marking a 4.14% increase from 2022. These imports constituted 0.003% of the country's total imports, which amounted to 16.3 billion USD in 2023, maintaining the same proportion as in the previous year as per Export Development Board (EDB) data.

World coffee production increased by 0.1% to 168.2 million bags in coffee year 2022/23 (International Coffee Organization, 2023). Brazil is the largest coffee producer in the world. Vietnam is in second place, while Colombia is in third place, a long way behind. Indonesia, India, Ethiopia, Nepal and Sri Lanka are primary producers. These countries have made several efforts to increase coffee production. Major coffee-importing countries include the United States, Germany, France, Italy, and Japan, where coffee consumption is deeply embedded in daily life. These countries import vast quantities of coffee to meet domestic demand, driving international trade. The relationship between imports and exports is vital for the economic sustainability of developing countries (Eshetu and Goshu, 2019). Importing necessary goods helps in boosting domestic production and meeting consumer needs, while exporting allows countries to earn foreign exchange and maintain a balance in their trade activities. This balance is essential for ensuring a stable economy and sustainable growth over time.

The global coffee trade is a dynamic and complex market influenced by a multitude of factors, including economic, political and social

determinants. The literature on coffee trade has extensively employed gravity model to understand these determinants, offering valuable insights for both producing and consuming countries.

Economic Determinants

Economic factors such as GDP, population, and exchange rates are critical in influencing coffee trade flows. Bekele and Mersha (2019) applied a dynamic panel gravity model to explore Ethiopia's coffee export performance, finding that the GDP of both exporting and importing countries significantly enhances trade volumes. Higher GDP indicates greater production capacity and higher consumption potential, leading to increased trade. Similarly, Ademe and Yismaw (2013) found that the economic size of trading partners positively affects Ethiopia's coffee trade, affirming the central role of economic strength in driving trade flows. Population size is another economic determinant that affects trade. A larger population can lead to greater demand for coffee, boosting imports. Dwi and Lakner (2022) investigated the effect of globalization on coffee exports in producing countries and found that favourable exchange rates positively impact coffee exports by making them cheaper for foreign buyers.

Political and Institutional Determinants

Political stability, governance quality, and institutional frameworks are vital in shaping trade environments. Tadesse and Abafita (2021) explored the impact of regional trade agreements (RTAs) on global coffee trade, finding that RTAs has no significant impact on coffee trade. But, Scartezzini *et al*., (2019) analyzed the influence of the International Coffee Agreements (ICA) of 2001 and 2007 on bilateral coffee trade. They concluded that these agreements were effective in stabilizing coffee prices and promoting trade among member countries. Additionally, historical ties such as colonial relationships can influence trade patterns. Common colonial ties often lead to shared legal systems, languages, and business practices, which can reduce transaction costs and enhance trade. Eshetu and Goshu (2019) noted that historical ties, although less influential in modern times, still play a role in shaping trade relationships by fostering trust and reducing cultural barriers.

Country-specific Studies

Country-specific factors such as geographic location, infrastructure quality, and production capacity significantly impact coffee trade. Distance between trading partners is a critical determinant. Bekele and Mersha (2019) found that greater distances reduce trade volumes due to higher transportation costs and logistical challenges. Similarly, Salami *et al*., (2021) highlighted that geographical proximity facilitates trade by lowering costs and simplifying logistics.

Comprehensive research focusing on the determinants of Sri Lanka's coffee trade remains notably absent from the literature. This research aimed to address this gap by applying the gravity model analysis. to examine the factors influencing Sri Lanka's coffee trade by introducing a novel perspective on Sri Lanka's coffee industry. This research seeks to provide empirical evidence and insights that can inform policy formulation, strategic decision-making, and future research in this area. Therefore, the objectives of the study were to determine the factors influencing bilateral coffee trade flows between Sri Lanka and major trade partners and to explore Sri Lanka's bilateral coffee trade potential.

METHODOLOGY

Data Collection

To achieve the objectives outlined in this study, secondary data were sourced from various reputable organizations. Data were collected by accessing datasets from the world trade organization (WTO), UN Comtrade and CEPII's database for the period 2014 to 2022. The research framework comprises a single dependent variable and seven independent variables (Table 1). These variables were selected to comprehensively investigate the determinants of Sri Lanka's coffee trade potential.

Table 1. Types of data and respective source

Variable	Symbol	Source
	Dependent	
Coffee Export Volume (kg)	V	UN **C**omtrade
	Independent	
Gross Domestic Products	GDP	WTO
Distance	DIST	Online distance calculator
Population	POP	WDI
Common Colony	CC	CEPII
Regional Trade Agreement	RA	CEPII

Gravity Model Approach

The gravity model of trade is a widely used analytical framework in international economics that explains bilateral trade flows between countries. Drawing inspiration from Newton's law of gravity, the model posits that

the volume of trade between two countries is directly proportional to the size of their economies (usually measured by GDP) and inversely proportional to the distance between them (Tinbergen, 1962).

$$Tij = A\frac{Yi.Yj}{Dij} \dots\dots\dots (1)$$

Tij is the trade flow from country *i* to country *j*.
Yi and *Yj* are the GDPs of country *i* and country *j*, respectively.
Dij is the distance between country *i* and country *j*.
A is a constant.

The gravity model has been extensively used in trade research to analyse the impact of various factors on trade flows. For instance, Anderson and Van Wincoop (2003) extended the gravity model to account for multilateral resistance factors, providing a more comprehensive framework for understanding trade flows.

The conceptual framework for this research employs the gravity model of trade to analyse the determinants of export volume between countries. The dependent variable is export volume, influenced by several independent variables: the GDP of the importing country (IGDP), the GDP of the exporting country (EGDP), the population of the exporting country (EPOP), the population of the importing country (IPOP) and the distance between the two countries (DIST)). Additionally, several dummy variables were included to capture specific trade-facilitating or hindering factors: common colonial history (CC)and the regional trade agreements (RTA). The model can be expressed by transforming dependent and all independent variables into their logarithmic forms to linearize their relationships with export volume as below equation.

$$\ln(V_{ijt}) = \beta_0 + \beta_1.\ln(EGDP_{it}) + \beta_2.\ln(IGDP_{jt}) + \beta_3.\ln(EPOP_{it}) + \beta_4.\ln(IPOP_{jt}) + \beta_5.\ln(DIST_{ijt}) + \beta_6.CC_{ijt} + \beta_7.RTA_{ijt} + \varepsilon_{ijt} \dots\dots\dots (2)$$

i - Sri Lanka
j - Australia, Bahrain, Canada, Chile, China, France, Germany, Italy, Japan, Maldives, Netherlands, New Zealand, Norway, Switzerland, United states, United Arab Emirates, Ukraine and United Kingdom.
t – Time (2014-2022)

Measures

For this study, information on the quantity of coffee exported from Sri Lanka and 18 significant importing nations was acquired. Eighteen countries that frequently imported coffee from Sri Lanka during the period of 2014-2022 were selected. The statistics on coffee trade volume were sourced from the UN Comtrade database and were assigned the HS 4-digit code 0901 for both roasted and unroasted coffee. The independent variables include the GDP and population of both importing and exporting countries, distance between trading partners, and relevant dummy variables such as common colonial history and trade agreements. These measures provide a detailed and accurate representation of the factors influencing coffee trade volumes in the gravity model of trade.

Data Analysis

For the data analysis, Stata software was used. The data was first log-transformed to linearize relationships and stabilize variances. This transformation was applied to all continuous variables, including IGDP, EGDP, EPOP, IPOP, and DIST. Correlation analysis was conducted to examine the relationships between the independent variables and to check for multicollinearity issues. The regression model was then specified in Stata, and multiple regression analysis was performed to estimate the coefficients of the model. The significance levels, coefficients, and R-squared values were examined to determine the explanatory power of the model and the relative importance of each variable.

Fixed effects were checked for country-specific and time-specific effects to account for unobserved heterogeneity. To control country-specific factors that do not vary over time but might influence export volumes (distance, common colony), a country fixed effects model was employed. This model helps to isolate the impact of the independent variables on export volumes by removing bias from omitted variables that are constant within a country but vary between countries. Additionally, a time fixed effects model was used to control for any temporal factors that might influence trade volumes across all countries in the sample.

RESULTS AND DISCUSSION

The pearson correlation coefficients from the inter correlation matrix were found below 0.90 and by comparing tolerance values and variance inflation factors, it was found that the tolerance values are higher than 0.2 and VIF values are less than 5. Therefore, the tolerance values and VIF values are within the expected

range that prevents the multicollinearity. Hence, the multi-regression analysis can be carried out. The F-ratio in the ANOVA table tests whether the overall regression model is a good fit for the data. The results show that the independent variables statistically significantly predict the depend variable, F (7,124) = 1.18, P<0.05. Consider R squared (Coefficient of Determination) value in our analysis R squared is 0.624 with a statistical significance of P<.05. That means 62.4% of the variants in the determinants of coffee trade in Sri Lanka were predicted from independent variables that have taken. Table 2 shows the results of the regression analysis under three different models: no fixed effect, country fixed effect, and time fixed effect.

The results, both without fixed effects and with time fixed effects, consistently show the same signs for the variables. However, while import GDP and distance are both significant in the model without fixed effects, only import GDP remains significant in the time fixed effects model. Without the fixed effect coefficients reveal that import GDP (0.336) has a significant impact on coffee export volumes. The positive impact of import GDP on coffee export volumes aligns with the findings of Bekele and Mersha (2019), who demonstrated that wealthier nations have higher purchasing power, enabling them to import more coffee. On the other hand, the significant negative coefficient for distance (-0.531) implies that greater distances between countries reduce coffee trade volumes, likely due to higher transportation costs and logistical challenges. This finding is consistent with Salami *et al.* (2021), who emphasized the importance of proximity in facilitating trade due to lower transportation costs and simplified logistics. Additionally, while export GDP and import population exhibit negative coefficients, suggesting potential complexities such as higher domestic consumption in larger economies. Variables like export population, common colony, and regional trade agreements show positive coefficients, indicating that larger populations a supportive historical and trade relationships facilitate higher trade volumes.

With the Country Fixed Effects, the consistent significance of import GDP (0.151) suggests that countries with higher GDPs still import more coffee, even after accounting for country-specific factors. Higher population in importing countries shows a negative impact on coffee export volumes. This may be because larger populations demand higher coffee volumes, which Sri Lanka currently cannot supply. To address this, Sri Lanka could invest in expanding its coffee production capacity and improving supply chain efficiency to better meet the demand from populous markets. Also, the results show that greater distance negatively affects the export volume of Sri Lankan coffee. This indicates that Sri Lanka needs to implement more effective strategies to increase its export volume to distant markets. Developing targeted marketing strategies, improving logistics and transportation infrastructure, and forging stronger trade partnerships can help mitigate the challenges posed by geographical distance and enhance export performance. The negative coefficient for RTA may indicate that while trade agreements facilitate trade, they do not fully overcome the inherent barriers posed by

Table 2. Estimates of gravity model with and without bilateral fixed effects

Variables	Expected Sign	No Fixed Effect	Country Fixed Effect	Time Fixed Effect
lnEGDP	+	-0.960 (2.738)	-15.246 (7.756)	-0.738 (2.758)
lnIGDP	+	0.336* (0.153)	0.299* (0.151)	0.151* (0.321)
lnPOP	_	-0.202 (0.161)	-0.243 (0.1613)	-0.205 (0.163)
lnEPOP	+/-	1.758 (9.657)	-88.541 (69.791)	1.432 (9.724)
lnDIST	+/-	-0.531* (0.264)	-0.578* (0.263)	-0.478 (0.274)
CC	+	0.138 (0.342)	_	0.153 (0.344)
RTA	+	0.057 (0.363)	-0.901 (1.747)	0.063 (0.367)

*Note: Levels of statistical significance; * p < 0.05*

distance and other country-specific factors. This complexity is discussed by Scartezzini *et al*. (2019), who note that the effectiveness of trade agreements can be limited by practical challenges such as transportation infrastructure and regulatory compliance. Identifying determinants through analysis, it enables Sri Lanka to compete with global market dynamics, improve their export performance, and achieve sustainable growth in the coffee industry (Figure 1).

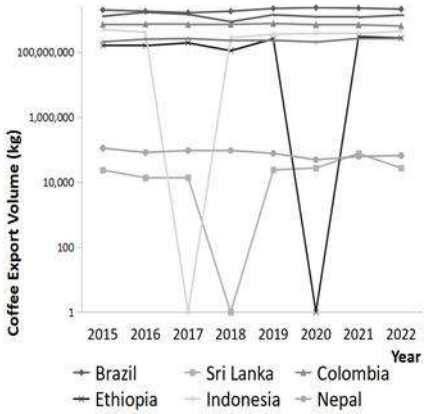

Figure 1. **Coffee export volumes from major global and selected South Asian countries**

CONCLUSIONS

In summary, this study clarifies the factors influencing Sri Lanka's coffee trade. Significantly, import GDP showed up as a significant factor, indicating that Sri Lanka's coffee exports are positively influenced by the economic strength of importing countries. Additionally, distance plays a crucial role, with greater distances negatively impacting trade volumes, highlighting the need to address logistical challenges. The findings underscored the importance of targeting economically robust markets, improving logistical efficiencies, and leveraging historical ties and trade agreements to enhance Sri Lanka's coffee export performance.

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Impact of Entrepreneurial Orientation on Farm Performance: Evidence from Smallholder Banana Growers in Jaffna District

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ABSTRACT

Bananas are one of the most extensively grown and consumed fruits in Sri Lanka. It has been recognized as a potential alternative sub-sector for driving sustainable growth in the rural economy. It is popular among farmers in the Jaffna peninsula due to its high demand and adaptability for the dry zone. Regardless of the importance and popularity of the crop, the Banana sub-sector faces challenges like declining yields, limited income diversification, and unsustainable practices. The entrepreneurial skills of farmers are critical to overcoming these challenges and the development of the banana farming sub-sector through improved farm performance. Therefore, this study was designed to investigate the levels of Entrepreneurial Orientation exhibited by smallholder banana growers in Jaffna and evaluate how these levels influence their farm performance. A multistage sampling technique was adopted to sample 345 smallholder banana growers in the Valikamam and Thenmarachchi regions due to the high banana farming activities in the Jaffna District. The data were analyzed using both descriptive and inferential measures. The results showed that the farm performance is significantly and positively affected by the three entrepreneurial orientation dimensions (i.e. Innovativeness, Risk-taking, Proactiveness). The study indicated that the majority of the Jaffna farmers have medium entrepreneurial skills and they struggle to perceive banana cultivation as a profitable and realistic economic opportunity. It was suggested that smallholder farmers be given sufficient training and knowledge of modern farming technologies and take steps to enhance their entrepreneurial orientation as a strategy for improving farm performance.

KEYWORDS: Entrepreneurial orientation, Farm performance, Jaffna district, Smallholder banana farmers, Sustainable rural development

INTRODUCTION

Banana (*Musa spp*.) is one of the most extensively grown and consumed fruits in Sri Lanka. It has been recognized as a potential alternative sub-sector for driving sustainable growth in the rural economy (Heenkenda and Chandrakumara, 2016). It is also an attractive perennial fruit crop for smallholder farmers, giving yearly economic gains. Banana production is popular among Jaffna peninsula farmers due to its high demand and adaptability for the dry zone since it is a staple fruit and a cash crop (Thiruchchelvan *et al.,* 2012). According to the Department of Agriculture (DOA), the total area under banana cultivation in Jaffna District is 1, 065 ha with an estimated annual production of 40, 494 tons (DOA, 2023). Moreover, 59.8% of the banana produce from the Jaffna District is contributed by the Urumbirai, Uduvil, and Puthur divisions, while Valikamam and Thenmarachchi are identified as the highest banana-cultivated regions.

The Banana industry in the Jaffna District faces challenges like declining yields, limited income diversification, price fluctuation, and climate change impacts (Kandegama *et al.,* 2022). Entrepreneurial approaches could hold the key to overcoming these challenges and building a more sustainable and profitable banana sector in Jaffna. The current level of Entrepreneurial Orientation (EO) among banana growers in Jaffna lacks a systematic measurement and understanding. Lack of knowledge about EO levels inhibits the development of the dynamic sector of Banana farming, and Farmers' entrepreneurial skills play a significant role in their production and capacity for effective marketing (Heenkenda and Chandrakumara, 2016; Salau *et al.,* 2017).

Lumpkin and Dess (1996) identified EO as a key construct in entrepreneurship. According to the literature, EO refers to the decision-making process utilized by entrepreneurs to initiate and sustain commercial activities. EO includes three dimensions: Innovativeness (In), Risk-taking (Rt), and Proactiveness (Pr). The majority of EO research has focused on these three features (Rauch *et al.,* 2009). According to the literature, innovativeness entails seeking creative or unusual solutions to problems and needs, while the risk-taking dimension refers to management's willingness to commit significant resources to opportunities in the face of uncertainty, as well as pro-activeness is the pursuit of new business opportunities. Farmers who exhibit entrepreneurial skills are more likely to boost production, productivity, diversity, innovation, and self-sufficiency and they suggest that understanding farming as entrepreneurship can lead to more effective agriculture policies.

The relationship between EO and farm performance (Fp) has become a main subject of interest in literature concerned with the positive implications that have on firm growth and performance. Therefore, the main objective of this study is to investigate the levels of EO exhibited by smallholder banana growers in Jaffna and evaluate how these levels influence their farm performance across various dimensions.

METHODOLOGY

Study Area and Data

Jaffna District was purposely chosen for this study since it is regarded as the highest Banana producer in the Northern Province and the second-largest land productivity Banana production area in Sri Lanka.

A multistage sampling technique was adopted to sample 345 smallholder banana growers, where the first stage was the purposive selection of the Valikamam region and the Thenmarachchi region due to its high banana farming activities in the Jaffna district.

According to the Provincial Department of Agriculture, there are approximately 2500 banana farmers in the Jaffna District, particularly in Valikamam and Thenmarachchi regions. The sample size was calculated using Yamane (1967) limited population formula (Equation 1).

$$n = \frac{N}{1+N(e)^2} \quad n = \frac{2500}{1+2500(0.05)^2} = 344.82(\approx 345) \quad .....(1)$$

Quantitative data was elicited from Banana growers of Jaffna District from February to April using a researcher-administered, structured questionnaire that was pretested and validated using a pilot survey (n=15). The farmers who took part in the pilot testing were not included in the main survey.

Variables and Measures

The Likert-scale items developed by Covin and Slevin (1989) and Lumpkin and Dess (1996) were used to measure the EO dimensions. Performance measures developed by Zou *et al*. (1998) were used to measure Farm Performance. The Questionnaire was divided into four sections: (1) Background information (a. Socio-demographic information b. Farm characteristics) (2) EO dimensions (3) Farm business (4) Farm performance.

The EO Dimensions; Innovativeness (In), Risk-taking(Rt), and Proactiveness (Pr) were measured using twenty-five variables, while Farm performance (Fp) was measured using nine variables on a five-point Likert scale, a scale ranging from "strongly disagree (1)" to "strongly agree (5)". The background information and farm business-related questions were gathered through open-ended questions.

Data Analysis

The data were analyzed with Statistical Package for the Social Sciences (SPSS) Version 27. Descriptive Statistics such as Mean, Standard deviation, Frequency, and Percentage were computed for the Likert statements (Agbolosoo and Anaman, 2021) and socio-demographic characteristics and farm characteristics. The reliability of the questionnaire was retained by using Cronbach's alpha value (Cronbach, 1951).

Before Factor Analysis, Barlett's test of Sphericity was carried out to ensure the EO dimensions and Farm performance fit for analysis, and the Kaiser-Meyer-Olkin (KMO) test was done to ensure that the sampling was adequate for the Exploratory Factor Analysis (Dendup and Acharja, 2017). The Exploratory Factor Analysis (EFA) was carried out to summarize the EO and Farm performance data using the Principal Component Analysis with Varimax rotation method in extracting components.

Boruah *et al*. (2015) employed an Entrepreneurial Behavior Index (EBI) to assess respondents' entrepreneurial behavior. The formula to calculate EBI is given in Equation 2.

$$\text{EBI} = \frac{\text{Obtained score by respondents}}{\text{Actual total score}} * 100 \quad .....(2)$$

Respondents were divided into three types based on the index. They are Low ($\bar{X}$ - SD), Medium ($\bar{X}$ ± SD), and High ($\bar{X}$+ SD) where $\bar{X}$ indicates mean and SD denotes Standard Deviation.

Regression Analysis was employed to investigate the impact of independent variables (i.e. Innovativeness, Risk-taking, Proactiveness, Education, Experience, and Access to training), on the dependent variable (i.e. Farm performance). These arguments recommend the following hypotheses:

H1: Innovativeness has a significant and positive impact on farm performance.
H2: Risk-taking has a significant and positive impact on the farm performance.
H3: Proactiveness has a significant and positive impact on farm performance.
H4: Education level has a significant and positive impact on farm performance.
H5: Experience has a significant and positive impact on the farm's performance.
H6: Access to training has a significant and positive impact on the farm performance.

RESULTS AND DISCUSSION

Descriptive Statistics of Socio-demographic Factors

Table 1 reveals the summary of socio-demographic characteristics identified in this study. The results show that 18.8% of them were females, while 81.2% of them were males. It is evident that 84.1% were from the Valikamam region whereas the remaining 15.9% were from the Thenmarachchi region.

The age-wise distribution shows that 24.9% were young, 46.1% belonged to the middle-aged group followed by 29.0% in the old age group. In the sample, 14.5% had primary education, 26.7% were educated up to the secondary lower level, 29.9% had completed up to O/L, 23.5% had completed up to A/L and 5.2% had completed a tertiary level of education (Table 1). Moreover, as depicted in Table 1, 26.4% of farmers had at least 10 years of experience, while the majority of them had 10 to 30 years of experience. However, only 15.4% had more than 30 years of experience.

Table 1. Farmer profile summary

Variable	Categories	Percentage
Gender	Male	81.2%
	Female	18.8%
Region	Valikamam	84.1%
	Thenmarachchi	15.9%
Age	25-45 (Young)	24.9%
	45-65 (Middle)	46.1%
	Above 65	29%
Education	Up to Gr 5	14.5%
	Gr 5 – Gr 9	26.7%
	Up to O/L	29.9%
	Up to A/L	23.5%
	Tertiary Level	5.2%
Experience	Up to 10 years	26.4%
	10 to 30 years	58.3%
	Above 30 years	15.4%

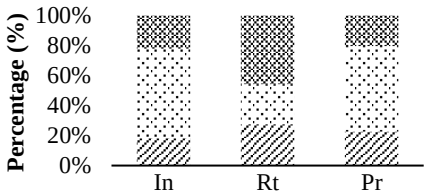
Descriptive Statistics of Farm Characteristics

It is observed that 67% of farmers didn't maintain farm records while 33% kept farm records. On the other hand, 78.3% of farmers hadn't attended the training conducted by the Agrarian Service Centre (ASC) whereas 21.7% attended the training. The majority of the farmers 73.3% were doing banana cultivation as a primary job, while 26.7% were undertaking that as their secondary job.

Thirty-seven percent of farmers have implemented the tissue-cultured new variety in their farms. At the same time, most of them (62.8%) followed traditional methods in their cultivation. The majority of the farmers (82.9%) used farm planning before cultivation while 17.1% did not do any farm planning.

Entrepreneurial Behaviour Index (EBI)

Figure 1 shows that more than half of smallholder banana growers (59.71%) reported medium-level innovativeness, followed by low (18.26%) and high (22.03%). Approximately 26.67% identified a medium-level risk-taking tendency, followed by low (27.54%) and high risk-taking ability (45.80%). According to the study outcomes, 57.10% of farmers were moderately proactive, along with 22.61% with low-level and high-level (20.29%) proactiveness.



	In	Rt	Pr
High	22.03	45.80	20.29
Medium	59.71	26.67	57.10
Low	18.26	27.54	22.61

Figure 1. Distribution of EO skills

It can be seen from Figure 2 that 29% of banana farmers in Jaffna had high EO skills, 48% had medium EO skills, and 23% had low EO skills according to their EBI Index.

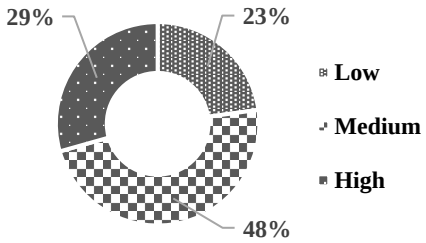


Figure 2. Overall EO skills of Banana farmers in Jaffna

Reliability Analysis

Cronbach's alpha test was used to evaluate the internal consistency of Likert-scale items. For Cronbach's alpha, values between 0.6 to 0.8 are deemed acceptable for a sample of 345 respondents (Hair *et al*., 2013). Cronbach's alpha values in Table 2 are substantially above 0.7, indicating that the instruments were dependable enough for measurement. KMO values were greater than 0.50 confirming the sampling adequacy for Exploratory Factor Analysis to be suitable and fit for analysis (Kannusamy, 2016). Bartlett's Test of Sphericity is significant to a level of significance of <0.001, which shows a high correlation level between variables, making it suitable and fit for analysis.

Table 2. Results of the Reliability Analysis

Variable	Cronbach's Alpha	KMO	Barlett's test
In	0.760	0.606	0.000
Rt	0.722	0.685	0.000
Pr	0.741	0.632	0.000
Fp	0.703	0.509	0.000
EO	0.864	0.634	0.000

In: Innovativeness, Rt: Risk-taking, Pr: Proactiveness, Fp: Farm performance, EO: Entrepreneurial Orientation

Exploratory Factor Analysis

Eight factors were recognized within the Innovativeness dimension before the extraction. Upon extraction, three factors were taken whose Eigenvalues were greater than one (Hair *et al*., 2013) namely; Precise farming practices, Customer-centric marketing, and Bootstrapping behavior. For Risk-taking, two factors with Eigenvalues greater than one were extracted out of eight factors and were named Risk-averse approach and Making informed decisions. After the extraction, three factors were retained from nine factors of Proactiveness that were with Eigenvalues greater than one and they were entitled Pioneering a progressive approach, Proactive strategic management, and Customer relationship upholding.

Three factors named Profitability, Market orientation, and Productivity were extracted through EFA, which has an Eigenvalue greater than one out of nine factors from Farm performance.

Development of Indices

Indices were developed using component score coefficients as weights and raw scores provided by the respondent. The indices were developed for Innovativeness, Risk-taking, Proactiveness, and Farm performance separately for the Regression Analysis to use as independent and dependent variables respectively.

Multiple Linear Regression Analysis

It was used to determine the relationship between dependent and independent variables to test the hypothesis. The regression model is given in Equation 3 below.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon \text{.....(3)}$$

Where: Y= Farm performance of Banana Growers, β_0=Intercept term, β_i= Coefficients of the Independent Variables, X_1= Innovativeness, X_2= Risk-taking, X_3= Proactiveness, X_4= Education, X_5= Experience, X_6= Access to Training, ε = error term.

The Adjusted R^2 score was 0.802, which indicates that 80.2% of the variation in the dependent variable was explained by the model. The significance of the model was also confirmed by the probability value (0.000) which was less than 0.05 significance level.

Table 3 shows the results of the regression analysis including the relevant coefficients and the probability values. Hence, the regression equation can be given as in Equation 4;

$$Y = \beta_0 + 0.116X_1 + 0.644X_2 + 0.150X_3 + 0.025X_4 + 0.010X_5 + 0.146X_6 + \varepsilon \text{.....(4)}$$

The overall farm performance of these banana growers was positively and significantly impacted by innovativeness, risk-taking, proactiveness, education, experience, and access to training at different levels or magnitudes. The magnitude of the relationship was depicted by the coefficient value. All of the coefficients were positive. As a result, the performance of the smallholder banana farmers was positively impacted by these six independent factors and all independent variables had a significant and positive impact on the dependent variable.

Table 3. Regression analysis coefficients

Variable	β coefficient	P value
Innovativeness	0.116	0.003
Risk-taking	0.644	0.000
Proactiveness	0.150	0.000
Education	0.025	0.005
Experience	0.010	0.004
Training	0.146	0.000

Dependent variable: Farm performance, P: Probability

CONCLUSIONS

Entrepreneurial Orientation (EO) is a key aspect of farming success. Literature supports the fact that even though there are many investigations conducted in various country contexts including developed and developing, there is a paucity of studies conducted in the Sri Lankan context investigating the impact of EO on farm performance. Moreover, due to various socio-political reasons, Jaffna District has been neglected from doing any sort of research activity for decades. Therefore, this study investigated the levels of EO exhibited by smallholder banana growers in Jaffna and evaluated how these levels affected their farm performance across various dimensions.

The study demonstrates a significant relationship between entrepreneurial approach and farm performance among banana growers

in Jaffna District, with socioeconomic criteria such as education, experience, and training having a positive effect on overall performance. It can be concluded that most smallholder banana farmers have a medium level of EO skills due to low annual farm incomes because of price fluctuations, engaging in traditional methods of cultivation, and lack of access to training.

It suggests that training in entrepreneurial skills, including practical demonstrations and effective communication, can empower smallholder banana growers. There is a necessity to standardize farming practices to improve the economic conditions of the farmers and in turn the country.

On the other hand, the medium Entrepreneurial Behavior Index of farmers is a clear indication of the progressiveness of the growers. Knowledge of current tissue culture cultivation and technology can lead to high banana farm performance and sustainable farming. So educating smallholder farmers on modern agricultural practices and technologies can increase their adoption of EO skills leading to higher banana productivity and profitability.

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An Econometric Analysis of the Impact of the Weather and Natural Disasters on Sri Lankan Spice Exports: A Gravity Model Approach

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ABSTRACT

Agriculture in Sri Lanka faces significant challenges due to variations in weather patterns and the increasing frequency of natural disasters. Considering the greater sensitivity of agricultural productive activities to these issues, it is crucial to ascertain the impact of which on the export of key agricultural products. This study addresses this gap by empirically analyzing the impacts of annual weather conditions and natural disasters on spice exports from Sri Lanka, to which the Gravity Model approach was employed. It focuses on how factors such as rainfall, temperature, and the prevalence of natural disasters. The panel data used for this purpose includes the 12 main spice destination countries from Sri Lanka. The outputs from the Gravity Model demonstrate that weather factors, measured by the level of precipitation and temperature, significantly decrease the export value of spices. Moreover, the occurrence of natural disasters has a detrimental impact. Specifically, events such as droughts and tsunami have significantly reduced export values. This study provides insights into setting of climate-resilient strategies and policies to enhance the performance of much valued spice sector in Sri Lanka.

KEYWORDS: Gravity model, Natural disasters, Spice exports, Weather patterns

INTRODUCTION

Weather refers to the short-term atmospheric state characterized by variables like temperature, precipitation, humidity and wind while climate change signifies a long-term shift in average weather across a region or the globe. This phenomenon is often associated with an increase in the frequency of natural disasters such as floods, droughts and heat waves (Hallegatte, 2014). It is well known that agricultural productivity is significantly influenced by the climate (Lemi and Hailu, 2019). A decrease in production due to climate change has the potential to significantly disrupt agricultural trade patterns, as evidenced by recent research indicating that international trade patterns are often distorted by climate induced changes (Jones and Olken, 2010).

Sri Lanka is a developing country that has a predominantly agricultural economy from its early history. Due to its tropical location in the Indian Ocean, Sri Lanka ranks among the top ten countries most susceptible to natural disasters according to the Global Climate Risk Index (United Nations, 2024). Furthermore, the Intergovernmental Panel on Climate Change (IPCC) regional climate model predictions indicate that Sri Lanka is projected to experience a temperature increase of 1– 1.1 degrees Celsius by 2030, further heightening its vulnerability to natural disasters. Its primary impact is on crop production, as it alters the natural growth conditions of crops (Huang *et al.*, 2011), which can pose a potential threat to export volume.

Sri Lanka exports a variety of products including tea, coconut, rubber, spices and vegetables to various countries according to BACI trade data, which provides yearly data on bilateral trade flows at the product level (EPII, 2024). Although the sensitivity of agricultural production to weather variability and natural disasters is well-established, the specific effects of these factors on Sri Lankan exports remain a subject of limited research. To address this gap, this study focuses on the effect of natural disasters and weather conditions on the spice exports, an important sub-sector contributing 9% to the country's agricultural GDP (Central Bank of Sri Lanka, 2015). Furthermore, the spice sector is one of the most vulnerable to climate change (Das and Sharangi, 2018).

Sri Lanka, a leading player in the global spice trade, showcases a rich history of exporting a diverse range of spices, including cinnamon, pepper, cardamom, clove and nutmeg. According to the World Bank World Integrated Trade Solution (WITS) data in 2022, Sri Lanka ranks as the second-largest exporter of cinnamon globally (World Bank, 2024). The country further ranks fifth in exports of both pepper and nutmeg and sixth in clove exports, solidifying its significant role within the international spice market. Notably, Sri Lanka exhibits a high export orientation, with data indicating that the country exports over half of its total spice production on average (Table 1).

The export could be impacted if the adverse weather conditions disrupt production. Therefore, this study assesses the effects of

natural disasters on Sri Lanka's spice exports and examines how temperature and precipitation affect spice exports.

Table 1: Relationship between spice production and export

Year	Production (ton)	Export (ton)	Export %
1999-2002	34,580	18,613	54
2003-2006	36,183	23,830	66
2007-2010	41,983	26,260	63
2011- 2014	47,482	30,601	64
2015-2018	48,783	24,860	51

Source: FAOSTAT (Food and Agriculture Organization) and WITS (World Integrated Trade Solution) website.

METHODOLOGY

Sampling Framework

To empirically reveal the effect of climate change on spices export in Sri Lanka, this study employs a panel dataset of 12 importing countries from Sri Lanka for the years from 1999 to 2022, obtained from the WITS database (World Bank, 2024).

Model Specification

The gravity model is a well-established econometric technique employed to analyze the determinants of export flows. The model is proposed based on the theory called the law of universal gravity, which states that the appeal of gravity of two objects is proportional to their masses and reverses with their distance. The gravity model, initially applied to trade flows by Tinbergen (1962), has become a foundational framework for subsequent research in international trade. The most basic form of the gravity model equation can expressed as follows (Deardorff, 1998).

$$T_{ij} = A.\frac{Y_i Y_j}{D_{ij}} \dots\dots (1)$$

Where,

T_{ij} = Trade flows between country i and j
Y_i = GDP of country i
Y_j = GDP of country j
D_{ij} = Distance between country i and j
A = Constant of proportionality

Econometric Model

To understand the impact of natural disasters and weather state on Sri Lanka's spices exports, this study added several additional variables to the established gravity model framework as explanatory variables as follows.

$$lnEXP_{it} = f(lnSLGDP_t + lnGDP_{it} + lnRemoteness_{it} + Tem_t + Rainfall_t + Disaster_t + FTA_{it} \dots\dots (2)$$

Where,

ln EXP_{jt} =Natural log of export value of spices from Sri Lanka to j^{th} country in t^{th} year
ln $SLGDP_t$ = Natural log of GDP of Sri Lanka in t^{th} year
ln GDP_{jt} = Natural log of GDP of the trading partner in t^{th} year
ln $Remoteness_{jt}$ =Natural log of economic distance between Sri Lanka and j^{th} country in t^{th} year
Tem_t = Temperature of Sri Lanka in t^{th} year
$Rainfall_t$ = Rainfall of Sri Lanka in t^{th} year
$Disaster_t$ =Occurrence of natural disasters in Sri Lanka in t^{th} year
FTA_{jt} = Free trade agreement between Sri Lanka and j^{th} country in t^{th} year

This study utilized export data for Sri Lanka's main spices (cinnamon, pepper, cardamom, clove, and nutmeg) obtained from the WITS database (World Bank, 2024). As the export values are in terms of US dollars, they are deflated using the GDP deflator to remove the effect of inflation.

GDP data for Sri Lanka and its trading partners are obtained from the World Bank World Development Indicators (WDI) database (World Bank, 2024). Similar to the export values, these data are adjusted using country-specific GDP deflators to control inflation and facilitate real value.

The remoteness variable captures not just the physical distance between countries but also considers the economic gap between Sri Lanka and its trading partners. It is determined by summing the distances between Sri Lanka and its trading partners, weighted by the size of the partner's GDP relative to the total world GDP (Wei, 1996). The distance data between Sri Lanka and its trading partners, a measure of remoteness, are obtained from the GeoDist database (Mayer and Zignago, 2011).

The presence of Free Trade Agreements (FTAs) between Sri Lanka and its trading partners, potentially influencing trade flows, is obtained from the WDI database (World Bank, 2024).

To capture the influence of weather, this study used key variables: precipitation and temperature. Precipitation data is obtained from the NASA Power dataset (NASA, 2020), offering observations since 1980. Land surface temperature data, including maximum/day temperature and minimum/ night temperature are also obtained from the NASA Power dataset (NASA, 2020).

The data on natural disasters were obtained from the Emergency Events Database (EM-DAT) delivered by the Center for Research on the Epidemiology of Disasters (CRED) (CRED, 2023). The study concentrated uniquely on significant events, like drought, flood, tsunami, and epidemics, set them as a dummy variable, whether the event occurred or not in the considered year.

RESULTS AND DISCUSSION

To determine the most appropriate econometric model for this study, a comparison between fixed-effects and random-effects models was conducted using the Hausman test (Hausman, 1978). The Hausman test, which compares the two sets of estimates (fixed effects and random effects), rejects the null hypothesis of fixed effects in our model. Therefore, only the results of the random effects model were reported in Table 2.

Table 2. The effect of climate change on spice exports

Variable	Coef.	S.E.
ln SLGDP	0.927***	0.166
ln GDP_{jt}	1.025**	0.396
ln $Remoteness_{jt}$	-0.329	0.304
FTA_{jt}	0.036	0.150
Flood	-0.161	0.142
Drought	-0.294**	0.095
Tsunami	-0.362**	0.116
Epidemics	-0.128	0.155
Maximum T	-0.151*	0.068
Minimum T	-0.952***	0.232
Annual precipitation	-0.011***	0.003
Maximum T # Annual precipitation	<0.000	0.000
Minimum T # Annual precipitation	0.001***	0.000

*Significant level: *P <0.05, **P <0.01 and ***P <0.001, Coef.: coefficient, S.E:standard error*

Effect of Weather on Spice Export

The impact of weather, all other things being equal, was evaluated in relation to three primary variables rainfall, minimum temperature and maximum temperature while controlling for typical factors that influence exports within the framework of the Gravity model. The results reveal statistically significant negative coefficients for both temperature variables, indicating that an increase in temperature (day and night) leads to a decrease in export value. A 1 ^{0}C rise in maximum temperature is associated with a 5.7% decrease in export value, while a 1 ^{0}C rise in minimum temperature is associated with a 1.2% decrease in export value. These findings support existing literature which suggests that temperature variations in exporter countries negatively affect aggregate bilateral trade as well as exporters, closer to the equator experience more significant negative effects due to climate-related factors (Dallmann, 2019). Similarly, precipitation exhibits a negative coefficient, suggesting that a one unit increase leads to a 0.05% decrease in export value.

Das and Sharangi (2018) highlighted the temperature and precipitation changes can impact various spice crops, including disrupting flowering and pollination, promoting pest and disease outbreaks, which collectively influence different physiological growth stages and ultimately impact the reproductive or vegetative yield, seed production, and storage life of various spice crops. These combined effects likely contribute to the observed decrease in export value.

Interestingly, the interaction term between minimum temperature and annual precipitation is positive and statistically significant; indicating that, with higher annual precipitation, there is a positive relationship between minimum temperature and export value. This suggests that the negative impact of rising minimum temperatures on export value is reduced by higher levels of precipitation. Specifically, for each one-unit increase in minimum temperature and annual precipitation, the export value increases by approximately 0.1% (Figure 1).

The interaction term between maximum temperature and precipitation, although positive, is not statistically significant. This suggests a potential positive association between maximum temperature and export value in higher annual precipitation. Overall, the results suggest a combined effect of the temperature and the precipitation effect in a positive manner for the export value.

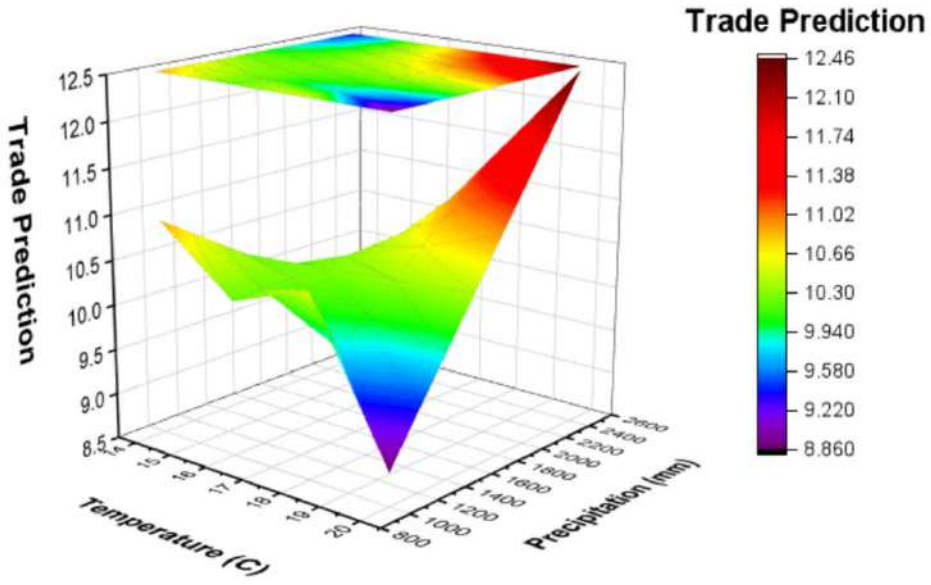

Figure 1. Interaction plot between minimum temperature and Annual precipitation

Effect of Natural Disasters on Spice Export

By controlling the basic gravity variables, the research assesses how natural disasters affect the export value of spices. All natural disasters have a detrimental impact, while drought and tsunami events have statistically significant negative effects. The occurrence of drought leads to a decrease in export value by 29.4% and tsunami will lead to a decrease in export value by 36.2%. The frequency of natural disasters within an exporting nation can exert a negative impact on bilateral export volumes (Oh and Reuveny, 2010). Natural disasters have an impact on exports because they can be responsible for the destruction of factors of production including labor, physical capital, crops, land and infrastructure in addition to influencing the availability of water, which could lead to a decrease in output, ultimately challenges a country's ability to maintain its export levels (El Hadri *et al*., 2019).

Effect of Free Trade Agreement on Spice Export

FTA has a positive effect on export value but is not statistically significant. The positive coefficient means that having a free trade agreement between Sri Lanka and the trading partner causes an increase in export value by 3.6% because it helps in minimizing export trade restrictions, thus promoting higher export values (Urata and Okabe, 2007).

Effect of Basic Gravity Variables on Spice Export

The analysis reveals a statistically significant positive coefficient for Sri Lanka's GDP. This indicates that a 1% increase in Sri Lanka's GDP, holding all other variables constant, is associated with a 0.92% increase in spice export value. Similarly, the coefficient for the trading partners' GDP is positive and statistically significant, suggesting a 1.025% increase in export value for a 1% increase in their GDP. This result aligns with the fundamental assumption of the gravity model that the volumes of trade will increase with an increase in economic size (Deardorff, 1998; Tinbergen, 1962). The negative coefficient for remoteness suggests that countries with more economically distant partners tend to have lower export values. Here one percent increase in remoteness leads to a 0.329% decrease in export value. This could be due to higher trade costs, market access barriers, differences in economic structures, or other factors that hinder trade between economically distant countries (Choi *et al*., 2019).

CONCLUSIONS

In conclusion, this study focuses on the impacts of weather variables and natural disasters on Sri Lanka's spice exports. Through the integration of precipitation, temperature, and natural disasters variables within the gravity model framework highlights their significant influence on spice export

values. The findings reveal a concerning decline in export value with rising temperatures and precipitation. However, higher rainfall appears to mitigate the negative effects of temperature. This implies that sufficient rainfall can partially mitigate the detrimental effects of rising temperatures on spice exports. Furthermore, natural disasters, particularly droughts and tsunamis, pose significant threats to spice exports. This study provides valuable insights into the development of climate-resilient strategies and policies to enhance the performance of the highly valued spice sector in Sri Lanka.

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Factors Influencing Farmer Adoption towards Organic Paddy Farming in Monaragala District

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ABSTRACT

Despite the challenges, there's a growing interest in organic farming among Sri Lankan consumers. This has been driven by the concerns about health, environmental sustainability, and fair-trade practices. Organic farming is a sustainable agricultural approach that emphasizes environmental biodiversity through the usage of natural methods to cultivate crops and raise livestock. With the consideration of timely importance of organic farming, this study was carried out to examine the factors influencing the farmer in adoption of organic paddy farming in Monaragala district. Data were collected through a questionnaire-based survey via face-to-face interviews with a sample of 261 paddy farmers who were selected randomly covering four Divisional Secretariat Divisions in Monaragala district. Data were analysed using descriptive statistics and Structural Equation Modelling (SEM) via AMOS in the SPSS 26 version. The study results revealed that, subjective norms and government support are the main factors that influence farmers in adoption of organic paddy farming practices. The implications of these findings for policy formulation, extension services and sustainable agricultural development are discussed while, highlighting the need for holistic interventions to promote the widespread adoption of organic paddy farming practices.

KEYWORDS: Farmer adoption, Organic paddy farming, Structural equation modeling

INTRODUCTION

Organic farming is the fundamental alternative to conventional farming for harnessing the biodiversity in agricultural landscapes. Now it is re-emerging as a major agriculture practice as it safeguards soil health and promotes public well-being. However, the adoption rate of organic farming is still low among Sri Lankan farmers.

Organic farming is a production system which avoids, or largely excludes, the use of synthetic fertilizers, pesticides, growth regulators, and livestock feed additives (Singh, 2021). The organic sector is now one of the most rapidly growing segments of the global food market and the global demand for organic products is increasing by 15%-20% per annum (Malkanthi, 2020; Singh, 2021).

Consumer interest towards the products with an organic origin has been steadily growing for last twenty years. According to the statistical findings, the global sales of organic food have increased in between the years 2000 and 2021. Organic food production is performed by 2.4 million producers in 179 countries around the world (Golijan and Dimitrijevic, 2018). According to Willer *et al*., (2024), the regions with the largest organic agricultural land areas were Oceania (53.2 million hectares – comprising more than half of the world's organic agricultural land, at 55%) and Europe (18.5 million hectares, 19%). Latin America followed with 9.5 million hectares (10%), succeeded by Asia with 8.8 million hectares (9.2%), Northern America with 3.6 million hectares (3.8%), and Africa with 2.7 million hectares (2.8%).

In Sri Lanka, rice is not only the staple food, but also a main income source of villagers (Nayakarathna *et al*., 2013). It is often cultivated using conventional methods that rely heavily on synthetic fertilizers and pesticides. However, amongst the organic food producing countries, Sri Lanka maintains a reputation for organic crop production and exports as defined and specified by the International Federation for Organic Agriculture Movement (IFOAM). Consequently, Sri Lanka is blessed with fertile land, diverse climate, and traditional knowledge which offers an immense potential for expanding organic agriculture.

According to the statistics, Sri Lanka possessed 77,169 hectares of organic agricultural land in 2018, which is a decrease of 19,149 hectares compared to 2017 (De Silva and Rajapakse, 2023). Organic farming has been a highly debated topic in Sri Lanka in recent years due to the shifting of the government's agricultural policy from inorganic to organic farming in 2021. In recent years, the Sri Lankan government restricted the importation of inorganic fertilizers and pesticides in order to promote organic farming by aiming to mitigate the adverse environmental and health effects associated with the widespread use of chemical fertilizers and pesticides. It has encountered various challenges related to limited knowledge among farmers, insufficient technical support, and resistance to adaptation. As rice is the staple

crop in Sri Lanka, it is timely and important to identify factors affecting farmer's adoption in organic farming. Thereby, the specific objective of this study was to identify the factors influencing farmer adoption towards organic paddy farming in Monaragala district. Selected factors for the study were health concerns, subjective norms, the general attitude of farmers, government support, level of knowledge, and adaptability for organic paddy farming other than demographic factors.

METHODOLOGY

Conceptual Framework

Based on the selected variables, the following conceptual framework was proposed (Figure 1).

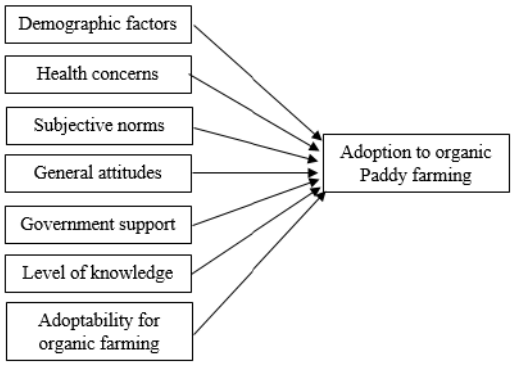

Figure 1. Conceptual framework

Data Collection

Primary data were collected from 261 paddy cultivating farmers from randomly selected four Divisional Secretariats (DS) in Monaragala District. Two *Grama Niladhari* (GN) divisions were included in the sample from each selected DS division. Farmers were selected randomly by using a list of paddy farmers from each GN division.

Measures

The questionnaire consisted of two sections, including demographic factors, and other selected variables, i.e., health concerns, subjective norms, general attitude, government support, level of knowledge and adoptability for organic farming. Other than demographic factors, 26 statements were used to evaluate these factors. All the indicators were evaluated using a five-point Likert scale, ranking from 1 to 5, where 1 was denoted "strongly disagree" and 5 was denoted "strongly agree".

Data Analysis

Data were analyzed by using Confirmatory Factor Analysis (CFA) in Analysis of Moment Structure (AMOS) in SPSS 26 version. The demographic parameters of respondents were analyzed by using descriptive statistics, while Cronbach's Alpha Coefficient was used to determine the reliability of the factors. Structural Equation Modelling (SEM) was used to identify the relationship between independent variables and dependent variable. The estimates were based on the Maximum likelihood estimation technique.

RESULTS AND DISCUSSION

Descriptive Statistics of the Sample

According to the survey statistics (Table 1), the highest number of farmers were above 50 years of age and 42.9% of farmers were between the age ranges of 35 and 50 years. There were no any farmers between the age range of 18 -24. The Majority of the farmers (64.4%) have completed their education up to Ordinary Level (O/L) and 23% of farmers have completed their Advanced Level (A/L). Most of the farmers engage in inorganic farming (72.8%) while 27.2% are semi-organic farmers. Unfortunately, there were no any organic farmers in the studied sample. Among the studied population, the highest monthly income (51.7%) was reported between the ranges of Rs. 61,000-100,000 from paddy farming.

Table 1. Demographic factors of the sample

Parameter	Category	Percentage (%)
Age	18-24 years	-
	25-34 years	4.6
	35-50 years	42.9
	Above 50 years	52.5
Educational Level	Primary education from grade 1 to 8	7.7
	O/L	64.4
	A/L	23
	Diploma	5
	Bachelor's degree	-
	Others	-
Current Method	Organic	-
	Semi-organic	27.2
	Inorganic	72.8
Income from paddy farming	<Rs.25,000	7.7
	Rs. 26,000- 60,000	27.6
	Rs.61,000-100,000	51.7
	>Rs.100,000	13

Validity and Reliability Statistics

To verify the factorability of the data, the Kaiser-Meyer-Olkin (KMO) test and Bartlett's Test of Sphericity (BTS) were conducted. The KMO test evaluates whether the data is suitable for factor analysis, with a recommended threshold value of at least 0.60. Additionally,

the BTS assesses the significance of the correlation matrix, with a threshold of $P < 0.1$. The results of both tests, met the minimum requirements, indicating that the data were suitable for further factor analysis.

To assess internal consistency, a reliability analysis was conducted using Cronbach's alpha coefficient and all factors exhibited the threshold of 0.7, signifying acceptable consistency within their indicators (Table 2).

Table 2. Cronbach's Alpha of each factor

No	Variables	Cronbach's Alpha	Indicators
1	Health Concerns	0.936	4
2	Subjective Norms	0.749	5
3	General Attitudes	0.830	5
4	Government Support	0.717	4
5	Knowledge	0.743	3
6	Adoptability	0.753	3

Composite reliability was also assessed, with all values surpassing the threshold of 0.7 except knowledge, indicating that all other constructs exhibit satisfactory reliability (Table 3). However, the Average Variance Extracted (AVE) of subjective norms and government support indicators fell below the recommended threshold of 0.5, while others were estimated above 0.5 (Table 3). Composite reliability and AVE indicate that the overall measurement model has good convergent validity.

Measurement Model

The model initially used 26 indicators, all of which exhibited insufficient fit. As a result, two indicators with low factor loadings (below 0.05) and insignificance (at p=0.05) were removed, including K1 and GS5. Table 2 presents the re-estimated results, indicating that all standardized estimates are statistically significant, except for Ad1, Ad2, SN5, A1, A5, GS3, GS4, K3 and K4. The remaining indicators effectively reflect their respective latent variables (factors).

Among the remaining indicators, HC3 has the highest factor loading (0.951) for the health concerns factor, indicating that the nutritional quality of organic rice is higher than that of inorganic rice. The SN1 indicator showed the highest contribution (0.776) for subjective norms, reflecting the influence of family members on adoption. A3 has the highest factor loading (0.992) for the general attitudes of farmers. The GS1 indicator (Government's support and encouragement) showed the highest factor loading (0.968) towards government support. The K3 indicator has the highest factor loading (0.956) for knowledge, indicating that farmers have limited knowledge of organic paddy farming. The Ad3 indicator has the highest factor loading (0.812) for adoptability, indicating that farmers may shift within the next five years.

Table 3. Properties of the measurement model

Factors	Estimate	Composite Reliability	AVE
Health Concerns		0.933	0.776
HC1	0.856***		
HC2	0.789***		
HC3	0.951***		
HC4	0.92***		
Subjective Norms		0.752	0.383
SN1	0.776***		
SN2	0.687***		
SN3	0.508***		
SN4	0.597***		
SN5	0.480		
General Attitudes		0.886	0.636
A1	1,131		
A2	0.785***		
A3	0.922***		
A4	0.561***		
A5	0.352		
Government Support		0.754	0.471
GS1	0.968***		
GS2	0.804***		
GS3	0.348		
GS4	0.426		
Knowledge		0.051	1.055
K2	0.32		
K3	0.956***		
K4	-1.08		
Adoptability		0.837	0.653
Ad1	0.458		
Ad2	1.044		
Ad3	0.812***		

*Levels of statistical significance, ***P<0.001.*

Standardized Regression weight analysis shows that (Table 4) farmer adoption towards organic paddy farming is positively and significantly influenced by subjective norms and government support.

There were five indicators under subjective norms, which are the influence of family members, agriculture extension programs and training, NGO and other private organizations, government and professionals in the agriculture field. According to the results, subjective norms were significant ($\beta = 0.627$,

p< 0.001) for farmer adoption of organic paddy farming.

Government support was also measured by five indicators as government provides support and encouragement, does promotions through advertisements, provides necessary seeds and planting materials, demand for organic rice and provides necessary subsidies. Government support was found to be another significant factor in this study ($\beta = 0.145$, $p < 0.001$).

Health concerns, knowledge and general attitudes did not significantly impact farmer adoption of organic paddy farming.

Therefore, it can be concluded that farmer adoption of organic paddy farming is significantly and positively influenced by the subjective norms and government support.

Table 4. Standardized regression weight

Relationship	Estimate
Adoptability ←Health concerns	-0.046
Adoptability← Subjective norms	0.627***
Adoptability← Government support	0.145***
Adoptability← Knowledge	-0.049
Adoptability ←General Attitudes	0.01

*Levels of statistical significance, ***p<0.001.*

The structural relationship between adoptability and factors is shown in the figure 2.

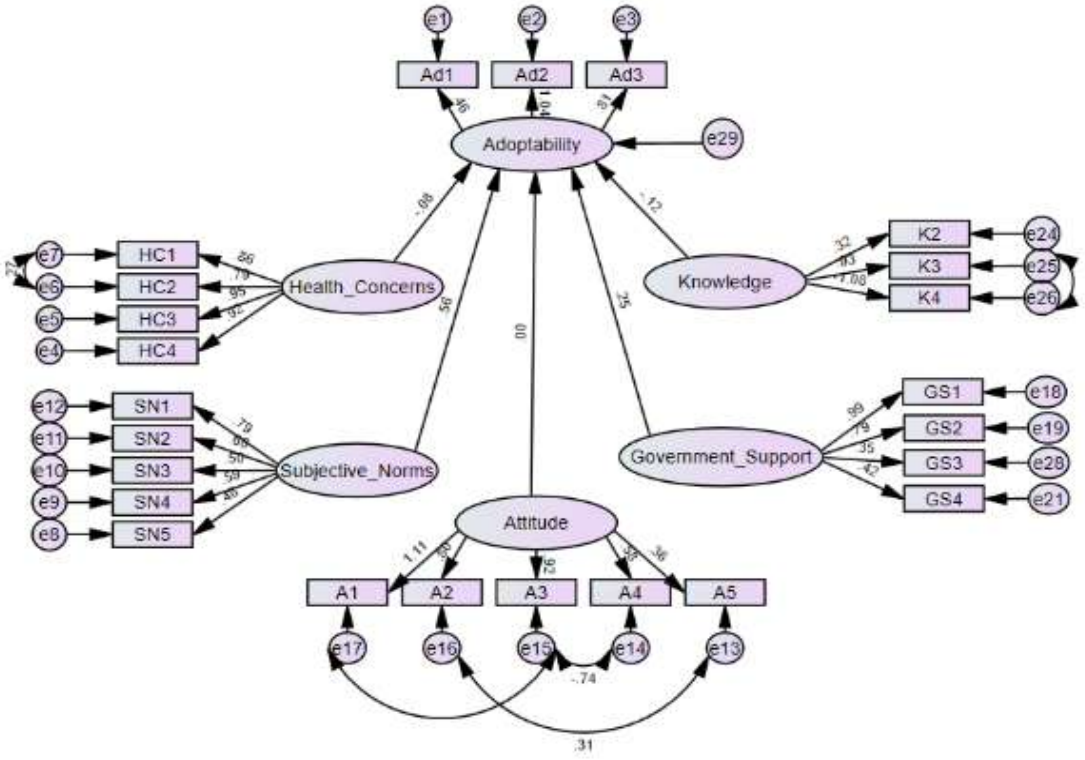

Figure 2. Structural relationship between adoptability and factors.

HC: Health concerns, HC1: protects the good health of a farmer and farm family, HC2: does not have any harmful residue, HC3: Nutritional quality of organic rice is higher than non-organic rice, HC4: organic rice has fewer side effects, SN: Subjective Norms, SN1: Influence from family members, SN2: Influence from Agriculture extension programs, SN3: Influence from NGOs, SN4: Influence from government, SN5: Influence from professionals in agriculture, A: General attitudes, A1: Eco friendly, A2: Improve quality of soil and water, A3: Consumer preference, A4: Cost of production, A5: Profit, GS: Government Support, GS1: Support and encouragement, GS2: Promotions, GS3: Providing seeds and planting materials, GS4: Demand for organic rice, K: Level of knowledge, K2: Heard only term, K3: Little knowledge, K4: Very good knowledge, Ad: Adoptability, Ad1: Adopt immediately, Ad2: Within next 2 years, Ad3: Within next 5 years

CONCLUSIONS

The results suggest that the farmer adoption towards organic paddy farming in Sri Lanka is significantly and positively influenced by subjective norms and government support. Conversely, health concerns, knowledge, and general attitudes did not significantly impact the adoption of organic paddy farming.

Notably, the influence of family members, agriculture extension programs, NGOs, the government and professionals in the agriculture field emerged as pivotal factors, contributing to the adoption of organic farming, indicating a strong social dimension to the decision-making process. Furthermore, the results suggested a strong positive correlation between governmental support and farmers' inclination towards organic agriculture. Specifically, the findings indicate that when farmers perceive tangible support and encouragement from governmental authorities, their propensity to embrace organic farming significantly increases.

Further, it was noted that the Agricultural extension programs (SN2) play a crucial role in providing farmers with the necessary knowledge and resources to adopt organic farming practices. These programs should be strengthened to offer comprehensive support and guidance on organic farming practices, including training workshops, demonstration plots, and access to certified organic inputs.

The influence of professionals in agriculture can be harnessed to promote organic farming practices. Agricultural experts, researchers, and educators can provide farmers with training and technical assistance on organic farming techniques.

The government can promote organic paddy farming through targeted advertisements on various media platforms such as television, radio, social media, and newspapers. By showcasing the success stories of farmers who have transitioned to organic farming, the government can inspire farmer’s confidence and interest.

By providing the necessary seeds and planting material, the government can reduce the initial investment burden on farmers, making it easier for them to adopt organic practices. Access to high-quality organic seeds and materials ensures better crop yields and farmers' confidence in organic methods.

The rising demand for organic rice significantly influences farmers' adoption of organic farming practices. As consumers become more health-conscious and environmentally aware, the market for organic products, including rice, expands. This growing demand translates into higher prices and better market opportunities for organic rice, making it financially attractive for farmers.

Furthermore, the government can provide subsidies for farmers to adopt organic paddy farming through various means, such as direct financial aid, tax incentives, low-interest loans, insurance subsidies, training programs, and market development support. These subsidies aim to alleviate the financial burden associated with transitioning to organic cultivation, making it more economically feasible for farmers to embrace sustainable farming practices.

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Estimation of the Economic Values of Cultural Service Arising from Village Tank Cascade System in Sri Lanka: Discrete Choice Experiment

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ABSTRACT

Sri Lanka is renowned for its hydraulic civilization, with the Village Tank Cascade Systems (VTCS) being a crucial part of this heritage. However, the lack of assessment of the non-economic values of ecosystem services has hindered funding for restoring degraded VTCS. This study aimed to determine consumers' willingness to pay (WTP) for the restoration and management of VTCS to enhance tank-related cultural services. A structured questionnaire and pre-tested interviews were used to collect socio-demographic information, knowledge about VTCS, and evaluations of the current ecosystem services from a randomly selected sample of 150 consumers in the Palugaswewa Divisional Secretariat Division in Anuradhapura District. A Choice Experiment (CE) was then conducted to study consumers' WTP. The data from the CE were analyzed using the Conditional Logit Model. This study is the first to apply CE to value cultural services in small tank cascade systems in Sri Lanka. It identified moderate and high levels of peace, humanity, and social cooperation as the primary drivers behind cultural services. The highest Marginal Willingness-To-Pay (MWTP) was recorded for the high peace, humanity and social corporation (85,126.1 LKR) followed by the second highest MWTP (62,831.7 LKR) was recorded by the level for the medium peace, humanity and social corporation. The findings demonstrate that the benefits of restoring small tank cascades, when viewed as an integrated decision-making unit, outweigh the costs, highlighting the economic feasibility and cultural importance of such restorations.

KEYWORDS: Cascade System, Cultural ecosystem service, Choice experiment, Restoration, Willingness to pay

INTRODUCTION

In Sri Lanka, early civilizations were formed in North Central parts and Southeast parts of the country which also considered as dry zone due to having annual rainfall less than 2000 mm (Dewapura *et al.*, 2020). In this area collection of water was needed to fulfil their household needs and agriculture which is their main activity. So, water tanks are not merely structures built to store water but complex man-made ecosystems involving many natural resources and has the capability to provide a wide variety of functions and services. The central presence of the lake provides the essential structure to the land as is evident in the Village Tank Cascade Systems (VTCS) prevalent in the North Central Province of the country. A cascade system is defined as a "connected series of tanks organized within a 'meso-catchment' of the dry zone landscape, storing, conveying and utilizing water from an ephemeral rivulet" (Bandara, 2007; Panabokke, 2003). The primary function of a village tank was to irrigate dry low-land plains for paddy farming during major cultivation seasons.

A VTCS are generally designed with different important zones. Each of these zones contributes a unique function or significance. Four distinctive zones can be identified in a VTCS such as (i) tank bund and tank bed, (ii) associated irrigation channels and paddy fields, (iii) protected forest in the catchment and rainfed uplands and, (iv) "gangoda", (hamlet or high elevation household area). Each zone had a significant component. (Avsadahamy, 2003; Dharmasena, 1994).

Water tanks provide different habitats creating a heterogeneous net of interconnected territories. The different ecological, social, and economic elements involved in the ecosystem are closely related and dependent on the existence of the water tank. It is important to analyze the ecosystem functions and ecosystem services of VTCSs to safeguard its sustainability. According to Millennium Ecosystem Assessment (MEA, 2005) and Economics of Ecosystems and Biodiversity (TEEB) VTCS have four major ecosystem services.

They are provisioning, regulating, supporting and cultural services. Provisioning services are the products obtained from ecosystems which provide direct benefits and often with a clear monetary value such as food, water, wood, fiber, and fish from rivers and lakes. Regulating Services are ecosystem regulates variety of services such as climate regulation, mitigation of climate change, carbon sequestration, maintaining air quality, pollution control, erosion prevention, land degradation regulation and etc. Supporting Services are the services that has no direct benefit to people but

essential to the functioning of ecosystems and therefore, indirectly responsible for all other processes such as soil formation and plant growth and Cultural Ecosystem Services (CES) include non-material benefits that people obtain from ecosystems such as spiritual enrichment, intellectual development, recreation and aesthetic values and tourism. CES may be one of the most useful vehicles for communicating the importance of protecting ecosystems but CES are poorly reflected in economic indicators and rarely marketable.

The ecosystem service that provided by VTCS consists of total economic values of environmental amenities which comprises explicit use benefits as well as implicit non-use benefits. Use value refers to the benefit that a user obtains, either directly or indirectly, from participating in an activity. Direct uses can be divided into consumptive use and non-consumptive use. Consumptive use involves activities that deplete forest resources, while non-consumptive uses do not. Indirect use value comes from indirect utilization through ecosystem function and regulation services. Option values arise from uncertain future demand for resources. Non-use values, such as existence value and bequest value, do not involve physical consumption and are classified into existence value (EV) and bequest value (BV). Existence value is the knowledge of a particular asset's existence, while bequest value is the satisfaction from preserving natural or historic environments for future generations.

These values of ecosystem services are assessed in three different ways such as; qualitative analysis, quantitative analysis, and monetary analysis. According to that ecosystem service valuation utilizes various methods and approaches to estimate the value of ecosystem services. In this case, value of cultural services are accessed through non–market valuation methods or stated preference (contingent valuation methods, Choice modelling methods, and group deliberation) (Koetse *et al.,* 2015).

Research Gap

In the Sri Lankan context, not having any kind of estimation of the cultural service values of VTCS is quite observable. Therefore, non-economic value component of total economic values is unidentified. Further, lack of recognition of VTCS as an interconnected system in the design, analysis and planning of small tank restoration in Sri Lanka (Vidanage, 2018).

When compared with previous studies it was recognized as the research gap. Under this, Choice experiment surveying people's willingness to pay for nature restoration was performed to capture all cultural services of VTCS in a single value function.

METHODOLOGY

Theoretical Framework for Analysis

Choice experiment can be used to determine what villagers are willing to pay for different cultural service attributes. Decision maker's perception on different attributes can be observed by using two methods. They are stated preference method (SP) and revealed preference method. This study was based on the stated preference method. Discrete Choice Experiment has been identified as a commonly used stated preference technique. It is usually conducted through choice card which comprise of key attributes and respective levels.

This technique has a theoretical basis with the Lancaster's model of consumer choice (Lancaster, 1966), and Random Utility Theory (Thurstone, 1927). Random Utility Theory, which explains the dominance judgment between pairs of offering where each alternative (i) in the choice set, thus, has and utility level represented by;

$$U_i = V_i + \varepsilon_i \text{ ……..……... (1)}$$

U_i = Utility of the i^{th} alternative
V_i = Objective component of the i^{th} alternative
ε_i = Error component

Indirect utility from newly designed labels takes the form,

$$V = \beta_0 + \beta X_{(Recreational\ activities)} + \beta X_{(Scenic\ beauty)} + \beta X_{(Educational)} + \beta X_{(Rituals)} + \beta X_{(Social\ corporation)} + \varepsilon_i \ldots \text{ (2)}$$

Where,
X = attribute associated with relevant alternative
β = coefficient vector of attribute
Ɛ = the error component

The marginal value of any attribute change can be expressed as the ratio of the coefficients of any of attribute. This equation can be estimated using a conditional logit model. Once estimated, parameters of the model could be used to obtain apart-worth or implicit price formula for the marginal rate of substitution between income and an attribute concerned as;

$$MWTP_{attribute} = -1\left(\frac{\beta_{attribute}}{\beta_{monetary\ attribut}}\right) \text{ ……. (3)}$$

This is the marginal welfare measure that seek for a change in any of the attributes sometimes known as, marginal willingness to pay, MWTP (Kuruppu *et al.*, 2014).

Experimental Site

The study was based on Bellankadawala tank cascade system situated in the Palugaswewa Divisional Secretariat Division in Anuradhapura District of the North Central Province.

Eleven tanks constitute the selected cascade system namely Bellankadawala wewa, Thumbikulama wewa, Siyambalawa wewa, Bulana wewa, Vidanewewa, Ulpotha wewa, Rambawalawewa, Moragaswewa, Thimbalawa wewa, Kelewa wewa and Pahalagama wewa.

Designing the Choice Experiment

Establishing the current status of the cascades through the problem identification and then selecting of attributes through the Focus Group Discussions conducted for cascade dependent communities. Then assigning levels to attributes was done by considering proper literature review, expert opinion, and focus group discussions. Then designed experimental design as five attributes with three levels and one attribute with four levels.

Alternatives, Attributes and Levels

These attributes and their levels were determined based on literature, expert consultation and focus group discussions with communities living in cascades and field testing of those through focus discussion with cascade communities (Table 1).

A discrete choice models describe respondent's choices among a set of alternatives. In this research, the alternatives are the different cascade restoration options. Levels of attributes for other two alternatives were generated in an experimental design. A design with four attributes with three levels and a five-level payment attribute, will result in a full factorial design with 1215 (3^5x5) different combinations of attributes. Therefore, a manageable fractional factorial design was created with 45 unique choice set.

Even the 45 sets of choices were too many for the respondents in the survey. Therefore, these, were blocked into five sets of choice set. These attribute levels were illustrated graphically and used in producing printed colour cards of choice profiles to be given to respondents to make their choices. There were total of 45 choices card. In the survey, each respondent faced 9 choice cards and all respondents are randomly selected from on-site area.

Table 1. Description of attributes and their levels

Attribute Name	Attribute Levels
Recreational activities and mental and physical health	Less than or equal to two (02) activities per year, Five (05) activities per year, More than five (05) activities per year.
Scenic beauty and amenity	Poor, Moderate, High.
Educational/ Traditional knowledge	Very few people aware about traditional practices, 25% of the community aware about traditional practices, 50% of the community aware about traditional practices.
Rituals	Few communities' member (< 5% of village population) follows rituals, Some of community member (25% of village population) follows practice rituals, Majority of community (50% or more of village population) follows practice rituals.
Peace, humanity and social corporation	Low, Moderate, High.
Expenditure of restoring and managing the cascade per year	2000, 4000, 6000, 9000, 12000

Sampling

Eleven tanks in a cascade system in the Palugaswewa Divisional Secretariat in Anuradhapura District was the focus of the study. Primary data was gathered using questionnaire survey employed in selected communities in the villages such as; Bellankadawala, Thimbalawa, Bulana, Siyabalagaswawa, Pahalagama, Rabawa, Nawathisgama, Ulpatha, Higgahayaya, Thulana, Kalawa and Wayaulpatha in Palugaswewa Divisional Secretariat. 150 households were randomly selected for the questionnaire survey from all twelve villages.

The questionnaire was divided into five sections. Section one consisted of information on respondents' socio demographic factors like age, gender, number of household members, monthly income and education level. Section two consisted for a knowledge segment to test the knowledge about VTCSs. Section three consisted to check respondents' perceptions on VTCS restoration. Section four consisted of

evaluating the current status of the ecosystem services arising from used tank. And the final section consisted Choice experiment questions.

Statistical Analysis

Data were analyzed by using the RStudio Statistical software with Package "support. CEs" (Aizaki, 2012).

RESULTS AND DISCUSSION

The socio-demographic charismatics of the study sample are given in Table 2. Out of 150 respondents, the majority of the respondents were female (50.67%). Respondents belonging to age categories of >58 and 38-48 dominated accounting for 41.33% and 26% of the study sample, respectively. Meanwhile, 73.33% of the respondents were farmers. A relatively higher portion of respondents had attended only up to the ordinary level (O/L), while the monthly income level of Rs.25000-50000 was dominant (49.33%).

Table 2. Socio-demographic characteristics of the sample

Parameter	Category	Percentage (%)
Gender	Male	49.33
	Female	50.67
Age	<18	0.67
	18-27	5.33
	28-37	16.67
	38-47	26.00
	48-57	10.00
	>58	41.33
Employ	private sector	1.33
	Govt. sector	6.67
	Self-employment	12.00%
	Farming	73.33%
	Others	6.67%
Education	Up to 7	25.33
	Up to O/L	42.67
	Up to A/L	9.33
	Pass A/L	1.33
	Degree	1.33
	Postgraduate	1.33
	Other	18.67
Income	<25,000	36.67
	25,000-50,000	49.33
	50,000 – 100,000	13.33
	100,000– 200,000	0.67

Outcome of Choice Experiment

Results relating to the ten levels related to five attributes and price attribute assessed in the analysis are illustrated in Table 3. According to the result, all eleven level and Price attributes were significant at 0.05 significance level. The coefficient received for all levels was positive Therefore, those levels indicate the respondent's willingness to pay for all levels which represent cultural service attributes.

Table 3. Outcomes of the fitted CL model

Levels	Coef.	SE	p-value
only5	-0.958	0.086	0.017
more5	0.204	0.092	0.070
Moderate	0.168	0.088	<0.002***
High	1.255	0.086	<0.002***
E25present	0.318	0.096	0.000***
E50present	0.647	0.087	1.510***
R25present	0.648	0.084	1.800***
R50present	0.973	0.085	<0.002***
Moderate.1	1.273	0.103	<0.002***
High.1	1.725	0.101	<0.002***
Price	-2.026***	9.794***	0.038

*SE-Standard error, Coef.-Coefficient, *p<0.05, **p<0.01, ***p<0.001, only5: Five (05) activities per year, more5: More than five (05) activities per year, Moderate: Medium Scenic beauty and amenity, High: High Scenic beauty and amenity, E25present: 25% of the community aware about traditional practices, E50present: 50% of the community aware about traditional practices, R25present: Some of community member (25% of village population) follows practice rituals, R50present: Majority of community (50% or more of village population) follows practice rituals, Moderate.1: Medium Peace, humanity and social corporation, High.1: High Peace, humanity and social corporation*

Estimated MWTP values for the significant levels of cultural service attributes that influence the utility of consumers for the restoration of VTCS. The coefficients of the respective levels received from the model fitted levels were used for the calculation of MWTP (Table 4) and use 97.5% confidence interval which provides a comprehensive understanding of the variability of the estimates.

It was noted that the VT consumers bear a high concern regarding high and moderate levels of Peace, humanity and Social Corporation through restoring VTCS with MWTP values of Rs. 85125.10 and Rs. 62831.70 to restoring and managing the cascade per year. Meanwhile they less concern regarding levels of Recreational activities and mental and physical health attributes (Only five activities per year, more than five activities per year) and those levels have MWTP values Rs.10109.4 and Rs.8300 are lowest values willing to pay to restoring and managing the cascade per year.

Table 4. MWTP values associated with significant levels

Levels	MWTP	97.5%	2.5%
only5	10109.40	-452.20	65023.50
more5	8300.50	-2839.40	58606.70
Moderate	45213.90	19193.60	256455.60
High	61945.30	28379.50	344549.40
E25present	15721.80	2886.10	93170.00
E50present	31975.60	12564.90	193321.80
R25present	32018.80	13044.60	186784.70
R50present	48045.60	20766.40	281670.20
Moderate.1	62831.70	28187.20	345931.40
High.1	85126.10	38638.20	475222.40

MWTP- Marginal Willingness-To-Pay

CONCLUSIONS

The research conducted on the Bellankadawala tank cascade reveals that the majority of respondents are willing to pay a fee for the proper management and restoration of the cascade system, recognizing the cultural services provided by the tanks. The study concludes that individuals who directly benefit from the cascade have a positive willingness to pay (WTP) for its restoration and sustainable management.

All levels of cultural services significantly influence the utility of tank-dependent people. They highly value both high and moderate levels of peace, humanity, and social cooperation (Rs. 85,126.10 and Rs. 62,831.70 respectively), considering these attributes as the most important cultural services. Interestingly, the cascade-dependent community appreciates scenic beauty and amenity but does not regard the level of recreational activities as important in their assessments.

This research likely represents one of the first valuations of the cultural services of VTCS. The findings suggest that proper restoration of degraded VTCS can be enhanced by understanding and leveraging the community's valuation of these cultural services. By acknowledging the high value placed on peace, humanity, and social cooperation, as well as scenic beauty, restoration efforts can be better aligned with the priorities of the local community, thereby increasing the effectiveness and support for such initiatives.

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Estimation of Economic Value of Ecotourism Associated with Village Tank Cascade Systems: A Contingent Valuation Method Approach

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ABSTRACT

A study investigated the potential of village tank cascade systems in Sri Lanka to become ecotourism hotspots, leveraging their rich ecological and cultural history. This research employed the contingent valuation method (CVM) to estimate the economic value of ecotourism associated with the Hiriwadunna village tank cascade system. The study assessed past travelers' willingness to pay (WTP) for ecotourism experiences and examined the factors that influenced their WTP. This study is important for being the first to assess ecotourism in Sri Lanka's village tank cascade systems from a financial viewpoint. The Hiriwadunna village tank cascade system in Sri Lanka has an opportunity to generate income from ecotourism, according to a study. Survey data from 371 international visitors was used to analyze visitor preferences, and the results showed that willingness to pay (WTP) varied with age, gender, income, and prices offered. The positive WTP range (USD 57.15 to 59.26) demonstrates the positive economic impact of ecotourism. The study suggests a sustainable ecotourism plan that prioritizes conservation, integrates the local community, and identifies particular activities that are in line with visitor preferences and environmental needs in order to fully realize this potential. Targeted marketing techniques should also draw travelers who have a verified WTP for ecotourism activities. By taking a balanced approach, the Hiriwadunna village tank system's economic potential can be fully realized while environmental preservation is maintained.

KEYWORDS: Contingent Valuation Method (CVM), Ecotourism, Economic Valuation, Village Tank Cascade Systems, Willingness to Pay (WTP)

INTRODUCTION

As a hotspot for biodiversity, Sri Lanka has seen a rise in ecotourism, which presents an attractive journey for sustainable development, especially in rural areas. The ancient village tank cascade systems of the North Central Province are a unique example of its cultural heritage. These interconnected tanks were traditionally used for families and agricultural purposes. More people are becoming aware of these systems' potential to promote ecotourism.

The physical characteristics of Village Tank Cascade System (VTCS) were highlighted in Madduma Bandara's initial definition (1985) (Dharmasena,2018). However, Dharmasena (2018) argues that this definition gets brief of gathering the ecological significance of the VTCS in every aspect and also the complex relationship between nature and humans within these systems. Dharmasena suggests an additional definition that emphasizes VTCS as an ecosystem designed to address this:

"An ecosystem, where water and land resources are organized within the micro-catchments of the dry zone landscape, providing basic needs to human, floral and faunal communities through water, soil, air and vegetation with human intervention on a sustainable basis (Dharmasena, 2018)."

Village tank cascade systems (VTCS) in Sri Lanka used to be a major source of income for growing rural communities. Several livelihood options have been made possible for generations by these interconnected tanks. Crops are grown by farmers on lowland fertile areas that receive watering from tanks and rainfed slopes. Agro-forestry techniques also incorporate the use of trees for fruit, timber, and animal feed. Homestead farming provides additional production for households, while livestock rearing for milk, meat, and eggs grows within the system. Additionally, through the processing of agricultural products like fruits and rice, nearby communities create income from agro-based industries. An additional economic benefit is added by fish farming in the tanks and canals, confirming the VTCS's historical and continued importance for rural Sri Lanka (IUCN, 2016).

Through ecotourism growing at the fastest rate in the tourism sector (Fennell, 2003), Sri Lanka's village tank cascade systems (VTCS) have a lot of exciting opportunities before it. These interconnected tanks include unique flora and fauna, rich biodiversity for wildlife viewing and birdwatching, and captivating landscapes (IUCN, 2016). By promoting low-impact activities and environmental awareness, responsible ecotourism can make the most of these assets and grow conservation efforts. likewise, homestays, expert-led guided nature walks, and traditional handicraft workshops are examples of community-based programs that

empower local people and highlight their cultural heritage (IUCN, 2016). With the potential social and economic advantages of ecotourism within VTCS so great, a greater awareness of its economic valuable is essential.

Non-market-based approaches are used because there is no market data for the value of ecotourism experiences in VTCS. For it to assess people's willingness to pay (WTP) or accept (WTA) compensation for environmental changes, these methods rely on surveys and other methods.

Among these is the widely used stated preference technique known as the Contingent Valuation Method (CVM) (Arrow *et al*., 1993). When it comes to hypothetical changes in the quantity or quality of an ecotourism experience within a VTCS, CVM asks people directly about their WTP. The CVM survey can be made to record both non-use values held by people who may not visit the VTCS but nevertheless value its preservation and use values enjoyed by travelers who actively engage in ecotourism activities.

Through careful survey instrument design and the application of rigorous data analysis techniques, CVM is able to offer important insights into the ecotourism industry's economic value in the VTCS. Decisions about resource allocation and sustainable development strategies can be made with this information in mind, ensuring that the preservation of the particular ecological and cultural heritage of the VTCS is balanced with the economic advantages of ecotourism.

This study searches into how ecotourism impacts the Hiriwadunna village tank cascade system in Sri Lanka economically. Objective of the study is to use the contingent valuation method (CVM) to measure travelers' willingness to pay (WTP) for ecotourism activities that turn around this system. Policymakers, environmentalists, and local communities who are trying to pick an equilibrium between the preservation of these ecologically and culturally important water management systems and the economic benefits of ecotourism will find significant value in the findings.

Although Sri Lanka understands the potential of ecotourism, there exists an important lack of information about the economic value of village tank cascade systems. Previous studies neglected the unique value proposition that these traditional systems give to the benefit of focusing on coastal ecosystems, national parks, and protected areas.

By focusing on the economic evaluation of ecotourism in the Hiriwadunna village tank cascade system, this study addresses in these gaps. Our objective is to provide stakeholders beneficial information and suggestions by assessing tourist WTP and identifying relevant variables. With the support of the local economy, this knowledge may guide the development and delivery of ecotourism initiatives that are sustainable and increase the long-term health of the village tank cascade system.

The economic valuation of ecotourism has gained popularity recently, providing an alternative approach to calculating the total economic value (TEV) of natural resources to the conventional market methods. TEV provides a more thorough understanding of the advantages gained from ecotourism experiences by incorporating both use and non-use values (Pearce and Moran, 1994). While many techniques have been used for valuation, one increasingly common technique for valuing non-market goods and services such as ecotourism is the contingent valuation method (CVM) (Pearce and Turner 1989).

The beneficial effect of the CVM in assessing ecotourism experiences has been displayed by extensive research. CVM has been used in studies to evaluate visitors' willingness to pay for programs that protect wildlife, enhance environmental standards in protected areas (Jacobsen and Hanley, 2009), and improve ecotourism activities like birdwatching tours and guided hikes (Hanley, 2008).

This research provides to the collection of knowledge by applying CVM to analyze the economic benefits of ecotourism in context of Sri Lanka's village tank cascade systems. Studying tourist WTP in that specific setting can provide useful details for the development of ecotourism that is environmentally friendly and beneficial to both the environment and the communities around it.

METHODOLOGY

Double Bound Dichotomous Choice contingent valuation method

This study assesses the financial value of ecotourism experiences in Sri Lanka's village tank cascade systems (VTCS) using the contingent valuation method (CVM). The conventional method of valuing non-market goods, known as CVM, generally measures respondents' willingness to pay (WTP) for false advances in environmental quality through surveys (Walsh, 1992). The present study uses a double-bounded dichotomous choice (DC) format within the CVM framework to reduce the limitations linked to open-ended WTP questions. Respondents are given a proposed payment amount along with a fictional scenario that describes an ecotourism experience in a

VTCS in this format. Either "accept" or "reject" this payment is up to them. A second question with a higher price (if they answered "yes") or a lower price (if they answered "no") is asked after they give their first response. This method helps to refine the respondent's true WTP by defining a range where the respondent's answer changes from "yes" to "no" or back again. (Bishop and Heberlein, 1979). By lowering the possibility of overestimation related to hypothetical scenarios, the addition of a real payment vehicle in the DC format improves the accuracy of WTP estimates even more (Lee and Han, 2002). A more accurate evaluation of the economic worth of ecotourism experiences in Sri Lanka's VTCS is possible thanks to this combined method. Bid values for the research is shown in following table 01.

Table1. Bid values use for the research

Initial bid	Lower bid	Higher bid
30	20	40
40	30	60
60	40	80
80	60	100

Model Specification and Procedures

There were three primary techniques for calculating Willingness to Pay (WTP) in relation to Hiriwadunna ecotourism. These techniques make use of the outcomes of a discrete choice model, most likely a survey in which travelers expressed their preferences for various price ranges.

1. Mean WTP: This technique determines the average price that visitors are prepared to pay over the whole range of potential bids, from zero to infinite.

$$E(WTP) = F\big(D(A)\big)\, dA \sum\nolimits_{0} \wedge (\infty) \dots\dots\dots (1)$$

F(D(A)): The probability of accepting a bid (A) based on the estimated model
E(WTP): Expected WTP
A: The bid sums

2. Overall Mean WTP: This technique integrates the probability function over a larger range, from negative to positive, and is comparable to the mean WTP.

$$E(WTP) = F\big(D(A)\big)dA \int \_\infty \wedge (\infty) \dots\dots\dots (2)$$

3. Truncated Mean WTP (Preferred Method): By emphasizing the reasonable range of bids made by visitors, this approach overcomes the drawbacks of the earlier techniques. By integrating the probability function from zero up to the highest bid submitted (Amax) in the survey, it determines the average WTP.

$$E(WTP) = F\big(D(A)\big)dA \int 0 \wedge (Amax) \dots\dots\dots (3)$$

Logistic Regression Model

The factors influencing visitors' willingness to pay (WTP) for ecotourism experiences in Hiriwadunna will be evaluated using a logistic regression model. The model is made simpler while retaining the essential choice (accept/reject) in this combined variable. The two offered bid options (bid1 & bid2), as well as the tourists' age, sex, and income, will all be considered independent variables. Using this method, can examine the ways in which these attributes and the bid sums affect travelers' choices about the costs associated with ecotourism in Hiriwadunna.

$$(Accept\ Bid) = \beta_{\circ} + \beta_1 \times Age + \beta_2 \times Sex + \beta_3 \times Income + \beta_4 \times BID + \varepsilon$$

Data Collection

The target audience for the data collection, which will take place in Hiriwadunna village, will be foreign visitors who are interested in ecotourism activities related to the VTCS. In particular, visitors to village homes will be contacted to take part in the survey. Public areas close to the village tank were also used.

The population being studied includes foreign visitors who are looking for ecotourism experiences in Sri Lanka's VTCS. It was decided that a sample size of 371 participants would be sufficient to fairly represent this population.

In order to guarantee a representative sample from the population of foreign tourists, a purposive sampling approach was selected. Choosing participants from a predefined list at predefined intervals is known as systematic sampling. This approach lessens bias and makes sure that every subpopulation in the target group has an equal opportunity to be included. Two stages of the data collection process: first, a pilot survey to improve the questionnaire, and then the main survey involving the targeted population of 371 foreign visitors.

The main techniques for gathering data will be in-person interviews and survey questions. In contrast to mail surveys, in-person interviews guarantee a higher response rate and provide the opportunity for question clarification. The purpose of the survey questionnaire is to collect data on respondent's preferences for VTCS experiences, their interest in ecotourism, and their willingness to pay for those experiences.

Statistical Analysis

Analysis of variance was used to analyze the data using R 5.2 statistical software.

RESULTS AND DISCUSSION

Demographic Profile of Respondents

As depicted in table 02 demographic characteristics of the survey done in Hiriwadunna, 46.90% of respondents were male (M) and 53.10% were female (F). This indicates a fairly balanced gender distribution among respondents. Most of the participants were worked in private sector (45.82%).

Regarding education, a significant proportion of participants (60%) possess a college or university degree (entry level: 16.71%, degree: 35.58%, postgraduate degree: 11.59%), whereas 30.6% have completed only high school (up to high school: 26.42%). This points to a populace that is highly interested in education and possibly learning-enhancing ecotourism activities.

According to the survey, prospective visitors have a comfortable spending capacity. Most respondents (25.88%) make between $5,000 and $10,000 and $10,000 and $15,000 (21.29%), and a sizeable percentage (5.39%) make more than $40,000 (>40,000). Their potential as high-value ecotourists is positioned by their economic strength.

Table2.Demographic profile of respondents

Characteristics	Percentages
Gender	
Male	46.90
Female	53.10
Employment	
private sector	45.82
Govt.sector	18.06
Self-employment	14.02
Farming	0.27
Other	14.02
NA	7.82
Monthly household income	
<$5,000	22.37
$5,000-10,000	25.88
$10,000-15,000	21.29
$15,000-25,000	10.51
$25,000-40,000	7.55
>$40,000	5.39
NA	7.01
Education	
Up to elementary school	0.81
Up to middle school	4.85
Up to high school	26.42
Pass uni. entrance	16.71
Degree	35.58
Postgraduate degree	11.59
Other	1.08
NA	2.96

Results of logistic Regression Model

Table 03 represents the results of regression model.

Age (β_1 = -0.3072): This coefficient suggests that as age increases, the likelihood of accepting a bid decreases. This could imply that younger individuals are more likely to accept bids in this context.

Table 3.Results of regression model

	Estimate Std.	Error	z value
intercept	4.148103	0.567645	7.308
age	0.007344	0.006500	1.130
sex	-0.307195	0.202686	-1.516
income	0.167389	0.071931	2.327
BID	-0.077618	0.004421	-17.558

Sex (β_2 = 0.2027): The positive coefficient for sex increases the possibility that the other sex category, which is more likely to accept a bid for ecotourism experiences, might be more likely to accept it compared to the reference group.

Income (β_3 = 0.1674): Individuals with higher income levels have a higher probability of accepting a bid in this scenario. This suggests that economic status plays a significant role in decision-making when it comes to accepting bids related to ecotourism.

BID1 (β_4 = -0.0776): negative coefficients, indicating that higher bid amounts decrease the likelihood of accepting a bid. This could suggest that participants are more price sensitive than expected when it comes to ecotourism-related decisions.

WTP Estimations

Table 04 shows the Wilingness to Pay (WTP) values for the estimates.

Table4.WTP estimations

Mean	57.62276
Mean (truncated at the maximum bid)	57.15646
Mean (truncated at the maximum bid with adjustment)	59.26302
Median	57.47481

The mean estimated willingness to pay for the Hiriwadunna village tour is $57.62. When the estimates are truncated at the maximum bid, the mean decreases slightly to $57.16. However, when the estimates are also adjusted, the mean increases to $59.26. The median estimated willingness to pay is $57.47, which is relatively close to the mean estimates. Overall, these results suggest that visitors to the Hiriwadunna village tour have a consistent willingness to pay for the experience, with some variation depending on the method of estimation.

CONCLUSIONS

This study examined at the Hiriwadunna village tank system in Sri Lanka's potential for ecotourism as a source of income. Through survey analysis of visitor preferences, the study realized that willingness to pay for ecotourism

experiences varies by age, sex, income, and offered prices. The positive willingness to pay range (57.15 to 59.26) shows that ecotourism is beneficial to the local economy.

For the Hiriwadunna village tank system, a sustainable ecotourism plan needs to be created in order to fully utilize this potential. In order to protect the environment, this plan should place a high priority on conservation measures. It should also integrate local communities to guarantee their economic well-being and encourage tourists to travel responsibly. It is also advised to conduct additional research to examine particular ecotourism activities that are appropriate for the tank system, taking into account the needs of the environment and visitor preferences. Lastly, as this study has shown, there is a need to create targeted marketing strategies to draw in tourists who have a confirmed willingness to pay for ecotourism experiences. By putting these suggestions into practice, the Hiriwadunna village tank system will be able to balance the advantages of ecotourism with environmental preservation, thereby maximizing its potential for economic development.

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Assessing Farmers' Willingness-to-Participate in Watershed Conservation in the Knuckles Region of Sri Lanka

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ABSTRACT

Knuckles is regarded as one of Sri Lanka's most significant nature reserves providing a range of ecosystem services with great potential to contribute to economic development. This area is also prone to considerable resource exploitation and pollution affecting watershed areas. Community involvement in conservation can bring about numerous economic, environmental and social benefits. Therefore, this study aims to elicit the preferences and willingness of residents to participate in watershed conservation activities. Employing a Contingent Valuation Method, data were collected by administering a structured questionnaire through face-to-face interviews with residents in the area (n=300). A Probit model was estimated for both single-bounded and double-bounded dichotomous choice models. Results revealed that 47% of the respondents were willing to pay for watershed conservation. The estimated double-bounded mean willingness to pay value was Rs. 440.00 per year. Which exhibits the region's high priority for watershed conservation. Lower income level and lower levels of education significantly influenced their willingness to pay. Results show that improving watershed ecosystem services results in mutual gains for both the environment and the local population. Implementation of a watershed conservation program in the Knuckles region is feasible as most of their livelihood activities revolve around this ecosystem. Findings therefore would support policymakers in effective planning of watershed conservation initiatives for sustainable development.

KEYWORDS: Contingent valuation, Double bounded model, Ecosystem services, Watershed, Willingness to pay

INTRODUCTION

The benefits that humans receive from ecosystems are known as ecosystem services (Brauman *et al.*, 2007). They are the direct and indirect benefits derived from the ecological functions of natural resources (Kamble *et al.*, 2012). By providing benefits and services like natural water purification, flood control, recreational opportunities, food supply, carbon sequestration, and many other things, the watershed ecosystem promotes human well-being. However, overuse of natural resources, land use changes, and soil erosion are all contributing to the degradation of ongoing watershed ecosystem services.

Sri Lanka is endowed with abundant natural wealth like rivers and water resources. Among them Knuckles is regarded as one of Sri Lanka's most Significant nature reserves. Knuckles range is in the districts of Kandy and Matale, which is a part of the central highlands. These forests offer the area excellent environmental services as watersheds and climate moderators for the region (Kamble *et al.*, 2012). The Knuckles Forest Reserve is considered a vital water catchment with many of its streams feeding important downstream rivers such as the gigantic *Mahaweli* River, the *Heen* River, *Maha Oya*, *Hasalaka Oya* and the *Theligama Oya* (Best of Lanka, n.d.).

The surrounding communities benefit greatly from the watershed's plenty of resources, services and revenue streams. Watersheds around the world are constantly declining despite their importance to the environment and the economy because there are insufficient resources to carry out conservation efforts and no reliable models for conservation (Thapa *et al.*, 2020).

This study has identified the factors influencing beneficiaries' payment decisions and has included a greater number of stakeholders living in the Knuckles watershed system (KWS) in order to estimate willingness to pay (WTP) using the contingent valuation method. This study has targeted residents' maximum WTP for the conservation of KWS, factors affecting the residents' WTP and residents' attitudes toward WTP (Rennekamp and Nall, 2006).

The increasing demand for ecosystem services and the scarcity of valuation data present significant obstacles for policymakers in developing successful watershed management initiatives. A suitable investment to regulate the ecosystem services of a watershed is justified by the valuation of its benefits. The amount that residents are willing to pay to use, enhance, and maintain Ecosystem services is measured using the widely used welfare measure known as WTP (Cardinale *et al.*, 2012). Previous research highlighted the significance of estimating WTP for identifying value preferences among interest groups (e.g., residents vs. non-residents), choosing better management options, and successfully

safeguarding natural ecosystems (Castro *et al.*, 2016).

Thus, the primary goals of this study are to assess the extent to which locals value the ecosystem services provided by the Knuckles Mountain range and to elicit the residents' preferences and willingness to pay for watershed conservation.

METHODOLOGY

Study Area

The Knuckles Forest Region (KFR), located in the districts of Kandy and Matale in Sri Lanka's Central Province, is the subject area of this study. The study was carried out in *Matale* district focusing on farmers in three distinct *grama niladari* divisions, which were specifically chosen to guarantee that each area had a high level of agricultural practices.

Questionnaire and Survey Design

The questionnaire was divided into five main sections. The respondents' demographic information was included in the first section. The second section contained respondents' awareness about watershed management techniques and the respondents' awareness about ecosystem services was covered in the third part of the questionnaire. The fourth section of the questionnaire asked about the respondents' awareness of climate change. The last section focused on their willingness to pay for watershed conservation and the reasons behind their unwillingness to pay. To measure respondents' awareness of watershed management techniques, ecosystem services and climate change we asked the respondents to assign rankings from 1 to 5 on a Likert scale ranging from "strongly disagree (1)" to "strongly agree (5)".

Data Collection

The survey questionnaire was pre-tested by conducting a pilot study using a sample of 25. Primary data were collected from randomly selected 300 farmers in the Knuckles Region. They were interviewed by face-to-face interviews followed by location visits physically with the use of pretested, structured questionnaires from January to March 2024.

Data Analysis

Contingent Valuation Method

The contingent valuation method (CVM) is a commonly used monetary valuation technique for estimating non market environmental service values (Hanemann, 2018). This approach is widely used to evaluate the nonuse value of ecosystem services in terms of their environmental impact (Ogundari and Awokuse, 2016). In the CVM, respondents were asked to complete a questionnaire regarding their maximum willingness to pay for a hypothetical improvement or to prevent environmental services from deteriorating. We used both single-bounded and double-bounded contingent valuation methods in our research. In the single-bounded model, we presented respondents with a single dichotomous choice question. Each respondent was asked whether they would be willing to pay a specified amount for watershed conservation in the area, and the response options were yes/no. In the double-bounded model the efficiency of the contingent valuation was measured by asking two sequential dichotomous choice questions, to obtain more information about respondents' WTP. Respondents were first asked whether they would be willing to pay Rs. 500 for watershed conservation in the region. If they answered "yes" to the bid amount, the amount was increased to Rs. 1000. However, if the respondents' response was "no" to the initial amount, the subsequent bid was decreased to Rs.300. If the respondents' answered "no", the bid was decreased to Rs. 200. Those who refused to pay were asked if they would rather pay in another way, such as by volunteering their time to protect the environment.

The Probit model was used to analyze data and STATA version 15 was used as software to analyze the data.

The Probit model can be expressed as in equation (1) and,

$$Y = \beta_n X_n + \varepsilon \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (1)$$

The econometric model can be expressed as in equation (2),

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon \dots\dots\dots\dots\dots (2)$$

Y is the yes/no response for the WTP (equation 1). Whether the residents are willing to pay for watershed conservation or not. β_0 is the intercept. β_1 to β_8 are the coefficients of the attributes 1-8. The independent variables, X_1 is the gender variable, X_2 is the age, X_3 is the education, X_4 is the monthly gross income, X_5 is the occupation, X_6 is the farmland ownership, X_7 is the land area of the farm, X_8 is the bid value and it was only applied in the single bounded model. ε is the error term.

The age variable consisted of three dummies as, age dummy 1 (36-45 years), age dummy 2 (46-55 years), and age dummy 3 (56-65 years), and the education variable consisted

of two dummies as education dummy 1 (No formal education), education dummy 2 (Primary education). The monthly gross income variable consisted with variable consisted with three dummies, monthly income dummy 1 (less than Rs.20,000), monthly income dummy 2 (Rs. 20,000-35,000), monthly income dummy 3 (Rs. 36,000-50,000). The occupation variable consisted of three dummies, as occupation dummy 1 (Government sector), occupation dummy 2 (Private sector) and occupation dummy 3 (Self-employment). The farmland ownership variable consisted of one dummy, farmland ownership dummy 1 (Own property). The land area variable consisted of one dummy, as land area dummy 1 (Less than 0.5 Ac).

The double-bounded model helped to improve the efficiency of the estimates by using two follow-up questions based on the initial response. The application of the double-bounded model in this research ensured robustness and accuracy in capturing the respondents' WTP (Alejandro, 2012).

RESULTS AND DISCUSSION

Demographic Profile of the Respondents

Among the respondents 63% were male and 37% were female. Similarly, people of age-group 36-45 were the majority (35%) followed by the 46-55 age group (24%). Furthermore, 62.8% of the respondents have completed their primary education and the remaining 31.2% have attained primary school, while 6% didn't receive any formal education. About 47% of the respondents were farmers and around 21% worked as self-employed workers, while 19% of the respondents worked in the private sector and the remaining were occupied in the government sector.79% of the respondents used their lands for farming purposes, while the other 21% used rented lands. The majority of the peoples' (64%) land area was less than 0.5 Ac. Only 36% of the respondents had lands bigger than 0.5 Ac.

Relative Importance Index

Data validity was assessed through Confirmatory Factor (CFA) analysis, while the reliability analysis was used to evaluate the reliability of data. It allowed for the calculation of the relative importance index (RII). The RII was employed to determine the relative importance of various qualitative variables in this study. With this approach, we were able to assess the respondent's awareness of ecosystem services, climate change, and watershed management techniques. That allowed us to determine that all three of the above variables and level of education had a positive relationship. That is, as the respondents' level of education rose, so did their awareness of ecosystem services, climate change, and watershed management techniques which is evident in the provided graph (Figure 1).

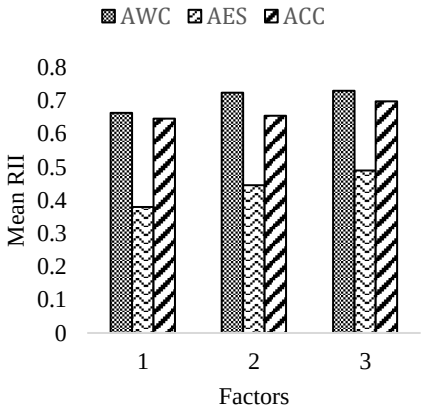

Figure 1. Relationship of RII with level of education

(AWC): Awareness of watershed conservation, (AES): Awareness of ecosystem services, (ACC): Awareness of climate change, (1): No formal education, (2): Primary school, (3): Secondary school.

WTP for Watershed Conservation

We primarily examined the decisions made by locals regarding their willingness to pay for the management and conservation of the watersheds in the Knuckles Region. Of the total sampled respondents, 47% were willing to pay, while 53% of respondents were not ready to pay. Of those who refuse to pay, 50% preferred to make alternative contributions, such as labor contributions. Thus, the respondents were asked to list the number of labor hours they preferred to work each week.

Among the total respondents who were willing to pay, 29% were to enjoy the future benefits generated by species and ecosystem, 27% were willing to pay to improve the quality of watershed management and ecotourism, 25% were to conserve watershed and ecotourism site, and 7% were to enhance the features of the ecotourism site.

Similarly, among those who refused to pay, 23% of the respondents said that they were already paying too many taxes and fees, 20% thought that the protection of watershed comes under the government's responsibility, whereas 14% mentioned that they are unwilling to pay since they were committed to other forms of conservation. An equal amount of the respondents (6%) was unable to pay because of financial problems and the biased views of the government. Just 1% of the respondents said

they had no interest in watershed conservation initiatives in the KFR (Figure 2).

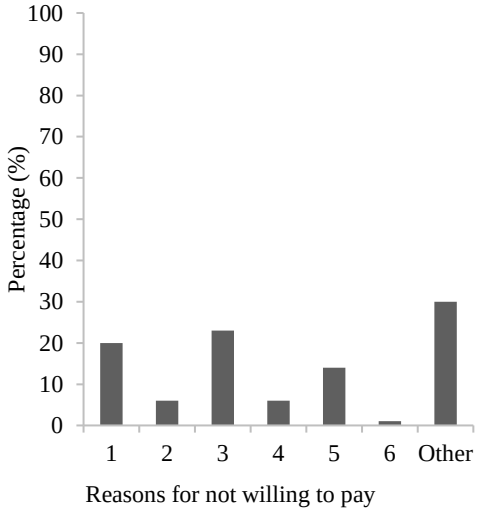

Figure 2. Reasons for not willing to pay
1: Conservation is a responsibility of the government, 2: Biased views of the government, 3: Already paying too many taxes and fees, 4: Facing financial problems, 5: Committed to other forms of conservation, 6: Not interested in the conservation project

From the analysis done through the Probit model, the data gathered was summarized in the table (Table 1).

Table lists the variables that respondents considered when deciding whether or not to pay for a program to conserve watersheds. In single -bounded model education_2 (Primary education) and income_1 (less than Rs.20,000) were significant at 0.05 level.

The coefficient (-0.482) for individuals with education_2 indicates a significant negative relationship with the WTP for watershed conservation. This tells that individuals with only primary education are less likely to financially support watershed conservation initiatives.

The magnitude of the negative impact of the coefficient (-0.597) is slightly stronger for those with education_1 (no formal education) compared to those with primary education. This suggests that lower levels of education are associated with a decreased WTP for watershed conservation. This could be due to several factors, such as a lack of awareness of environmental issues and the benefits of watershed conservation. Also having fewer financial resources to allocate towards such causes and prioritizing immediate needs over environmental conservation.

The coefficient (-0.581) for income_1 indicates a negative relationship with WTP for watershed conservation which is statistically significant. Therefore, we can confidently conclude that individuals in this lower income bracket are significantly less likely to support watershed conservation financially, due to financial constraints. This demographic may prioritize essential needs over environmental contributions.

There is also a negative relationship for income _2 (Rs. 20,000-35,000), which is not statistically significant, suggesting that they are somewhat less willing to pay for watershed conservation, but the relationship is not strong enough to be conclusive. This group might still face financial limitations, but perhaps to a lesser extent than the lower-income group.

Table 1. Results of the Probit Analysis

Variable	Single-Bounded Model			Double-Bounded Model		
	Coef.	**S.E.**	**Sig.**	**Coef.**	**S.E.**	**Sig.**
Bid	-0.000	0.000	0.962			
Age_1	0.076	0.319	0.810	-120.320	120.31	0.317
Age_2	0.052	0.328	0.872	-108.203	127.613	0.396
Age_3	-0.112	0.343	0.744	-108.265	128.982	0.401
Education_1	-0.597	0.643	0.354	-229.327	245.588	0.350
Education_2	-0.482	0.232	0.038	-144.153	90.462	0.111
Occupation_1	0.352	0.306	0.909	-42.803	119.559	0.720
Occupation_2	0.006	0.257	0.980	43.155	101.151	0.670
Occupation_3	0.093	0.264	0.726	59.496	106.186	0.575
Land ownership	0.041	0.246	0.866	105.983	96.732	0.273
Land area	0.288	0.213	0.177	105.942	83.379	0.204
Income_1	-0.581	0.281	0.039	-261.003	115.27	0.024
Income_2	-0.451	0.283	0.112	-177.914	108.665	0.114
Income_3	0.358	0.275	0.194	95.110	108.666	0.381
WTP per year (Rs.)	4.38			440.00		

Significant at 0.05 level, Coef: Coefficient, S.E.: Standard error, Sig.: Significance

The only significant variable in the double-bounded model was income_1, which had a negative relationship with the WTP for watershed conservation. They are less willing to pay than people with higher income levels, as evidenced by the results of the single-bounded model.

The WTP estimated for the single bounded model was Rs. 4.38 per year and for the double bounded model, it was Rs. 440.00 per year. The WTP value for the double-bounded model was more realistic, indicating the efficiency of the model.

CONCLUSIONS

The KFR has been providing a variety of products and services. A significant part of them are water system services. For long-term benefits, WTP would therefore act as a solid buffer to strengthen watersheds. It is evident from the findings that KFR's sustainable watershed conservation is influenced by socioeconomic factors. Residents were significantly affected in preferring WTP by indicators such as monthly gross income and the level of education. The government must enhance appropriate policies to enhance ecosystem services of watersheds and prohibit future deterioration of these resources. It is required to have a committee responsible for managing watersheds and endowed with the power to create strategic conservation plans. Therefore, the study's conclusion should be used to identify interest groups that are willing to pay for watershed management and create conservation plans.

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Bayesian Inference on Climate Change Impact on Coconut Cultivation in Sri Lanka: A Ricardian Approach Using Panel Data

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ABSTRACT

Coconut is a vital agricultural commodity that generates a significant amount of foreign exchange and sustains approximately 1 million livelihoods in the country. However, it is highly vulnerable to climate change as its reproductive development is more sensitive to high temperatures and rainfall distribution. Therefore, this study is aimed at quantifying the impact of climate change on estate-level coconut profitability in the coconut triangle. The study employed a panel data set collected from coconut estates between 2002 and 2018. A Ricardian model was employed for the analysis and as panel data was available, a pooled regression model was estimated using Bayesian methods. The findings indicate that climate change results in significant losses for coconut estates. Increases in long-term average temperature and long-term average precipitation are highly probable to negatively affect the estate-level profits and similarly, the drought before twelve months also leads to significant losses. Therefore, appropriate adaptation strategies must be implemented to mitigate the impact of climate change.

KEYWORDS: Bayesian analysis, Climate change, Coconut, Profit, Ricardian analysis

INTRODUCTION

Climate change is defined as a change in climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere, in addition to the natural climate variability observed over comparable periods (UNFCCC, 2011). The agriculture sector is more vulnerable to climate change because of its sensitivity to the direct impact of climate change through temperature and precipitation (Mahato, 2014). Gunathilaka *et al.* (2017) reported that a 1°C rise in long-term mean average temperature reduces tea yield by 4.6%. In addition to increases in temperature and precipitation, farmers incur losses due to extreme events such as floods and droughts. According to Islam *et al*. (2020) in 2014, the rice production in Bangladesh was significantly reduced due to widespread flooding

Coconut is the most widely grown plantation crop and is a main component of the daily diet, second only to rice in Sri Lanka. The coconut industry sustains approximately 1,192,000 livelihoods and contributes 0.9% to the national GDP. Sri Lanka is the world's fourth-largest coconut exporter (Annual Report, 2022; Sri Lanka Export Development Board, 2020; Coconut Research Institute, 2021).

As coconut is a rain-fed perennial crop, it is highly vulnerable to climate change in the production environment (Pathiraja *et al*., 2017). According to Fernando *et al.* (2007), climate factors account for 60% of yield variability leading to economic losses ranging from US $32–73 million during extreme shortages. Maximum temperature, rainfall distribution, and the rainfall received in the previous year are the key variables affecting nut setting. High temperatures and prolonged droughts result in immature nut falls and reduced nuts (Coconut Research Institute, 2021). The annual coconut production has significantly fluctuated over the past decade due to adverse climate conditions (Coconut Research Institute, 2021). The lowest was recorded in 2017, which was 2450 million nuts due to the unprecedented drought in 2016 (Annual Report, 2018). In 2017, due to low production, farm gate prices were sharply increased by 60% compared to 2016 (Annual Report, 2018). However, due to the significant reduction in nut weight and yield, farmers were unable to obtain the benefit of the price increase, and therefore their income was reduced.

Sri Lanka's low adaptive capacity as a developing country exacerbates its vulnerability to climate change (Mendelsohn *et al.*, 2006). Aadhar and Mishra (2017) opined that drought episodes in Sri Lanka have escalated to once every three years. The country has already reached its maximum temperature threshold for effective plant growth due to its low-altitude location (IPCC, 2014). Precipitation has shown high inter-annual variability from 1970 to 2020 but significant trends were not observed (Ratnayake *et al*., 2023). Therefore, an increase in temperature, frequency of extreme events, and change in inter-annual precipitation in the future will intensify the impact on the profitability of coconut.

In the Sri Lankan context, none of the Ricardian studies have been conducted, particularly on coconut. Therefore, the purpose

of this study is to quantify the impact of climate change on coconut estate profitability using a panel Ricardian analysis. The study differs from other panel Ricardian studies by; i) quantifying the impact of drought; and ii) incorporating a Bayesian approach for quantification which enables probabilistic statements about impacts.

METHODOLOGY

Data Sources

Monthly data on profits were collected from coconut estates in the coconut triangle for the period, 2002-2018 creating a panel dataset. Climate data were extracted from the WorldClim data website using QGIS software. For the analysis, precipitation and temperature normals, which are defined as the 30-year average temperature and precipitation, were used. Soil data were obtained using Google Maps and agroecological region maps. The standard precipitation index was calculated using R-Studio to capture the drought effect.

Theoretical Framework

The Ricardian model was proposed to examine long–term climate change impact on land values and farm revenues based on the assumption that in a competitive market, land values reflect net productivity (Mendelsohn *et al*., 1994). This model assumes that the farmer maximises net revenue from the given climate and other environmental variables and would adjust their inputs and outputs accordingly to maximise the net revenue and therefore, farmers completely adapt to the climate change impact. The net revenue can be represented as (1);

$$Max\ \pi = P_i Q_i\ (K_i, E_i) - TC_i\ (Q_i, \mathrm{W}, E) \ldots (1)$$

where π is net revenue which is the difference between revenue (PQ) and cost (TC) per unit of farmland. P_i is the market price of crop *i*, Q_i is the production function of crop *i*, K_i is a vector of production inputs other than land, E is a vector of exogenous environmental factors such as climate and geographic conditions.

Under the assumption of full adaptation to a given climate, net crop income or land value attains a long-run equilibrium containing information on the economic impact of climate change (Mendelsohn et al., 1994). Considering that fact, the Ricardian model was developed in the analysis. As panel data was available, the "pooled method" was used to estimate the Ricardian model (Masetti and Mendolsohn., 2011). The Ricardian equation estimated in this study using climate and soil characteristics is as below (2):

$$ln\ ln\ y_{it} = \beta_0 + \beta_1 lnT_{it} + \beta_2 lnR_{it} + \beta_3\ lnT_{it}^2 + \beta_4 lnR_{it}^2 + \beta_5 D_1 + \beta_6 D_2 + \beta_7 Drought_{t-12} + u_{it} \ldots (2)$$

where lny_{it} is the log of estate-level monthly profit (Net Revenue) per hectare, lnT_{it} is the log of the mean temperature of the i^{th} estate in t^{th} month, lnR_{it} is the log of the mean precipitation of i^{th} estate in t^{th} month, lnT_{it}^2 is the log of mean temperature squared of the i^{th} estate in t^{th} month, lnR_{it}^2 is the log of mean precipitation squared of i^{th} estate in t^{th} month. There were three soil types in the study area. They were included as dummy variables in the regression. D_1 is a dummy for red-yellow podzolic soils, D_2 is a dummy for reddish brown earth soils while the third category, the red-yellow latosol and regosols soil type was used as the reference category and therefore, not included in the equation. Drought is a dummy for lagged drought for 12 months and u_{it} is the error term.

The Bayesian Method

The Bayesian method was used as the inference method because it provides more intuitive probabilistic interpretation rather than frequentist analysis (Koop, 2003). According to (Koop, 2003) Bayes' theorem can be summarised as follows (3);

$$p(\theta|y) \propto p(y|\theta).p(\theta) \cdots (3)$$

where, $p(\theta|y)$ is the posterior probability of parameter θ given observed data y, $p(y|\theta)$ is the likelihood function, representing the probability of observing data y given parameter θ, $p(\theta)$ is the prior probability distribution of parameter θ, representing prior beliefs about θ before observing any data.

Calculating Marginal Effects

Marginal effects of mean temperature and precipitation were calculated using posterior simulations of Bayesian estimation. The marginal effect of mean temperature on monthly profit per hectare was calculated as below (4);

$$lny_{it} = \beta_1 lnT_{it} + \beta_3\ lnT_{it}^2$$

$$\frac{\partial y_{it}}{\partial T_{it}} \cdot \frac{1}{y_{it}} = \beta_1 \left(\frac{\partial T_{it}}{\partial T_{it}}\right) \cdot \frac{1}{T_{it}} + 2\beta_3 \left(\frac{\partial T_{it}}{\partial T_{it}}\right) \cdot \frac{1}{T_{it}}$$

$$\frac{\partial y_{it}}{\partial T_{it}} = \frac{\beta_1 y_{it}}{T_{it}} + 2\beta_3 y_{it} \cdots (4)$$

The marginal effect of mean precipitation on monthly profit per hectare was calculated as below (5);

$$lny_{it} = \beta_2 lnR_{it} + \beta_4 lnR_{it}^2$$

$$\frac{\partial y_{it}}{\partial R_{it}} \cdot \frac{1}{y_{it}} = \beta_2 \left(\frac{\partial R_{it}}{\partial R_{it}}\right) \cdot \frac{1}{R_{it}} + 2\beta_4 \left(\frac{\partial R_{it}}{\partial R_{it}}\right) \cdot \frac{1}{R_{it}}$$

$$\frac{\partial y_{it}}{\partial R_{it}} = \frac{\beta_2 y_{it}}{R_{it}} + 2\beta_4 y_{it} \cdots (5)$$

In the estimation of the model in (2) profit was deflated to remove the effect of inflation using the Colombo Consumer Price Index (CCPI). In interpreting the marginal effect, the real values of profits were reconverted back to the nominal values of 2018 for ease of interpretation. Hence, all the 'impact' measurements are in 2018 prices.

Statistical Analysis

Bayes software was used for the Bayesian estimation. The model was estimated with 50,000 iterations of which 10,000 were discarded as burn-in samples. As proper prior knowledge of the model parameters was not available, non-informative priors were used.

RESULTS AND DISCUSSION

The results obtained from Bayesian estimation are shown in Table 1.

Table 1. Results of the Bayesian Ricardian estimation (Pooled data)

	Mean	5%	95%
Constant	-35.73	-79.41	7.96
*ln*temp	15.95	-10.35	42.26
*ln*temp^2	-1.57	-5.53	2.39
*ln*prec	0.95	0.61	1.29
*ln*prec^2	-0.098	-0.134	-0.062
d_drought	-0.318	-0.423	-0.214
d_soil2	1.45	1.39	1.51
d_soil3	1.26	1.16	1.36

lntemp: log of mean temperature, lntemp^2: log of mean temperature squared, lnprec: log of mean precipitation, lnprec^2: log of mean precipitation squared, d_drought: dummy of lagged drought

Because the marginal effects of temperature depend on the level of temperature (because of the non-linear effect of temperature), the marginal effect of mean temperature on monthly profit per hectare was analysed under three scenarios: low (25 °C), medium (27.85 °C) and high (29.63 °C). The Bayesian estimation allowed the population distribution of the marginal effect to be simulated and thus, the simulated distributions are shown in Figures 1-3. At the low-temperature scenario (25 °C), a 1 °C increase in temperature leads to a decrease of 16,676.86 rupees per hectare on average. According to Figure 1, this impact has a minimum of -138,819.90 rupees to a maximum of +87,136.94 rupees per hectare.

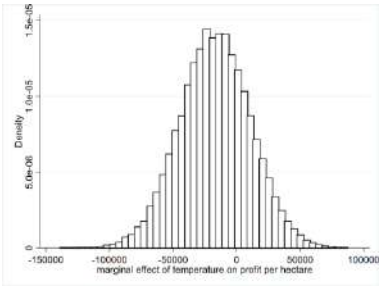

Figure 1. The marginal impact of temperature on monthly profit per hectare (low- temperature scenario- 25 °C)

Conversely, in the high-temperature scenario (29.63 °C), a 1°C increase in temperature results in an average monthly decrease of 17,206.63 rupees per hectare, ranging from a loss of 141,706.4 rupees to a gain of 88,614.48 rupees per hectare (Figure 2).

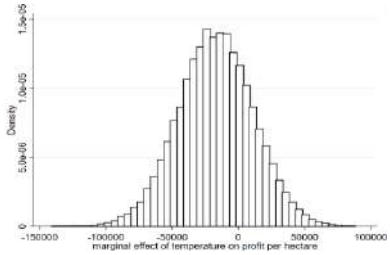

Figure 2. Marginal impact of temperature on monthly profit per hectare (high-temperature scenario- 29.63 °C)

At the medium temperature scenario (27.85 °C) when temperature is increased by 1 degree Celsius, monthly profit is reduced with a mean of 16,978.9 rupees per hectare, ranging from a loss of 140,465.6 rupees to a gain of 87,979.32 rupees per hectare (Figure 3). This finding is supported by Seo *et al.* (2005), who found that the net revenue decreased by 4,105 million rupees per degree for key crops, including coconut.

Across all scenarios, while there is a possibility of positive or negative marginal effects, the negative mean suggests a higher probability of profit decline with temperature rise. Probabilities calculated in Table 2 confirmed that although positive effects are probable, there is a high probability of marginal impact to be negative. According to Table 2, there is more than 70% chance that the temperature's impact on profitability to be negative. As observed climate predictions expect increases in maximum temperature in

coconut growing areas (Pathiraja *et al*., 2017; Jayalath, 2018) more losses will be experienced by estate-holders in the future.

The marginal effects of precipitation on monthly profit per hectare were also analysed under three scenarios: low (13.77 mm), medium (139.5 mm), and high (396.03 mm).

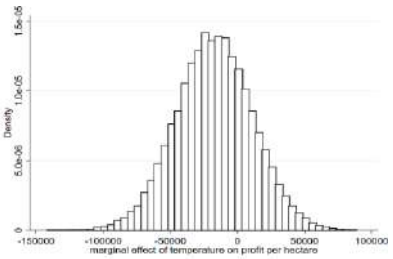

Figure 3. The marginal impact of temperature on monthly profit per hectare (medium-temperature scenario- 27.85 °C)

At the low precipitation scenario (13.77 mm), a 100 mm increase in monthly precipitation leads to a decrease of 84,788.4 rupees per hectare on average. This impact has a minimum of -155,275.6 rupees to a maximum of +7,064 rupees per hectare (Figure 4).

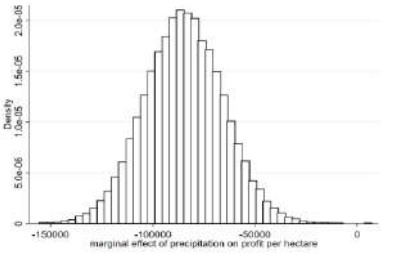

Figure 4. The marginal impact of precipitation on monthly profit per hectare (low-precipitation scenario- 13.77 mm)

Conversely, at the high precipitation scenario (396.03 mm), a 100-mm increase in precipitation results in the highest average monthly decrease of 128,672.10 rupees, with a minimum of -236, 2062.1 rupees to a maximum of +8,858.6 rupees per hectare (Figure 5).

The medium precipitation scenario (139.5 mm) shows an average decrease of 125,767.50 rupees per hectare, ranging from a loss of 230,851.10 rupees to a gain of 8739.87 rupees per hectare at 100 mm precipitation increase (Figure 6).

Across all scenarios, monthly profit per hectare can vary from losses to gains, indicating a probability of either negative or positive marginal effects. However, the negative means suggest a higher probability of profit decline with increased precipitation. Probabilities calculated in Table 2 confirmed that there is a high probability of marginal impact to be negative. Pathiraja *et al*. (2017) noted increasing rainfall trends in coconut-growing regions according to predicted future climate change. Therefore, we can expect greater losses in the future due to increased precipitation.

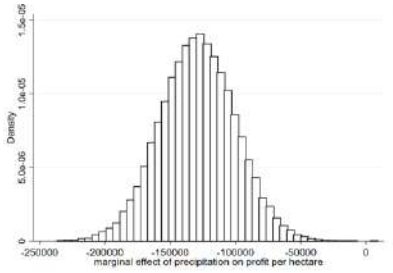

Figure 5. The marginal impact of precipitation on monthly profit per hectare (high-precipitation scenario- 363.03 mm)

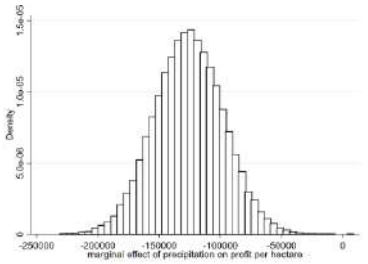

Figure 6. The marginal impact of precipitation on monthly profit per hectare (medium precipitation scenario- 139.6mm)

Results indicate that droughts before twelve months significantly harm profits, with a mean of 31.81% monthly profit reduction per hectare ranging from a loss of 42.3% to 21.4% at a 95% credible interval (Figure 7). It takes 12 months to develop inflorescence into a mature nut after spathe opening. A few months after the spathe opening is highly sensitive to drought. If drought occurs during that period, the yield will be reduced in the following year. The number of drought days in main coconut-growing areas increased from 2005 to 2014 (Jayalath, 2018). As they continue to increase in the future the impact will intensify.

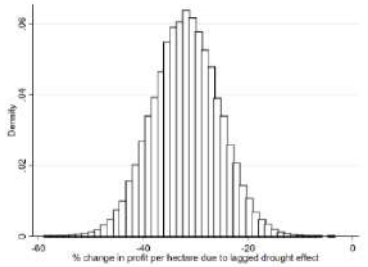

Figure 7. Percentage change in monthly profit per hectare due to drought

Table 2. Probability of impact of climate change being negative

Scenarios	Cases	Gains	Prob.
low temp<0	50000	36,252	72.5%
mid temp<0	50000	36,331	72.7%
high temp<0	50000	36,382	72.8%
low prec<0	50000	49,900	99.8%
mid prec<0	50000	49,900	99.8%
high prec<0	50000	49,900	99.8%

mid temp: medium temperature scenario, mid prec: medium precipitation scenario, prob.: the probability of being negative.

CONCLUSIONS

The results indicated that climate change has a significant negative impact on coconut estate-level profitability. An increase in mean temperature and mean precipitation is highly probable to negatively affect the monthly profit per hectare under different scenarios. The drought before twelve months is a crucial extreme event that has a significant negative impact on coconut cultivation in the main coconut-growing areas. Therefore, proper adaptation methods, such as access to irrigation and the development of heat-tolerant cultivars, should be implemented to reduce the impact of climate change.

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Value Chain Analysis of Traditional Village Cuisine: Unveiling Livelihood Development Opportunities in the North Central Village Tank Cascade System (VTCs) in Sri Lanka

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ABSTRACT

Traditional food production and marketing is a sector that significantly impacts the livelihood of the people. This study was carried out to evaluate the value chain performance of traditional village food production and catering. The strengths and weaknesses of the value chain were assessed, and appropriate upgrading, and development strategies were suggested using qualitative analysis. Primary data were collected through semi-structured questionnaires from 35 actors selected purposively in the Palugaswewa area. Value additions and gross profit margins were calculated on average for different actors and product categories. The results indicated that the traditional food value chain is relatively simple, including only three main actors: input suppliers, producers, and retailers. Value additions and gross profit margin percentages show a variation among different product categories for different actors, with the highest margin for those engaged solely in production activities, and the lowest margin for those engaged solely in retailing. The study recommends actions to mitigate the issues in the value chain, including incorporating technology, strengthening producers with financial aid and training, developing more channels, improving market conditions, catering to the ecotourism sector, and increasing the number of employment opportunities at the producer level. The study suggests the potential for improving livelihood conditions.

KEYWORDS: Livelihood development, Traditional cuisine, Value chain

INTRODUCTION

Traditional Sri Lankan food represents a unique culture. A wide range of diets is included in the traditional food. Among them, prepared food items include different kinds of local food and drinks. Village tank cascade system (VTCs) is a unique water harvesting and management system consisting of tanks and reservoirs (Bandara, 1995). This system is interconnected by canals and was developed by ancient inhabitants in Sri Lanka to ensure a regular water supply for agricultural livelihoods and personal needs (Bandara, 1995). This system is directly bound to rural livelihood. Therefore, the VTCs cannot be discussed in isolation. The study may also encompass an examination of the local populace, the societal dynamics, and the cultural practices prevalent within the VTCs. Exploring livelihood development opportunities for the community living in the system is essential in the process of developing the VTCs.

Chambers and Conway (1992) defined livelihood as, "the capabilities, assets (stores, resources, claims and access) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide sustainable livelihood opportunities for the next generation; and which contributes net benefits to other livelihoods at the local and global levels in the short and long term."

A value chain is defined as "the full range of activities to bring a product or service from conception, through the different phases of production (involving a combination of physical transformation and the input of various producer services), delivery to the final consumer, and final disposal after use (Kaplinsky and Morris, 2000). A typical food-related value chain includes the activities of input supplying, processing, storage, transport, wholesaling, retailing, food services and other functions. Different activities are undertaken in the value chain such as packaging. These activities generate value as it flows along the value chain. Value addition depends on quality, cost, delivery times, flexibility, and innovation by different actors, and is influenced by the consumer's willingness to pay (Trienekens, 2011). Value chain development considers the upgrading of the existing value chain. Upgrading is defined by McDermott (2007) as "the shift from lower- to higher-value economic activities by using local innovative capacities to make continuous improvements in processes, products, and functions".

Food production and marketing at the village level is a sector that needs high attention in assessing its potential to develop the quality of life for the community. Performing value chain analysis on prepared traditional food products in the village is important to identify the present status of traditional food production. Though there is a low demand for traditional

food products due to changing customer preferences, there is an emerging trend of consuming traditional food.

Consequently, the focus of this research is to delineate the current value chain and pinpoint potential areas for enhancement. The primary aim is to unearth opportunities for livelihood advancement within the framework of value chain progression for traditional village cuisine. This entails discerning avenues for rural livelihood improvement, cataloguing primary and ancillary stakeholders, and analyzing the profit margins and value contributions attributable to each participant.

METHODOLOGY

Sampling and Data Collection

The sample for this study was obtained from the Palugaswewa divisional secretariat division in Anuradhapura district. The study was conducted as a qualitative study and primary data were collected from the actors using purposive sampling. The sample size consisted of 35 actors including 20 producers, 8 retailers, 7 village input suppliers. They were selected from Horiwila, Kudarabawewa, Palugaswewa, and Thulana grama niladari divisions. Face-to-face interviews were conducted using a semi-structured questionnaire. The major data collected included the cost of production inputs, selling prices, production and selling quantities, problems faced by the actors, and opportunities to develop the chain. The weight of food products was also collected from food producers.

Data Analysis

The analysis of qualitative data was carried out by identifying the issues in the current value chain. Average value additions were calculated per unit of 50 g of fresh weight for each product category. Equation 1 was used to calculate the value addition amount made by the actors for different product categories.

$$VA = Selling\ price - Unit\ cost \cdots (1)$$

Where, VA = Value added (Rs.)

The gross profit margin percentages of each actor for different product categories in the value chain were calculated using Equation 2.

$$GPM\% = \frac{TRi - TVCi}{TRi} \times 100\% \cdots (2)$$

Where, GPM = Gross profit margin, TVC = Total variable cost (Rs.), TR = Total revenue (Rs.).

RESULTS AND DISCUSSION

Traditional Food Value Chain

Figure 1 depicts the fundamental processes and stakeholders within the value chain of traditional foods. Food items are produced on a small scale at the rural level. The value chain channels are notably succinct, indicating minimal distribution of value addition among the actors. The produce is introduced into a straightforward distribution network for market placement. Notably, transportation distances are primarily evident during the supply of inputs.

Three channels were identified (Figure 2). Channel 1 resembles the inception of a marketing channel at the input supplier level and the direct supplying of products to consumers. This channel operates because some producers take orders directly from consumers. It was revealed that some producers act as retailers, maintaining their retail shops (channel 2). Supplying of produced food by the producers to the retailers (channel 3) is a minor channel under the traditional food value chain.

Direct selling of products by the producers to the consumers (channel 1) is the most frequent channel, with 60% of the producers taking orders from customers. Producers acting as retailers themselves represent 30% of the producers. Only 10% of the producers sell their production to retailers.

Value Chain Actors

Actors are involved in acquiring inputs required for the production, producing finished items, and trading to reach consumers. The identified actors are input suppliers, producers, and retailers (Figure 1).

There are village input suppliers who collect food inputs from the village and supply them to producers. Self-supplying of inputs (mostly rice to process into rice flour) is another method used by producers who engage in cultivation. The most frequent method of input supply is from external suppliers who are wholesalers or retailers in the nearest town. Three types of producers were discovered, each performing different roles. All the producers operate their businesses on a small scale. Family labor is used for production due to the producers' lack of capability to pay for hired workers and the lesser requirement for hired labor due to small-scale production. Most retail shops are maintained as informal small businesses since they are not registered. Only a few retail shops have been established as registered businesses. Looking into the socio-economic profile of the producers, 90% are female. Concerning age, an equal percentage of 40% are between 35-45 years and 45-55 years.

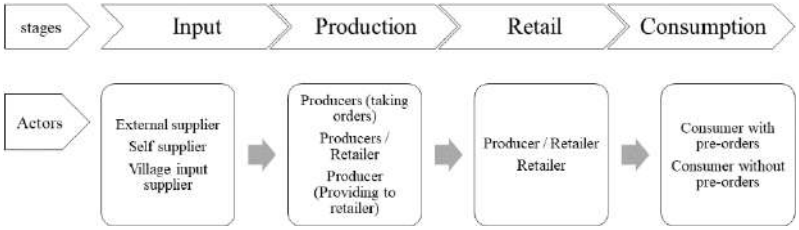

Figure 1. The stages and actors in the value chain

Therefore, 80% of the producers are in the age group of 35-55 years. Producers in the age group of 55-65 years represent only 20%. None of the producers are below the age of 35 years. All the producers in the sample are married. The majority of the producers have been educated up to the ordinary level, with 30% educated up to the advanced level. Traditional food production is the main occupation for all the producers.

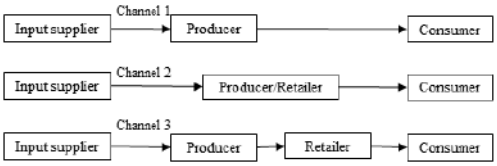

Figure 2. Channels of value chain

Value Additions and Gross Profit Margins

The food products prepared by producers were grouped into categories (Table 1). Some modern food items were also included in the product list since they were prepared using traditional ingredients. The cost of production can be observed in the steps of input provision, input processing, and preparation of the final product. Therefore, the cost of food ingredients, transportation cost incurred for acquiring inputs, operation costs and other costs were included in the cost of production. The operation cost includes labor costs, the cost for processing (including gas), and the utility costs for production (including electricity). Other costs include the cost of input processing, and packaging materials.

Producers add value to the chain through their production activities and by selling their finished items to retailers or consumers. Retailers add value to the chain by selling products to end consumers at a reasonable price. Table 2 represents the calculated average value additions and average gross profit margins.

Producers who take orders from consumers add an average of Rs. 29.42 in value to the ingredients, with a range of Rs. 19.45 and Rs. 39.50. Average Gross Profit Margin (AGPM) is 49.91%, varying from 33.97% to 59.82%.

Table 1. Grouped categories and included products

Food category	Food Products
Fried products	"Polos cutlet", "Kohila cutlet", "Cowpea wade", "Kokis", "Kurakkan patis"
Steamed products	"Lawariya", "Halapa", ''String hoppers", "Kurakkan wandu"
Baked products	"Maize based pizza", "Thosai", "Roti"
Cooked products	"Rice and curry"
Dishes	"Mango chutney"
Confectionery	"Dodol"
Snacks	"Hoppers"
Beverages	"Tea"

The Average Value Addition (AVA) for steamed products is Rs. 27.93, ranging from Rs 5.04 to Rs. 46.56 with an AGPM of 46.71%, ranging from 13.44% to 65.18%. An average value (AV) of Rs. 32.77 is added to baked products, resulting in an AGPM of 52.43%. For confectionery, they add an average value of Rs. 3.15, ranging from Rs. 0.23 to Rs. 6.06, with an AGPM of 9.04%, ranging from 0.78% to 17.31%. An AVA of Rs. 38.55, ranging from Rs. 28.96 to Rs. 48.14, with an AGPM of 41.22%, ranging from 28.96% to 53.49%, is observed for cooked products. The VA for beverages is Rs. 24.87, ranging from Rs. 24.19 to Rs. 25.56 with an AGPM of 49.74%, ranging from 48.36% to 51.12%.

Producers maintaining their retail shops add an AV of Rs. 16.59 for fried products, ranging from Rs. 7.71 to Rs. 22.88, with an AGPM of 31.13%, ranging from 25.7% to 40.67%. For steamed products, an AV of Rs. 14.28 is added, with a range of Rs 5.02 to Rs. 23.53, resulting in an AGPM of 28.03%, ranging from 27.95% to 28.12%. The AVA for baked products is Rs. 41.87, with a range of Rs 13.92 to Rs. 69.82, resulting in an AGPM of 50.14%, with a range of 36.5% to 63.78%. A VA of Rs. 29.98 and an AGPM of 46.6% are observed for dishes. An AV of Rs. 8.78 is added to snacks, with an AGPM of 39.5%.

Producers who engage only in the production of food items produce steamed products with an AVA of Rs. 40.12, ranging from Rs. 28.06 to Rs. 52.179, The highest AGPM in the chain which is 61.78%, is observed for steamed products by these producers, but it ranges from 50.5% to 73.05%. The observed reason for higher GPM is the low cost of ingredients, since most of the ingredients are obtained from home gardens.

The lowest AGPM in the chain which is 4.76% is observed among actors who engage only in retailing and who add a value of Rs. 22.22 to the products.

Table 2. Value additions and gross profit margin percentages

Actor and product category	AVA	AGPM
Producer (taking orders)		
Fried products	29.42	49.91
Steamed products	27.93	46.71
Baked products	32.77	52.43
Cooked products	38.55	41.22
Confectionery	3.15	9.04
Beverages	24.87	49.74
Producer, Retailer		
Fried products	16.59	31.13
Steamed products	14.28	28.03
Baked products	41.87	50.14
Dishes	29.98	46.6
Snacks	8.78	39.5
Producer (provide to retailer)		
Steamed products	40.12	61.78
Retailers		
Steamed products	22.22	4.76

AVA-Average value added (Rs), AGPM-Average gross profit margin (%)

Issues Within the Value Chain

Having little capital to invest is a key issue. Actors are reluctant to use credit facilities since they lack stability in their business. Producers who take orders have not taken any loans from any society. However, they have joined the Sithamu Women's Society to improve their knowledge and develop their small business. Only a few producers have taken small loans from village-level societies. The increase in retail prices of food ingredients directly affects the food producers.

A lack of specialized skills in upgrading and managing has resulted in inefficiencies in the businesses of small-scale producers and retailers.

The limited use of technology is a major barrier to market access for producers. They operate on a small scale with their traditional production system and have low interest in technology.

The producers aim only at a small number of consumers or channels to market their products. Low demand from consumers, due to low awareness of the traditional food market, has affected market development. There is little concern about the quality and safety requirements of the products. The products are served to the market without undergoing much value addition. The unavailability of a good consumer base is a reason for this. Attention has not been paid to the packaging requirements of food items.

Interventions to Improve the Value Chain

The importance of creating a good market for the products was identified. Facilitating market development while strengthening the actors is required.

Enlarging the technological capabilities of the actors is important. Technology can be utilized in production, marketing and distribution activities. Increased advertising through online platforms and digital media, including using websites and social media platforms, can ensure efficient communication and lead to higher development. Furthermore, a dedicated app can be developed to strengthen the process.

Improving access to finance for the value chain actors is essential. Developing microfinance services with an appropriate system is a better solution to provide the necessary credit facilities and training for the producers. This leads to generating stability over time. High investments are required if the sector needs higher development.

Training that improves both skills and know-how is required to strengthen human capital. Such training will be important for food producers to manage their businesses, and update their knowledge in line with modern developments.

Potentials to Develop Livelihood

Based on the identified low development of the traditional food sector, several possibilities were suggested to achieve livelihood development (Figure 3).

Establishing a food outlet that provides consumers with the experience of onsite food consumption, focusing on innovations in products and processes according to marketing requirements, can achieve higher consumer attraction. The model of 'hela bojun' food outlets play a leading role in demonstrating success in this type of outlet. The culinary skills of women food producers can be utilized for the success of these outlets.

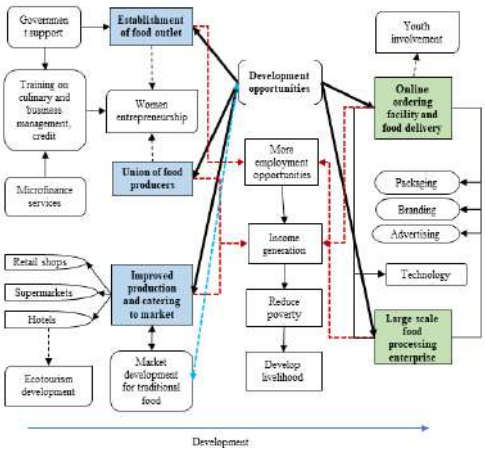

Figure 3. Possibilities to develop livelihood of the community

Catering to hotels can target foreign consumers more than local consumers. This sector needs much attention due to its high potential for ecotourism development. Since the area is a highly visited by tourists, traditional food products can be introduced to tourists. The producers can unite and develop their producer organization. Increased bargaining power and the ability to make suitable decisions can be achieved through this. Establishing a food selling center or another form of food distribution center and improving the order-taking procedures can be implemented with the collective action of food producers, focusing on new ideas and modifications to existing procedures. These strategies are important to upgrade the sector from its existing conditions.

Online ordering facilities, food delivery and large-scale food processing enterprises will lead the sector to further success and higher development. Medium-scale enterprises can be developed into large scale enterprises and cater to untapped markets in other districts. Branding, labelling, packaging, and advertising are highly important in maintaining the success of the business. The employment opportunities generated under the food enterprise will help improve the living standards of low-income people and subsequently reduce poverty. A system can be created that supplies raw materials directly from farmers to large-scale producers. Additionally, the role of transporters is needed to create an extensive and strong supplier and distribution network. Increasing awareness among value chain actors about the technology involved in online ordering facility and food delivery will further encourage women to initiate their entrepreneurial ventures.

Implementation these potentials will further stimulate the sector by encouraging youth involvement, market development, and ecotourism development.

CONCLUSIONS

The traditional food value chain in the village tank cascade system in the North Central province of Sri Lanka is relatively simple. There is a good potential to enhance the value chain of traditional village food production and develop the livelihood of the community through value chain development. The establishment of a food outlet, union of existing producers, improved production and catering to the market are suggested to uplift the existing condition of the value chain. Higher development can be expected through online ordering facilities, food delivery services, and large-scale food processing enterprise.

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Factors Influencing Purchase Intention for Coconut Milk Powder: A Case Study in Kandy District

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ABSTRACT

Considering the simplicity of consumption and freshness preserved, the powdered coconut milk from spray drying is a great substitute for fresh coconut milk. To protect the coconut sector, processed coconut milk products must be preferred over raw coconuts. This study was focused on identifying the effects of product factors, perceived expertise, availability, social norms, pricing, certification, perceived health, and advertising, on coconut milk powder purchase intention. Primary data were gathered through a structured questionnaire survey from 400 participants from five Divisional Secretariats in Kandy District. Data were analyzed using Confirmatory Factor Analysis in SPSS 24 via AMOS. The results show that product factors, subjective norms, certification, price attitude, and availability significantly influence the purchase intention of coconut milk powder in this population. These results provide significant perspectives for investors, producers, marketers, and policymakers to augment the coconut milk powder sector through the implementation of requisite product improvements and customized tactics that align with customer demands.

KEYWORDS: Coconut milk powder, Factors, Kandy district, Purchase intention

INTRODUCTION

The coconut industry is a cornerstone of Sri Lanka's agricultural sector, playing a pivotal role in the country's economy and livelihoods. Known for its extensive coconut cultivation, Sri Lanka is a major global player in the production of coconut-based products. Sri Lanka's coconut industry contributes significantly to foreign exchange earnings and job creation. A total of 1,095,000 acres are under coconut cultivation, with 178,675 acres under the estate sector and 917,307 acres under small holdings. (EDB, 2021).

Approximately 66% of Sri Lanka's coconut yield is utilized within the country, with the remaining 34% serving as inputs for coconut-related industry and exports, refined into value-added goods for diverse markets (Coconut Development Authority, 2021). The high local consumption of coconuts, coupled with population expansion, presents a significant challenge for the processing sector, which grapples with a shortage of raw materials.

Additionally, the extensive domestic utilization of raw coconuts results in the substantial waste within Sri Lanka. Hence, transitioning towards value-added coconut products emerges as imperative. This transition not only addresses the scarcity of nuts for local industries but also enhances opportunities for export markets.

Coconuts are valued primarily for copra or coconut oil, even though there are many opportunities for product expansion. Therefore, it is imperative to support the growth and marketing of substitute value-added products in Sri Lanka, including coconut milk powder. With numerous health benefits, including better heart health, weight loss, and cognitive function enhancement, coconut milk powder is one of the most widely used and important value-added goods on the market (Medical News Today, 2018). It is a widely used alternative to coconut milk, regardless of the context. Muralidharan and Jayashree (2011) revealed that coconut milk powder is a high-fat product that contains above 60% fat, 25% carbs, 10% protein, 3% ash, 1 to 5.0% moisture, and 0.02% crude fiber. Therefore, a person's daily fat requirement is mainly fulfilled by coconut consumption.

Based on global rankings from 2018, Sri Lanka is the world's top exporter of coconut milk powder (Coconut Development Authority, 2021). The Central Bank of Sri Lanka (2021) reports that Sri Lanka produced 7.88% of the world's total amount of nuts in 2021, with a 10% growth in exports from 2020 to 2021. The government's policy attempts to restrict raw coconut consumption, leading to a rise in the manufacturing of powdered coconut milk.

According to several studies, characteristics including flavor, smell, and appearance are important in influencing what people decide to buy (Kumar and Babu, 2014). Alphonce and Alfnes (2012) state that a key factor affecting consumers' decisions to purchase a specific product is the health factor. Scholars have also emphasized how important it is for consumers to know about products to influence their intentions to make purchases (Cakici and Shukla, 2017).

Subjective norms have a significant impact on customers' intentions to buy things (Teng and Wang, 2015). Moreover, numerous studies have shown the importance of product availability in consumers' intentions to make purchases (Kumar and Babu, 2014).

A study has mentioned that advertising significantly influences consumers' intentions to purchase a product (Latif and Abideen, 2011). Another important factor that influences purchase intention is trust (Arnot *et al*., 2016). Research has mentioned that price is a major factor in customer purchasing decisions (Brata *et al.*, 2017), and certification is also a key factor in determining purchase intention (Prentice *et al*., 2019).

Marketers comprehend consumer behavior in terms of coconut milk powder purchase intention in order to properly cater to their requirements and preferences. There are not sufficient studies that have been done in Sri Lanka to determine what factors influence consumers' inclinations to purchase powdered coconut milk. Therefore, the purpose of this study is to find out the factors that influence consumer purchase intentions for coconut milk powder in Kandy district. The selected factors for the study are product factors, advertising, subjective norms, perceived knowledge, purchase intention, health consciousness, price attitude, trust in the product, availability, and certification.

METHODOLOGY

Conceptual Framework

The proposed conceptual framework (Figure 1) explains the relationship among product factors, advertising, subjective norms, perceived knowledge, health consciousness, price attitude, trust in products, availability certification, and purchase intention.

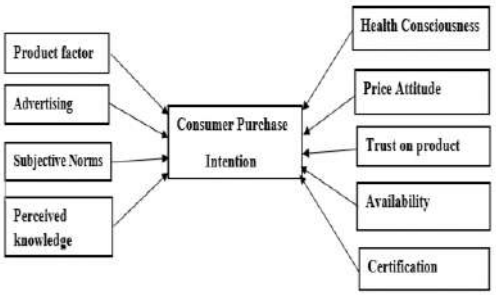

Figure 1. Proposed conceptual framework

Data Collection

Data were collected through face-to-face interviews using a pre-tested structured questionnaire. The sample size was 400 consumers selected from the Supermarkets consisting of Keells Super, Cargills Food City, Arpico Food City. Consumers were selected based on systematic sampling by interviewing each 3rd who customer arrived at the Supermarkets. Super markets were selected randomly from five Divisional Secretariats that were selected randomly from Kandy District to complying with multistage sampling.

Measures

The questionnaire was comprised of demographic factors and nine other factors, namely product factors, health consciousness, perceived knowledge, advertising, availability, subjective norms, trust in the product, price attitude, and certification.

The dependent variable was the consumer's purchase intention. A total of forty-one indicators were used to measure these factors and purchase intention. All indicators were assessed by a 5-point Likert-type scale, ranging from 1 to 5, where 1 was denoted “strongly disagree” and 5 was denoted “strongly agree”.

Data Analysis

Descriptive statistics were used to analyze the demographic factors, while Cronbach's Alpha Reliability Coefficient was used to evaluate the reliability of each factor. Confirmatory Factor Analysis (CFA) was employed to evaluate the validity of the measurement model. To examine the proposed model, Structural Equation Modelling (SEM) was used, employing the Analysis of Moment Structure (AMOS) in the SPSS 24 version. The estimates were based on the maximum likelihood estimation technique.

RESULTS AND DISCUSSION

Descriptive Statistics of the Sample

The majority of the respondents were women 63.5% and 36.3% were men in the studied population (Table 1). Population contained 44%, 40%, and 16% in the age groups of 16-30, 31-50, and above 50 respectively. Among the respondents, 9.8% had primary education while others had above that level. Most of the sample was in the secondary level of education 46.8%. Among the population, 69% were employed and 80% represented above LKR 35,000 income level.

Reliability Statistics

Cronbach's Alpha was employed to assess internal consistency, with a threshold of 0.7 indicating acceptability (Hair *et al*., 1998). All factors exhibited internal consistencies above this threshold, signifying acceptable consistency within their indicators.

Table 1. Socio-demographic characteristics of the sample

Parameter	Category	Percentage (%)
Gender	Male	36.3
	Female	63.5
Age	16-30 years	23.4
	31-50 years	57.5
	51 and above	19.1
Employment Status	Unemployed	31.0
	Employed	69.0
Monthly Income	Less than 15,000	11.3
	15,001-35,000	47.3
	35,001- 60,000	30.8
	Above 60,000	10.8
Educational Level	Primary	9.8
	Secondary	46.8
	Tertiary	43.5
Ethnicity	Sinhala	87.5
	Tamil	0.3
	Muslim	12.2

Confirmatory Factor Analysis (CFA) Results

The model initially used 41 indicators, all of which exhibited insufficient fit. As a result, nine indicators with low factor loadings (below 0.05) and insignificance (at p=0.05) were removed, including PR5, SN4, PK1, PK2, HC1, PA2, T2, AV1, and AV2.

Table 2 presents the re-estimated results, indicating that all standardized estimates are statistically significant. Among the significant indicators, PF4 indicator has the highest factor loading (0.865) for the product factor, indicating the convenience of the use of coconut milk powder. AD3 indicator shows the highest contribution to the factor of advertising (0.742) comprising Advertising provides sufficient information about coconut milk powder and thus has a significant influence on the purchase decision. SN2 has the highest factor loading (0.721) for subjective norms, indicating that family influences to buy coconut milk powder due to easiness. HC5 has the highest factor loading (0.857) for health consciousness, indicating that there are no health risks associated with consuming coconut milk powder. PA5 has the highest factor loading (0.856) for the price, indicating that consumers can save money buying coconut milk powder instead of raw coconut as its keeping quality. AV3 has the highest factor loading (0.862) for availability, indicating that if coconut milk powder is not available, I visit another place to buy coconut milk powder. TP1 shows the highest factor loading (0.861) towards the trust, indicating the quality of coconut milk powder.

PK3 has the highest factor loading (0.764) for perceived knowledge, indicating believe existing knowledge is enough regarding coconut milk powder to make a purchase decision. CF1 has the highest factor loading (0.842) for certification, indicating that certification of coconut milk powder influences purchase decisions.

Table 2. Confirmatory factor analysis output

Construct	Estimate of items	Cronbach's Alpha
Product Factors		0.724
PF1	0.622***	
PF2	0.575***	
PF3	0.728***	
PF4	0.865***	
Advertising		0.733
AD1	0.672***	
AD2	0.559	
AD3	0.742***	
Subjective norms		0.753
SN1	0.536***	
SN2	0.721***	
SN3	0.623***	
SN5	0.553***	
Perceived Knowledge		0.845
PK3	0.764***	
PK4	0.541***	
Health Consciousness		0.834
HC2	0.763***	
HC3	0.536***	
HC4	0.567***	
HC5	0.857***	
Price Attitude		0.867
PA1	0.784***	
PA3	0.541***	
PA4	0.561***	
PA5	0.856***	
Trust on product		0.764
TP1	0.824***	
TP3	0.657***	
TP4	0.577***	
Availability		0.733
AV3	0.862***	
AV4	0.826***	
Certification		0.880
CF1	0.842***	
CF2	0.529***	
CF3	0.668***	
Purchase Intention		0.779
PU1	0.857***	
PU2	0.549***	
PU3	0.622***	

*Levels of statistical significance, ***p<0.01*

Standardized Regression Weight analysis shows that (Table 3) consumers' intention to purchase coconut milk powder is positively influenced by product factors, Subjective norms, Certification and Price attitude.

There were four indicators under product factors, which are the flavor of coconut milk powder, ability to dissolve, shelf life, and ease of use.

Subjective norms were measured using four indicators, which evaluated "I consumed coconut milk powder as consumed by people around me, I used coconut milk powder instead of raw coconut due to easiness, friends promote I should buy coconut milk powder instead of raw coconut and new research findings have a significant influence on coconut milk powder purchase intentions. Also, the factor certification highly influences the purchase intention of coconut milk powder in this population. The factor certification consisting of the Certification of the coconut milk powder has an influence on my purchase decision, I believe the SLS, ISO, CDA (Coconut Development Authority) certification and I trust certified coconut milk powder is in higher quality. Price attitude and availability another significant factor that influences purchase intention.

Advertising, perceived knowledge, health consciousness, and Trust on product did not significantly impact purchase intention. Therefore, it can be concluded that Sri Lankan consumers tend to buy coconut milk powder based on the product factors, subjective norms, certification, price attitude and availability.

Table 3. Standardized Regression Weight

Relationship	Estimate
Purchase intention ← Product factors	0.323***
Purchase intention ← Advertising	0.023
Purchase intention ← Subjective Norms	0.241***
Purchase intention ← Perceived Knowledge	0.024
Purchase intention ← Certification	0.142***
Purchase intention ← Health Consciousness	0.112
Purchase intention ← Price Attitude	0.065***
Purchase intention ← Trust on Product	0.053
Purchase intention ← Availability	0.036***

*Levels of statistical significance, ***P<0.01*

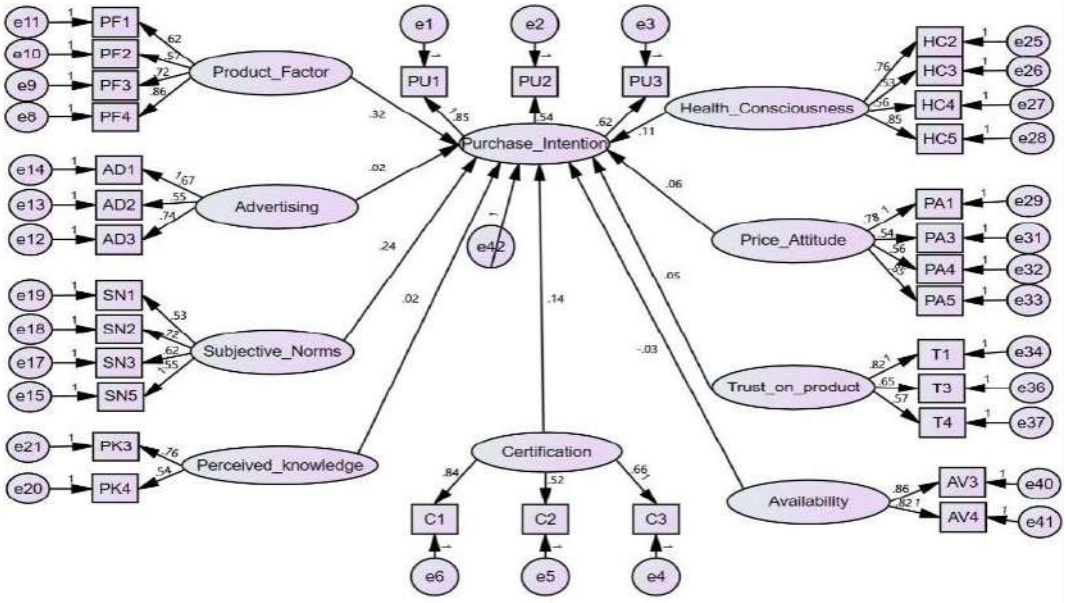

Figure 2. Structural relationship between purchase intention and factors

PF: Product factors, PF1: Taste, PF2: Dissolving ability, PF3: Long shelf life, PF4: Convenient to use, TP: Trust, TP1: Quality of product, TP2: Standard production process, TP3: Safety of packaging, TP4: Standard machines, TP5: Trust on label information, HC: Health consciousness, HC2: Healthier to consume, HC4: Not contain harmful chemicals, HC5: No health risk, PK: Perceived knowledge, PK1: Personnel knowledge, PK2: Knowledge of ingredients, PK3: Enough Knowledge, PK4: Knowledgeable to evaluate different products, PK5: Knowledge of the society, AV: Availability, AV1: Availability of the product, AV2: Poor availability, AV3: Visit another place to purchase, AV5: Availability in supermarkets, PA: Price, PA1: Affordable price, PA3: Low price, PA4: Effect of high price, PA5: Even though price is higher I buy it, SN: Subjective norms, SN3: People influence, SN4: Family influence, SN5: Friend influence, AD: Advertising, AD1: Advertisements influence, AD2: Celebrity character of advertisement, AD3: Advertising provides sufficient information, CF: Certification, CF2: Believe the certifications, CF3: High quality of certified products, PI: Purchase intention, PI1: Like to purchase, PI4: Like to buy forever, PI5: Plan to buy even in the future, PI6: Recommend others to use.

CONCLUSIONS

The study revealed that Sri Lankan consumers tend to buy coconut milk powder based on product factors, Subjective norms, Certification, price attitude and Availability. This research offers numerous recommendations targeting both policy and industry spheres. It underscores the necessity for coconut milk powder products to embody attributes such as palatability, extended shelf life, solubility, and user-friendliness to bolster consumer purchasing inclination. Upholding stringent quality benchmarks, integrating safety protocols throughout the production and packaging phases, and guaranteeing the veracity of product information on labels are pivotal for cultivating trust in coconut milk powder and stimulating purchase intent. Additionally, the accessibility of coconut milk powder in residential vicinities and conveniently situated food city holds considerable significance in consumer decision-making processes. Producers are urged to diligently attend to augmenting the availability of coconut milk powder, with governmental backing through initiatives such as financial incentives, infrastructure enhancement endeavors, advocacy for research and development initiatives, forging collaborations with private enterprises, fostering the adoption of innovative technologies, and enacting supportive regulatory frameworks conducive to coconut milk powder production within the nation. To boost the uptake of coconut milk powder, producers may consider lowering prices and enhancing quality concurrently, while marketing firms can adjust their targeting approaches to align with consumer preferences. These measures are anticipated to bolster the accessibility, credibility, perception, and inclination towards branded coconut milk powder among Sri Lankan consumers. Moreover, these proposals hold promise for yielding favorable results for producers, investors, policymakers, marketers, and governmental bodies. The insights gleaned from this study offer valuable guidance for formulating policies and marketing tactics tailored to meet consumer demands and stimulate coconut milk powder consumption.

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Determinants of Household Non-timber Forest Product Collection in the Dry Zone of Sri Lanka

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ABSTRACT

Non timber forest products (NTFP) play a crucial role in the livelihoods of millions worldwide particularly in forest-proximate communities and Sri Lanka is no exception. This study aims to explore the role non-timber forest products play in forest-proximate communities and the factors influencing the NTFP contribution to the overall livelihood strategies of the households in the dry zone of Sri Lanka. Data were collected from 324 respondents from forest-proximate communities in the North Central province by administering a semi-structured questionnaire through face-to-face interviews. A Probit model was estimated to identify the determinants of NTFP collection. Results show that variables such as household income, household head's income, number of employed members at home, and distance to the forest have a significant impact on NTFP collection. Distance from the forest shows a higher positive relationship with NTTP collection. The number of employees at home and household income have a negative correlation with NTFP collection, while household head's income has a positive relationship. Thus, the current study emphasizes the impact of multifaceted socio-economic on forest resource management which should be considered in policy development for the betterment of local community's livelihood and sustainable resource utilization.

KEYWORDS: Dry-zone, Livelihood, Non-timber forest product, Probit analysis

INTRODUCTION

Anuradhapura district in Sri Lanka stands as a testament to the country's cultural richness and economic vitality, with a population of 311,065 individuals distributed across 22 Divisional Secretariat Divisions and 694 Grama Nila Dhari Divisions. Within this district, livelihoods predominantly revolve around the non-timber forest product (NTFP) collection, which engages 91.8% of Grama Nila Dhari Divisions, complemented by activities such as livestock rearing (45%), non-agricultural activities (31%), and fisheries (11%) (Department of Census and Statistics, 2020). The varying levels of civic engagement, with *Nuwara gam Palatha* East Divisional Secretariat Division showing strong involvement (7.4%) compared to *Palugaswewa* Divisional Secretariat Division (1.9%), highlight the nuanced socio-economic dynamics at play (Department of Census and Statistics, 2020). Additionally, social welfare programs like "Samurdhi/aswasuma" benefit 71,002 people, underscoring community support amid economic diversity, particularly in NTFP utilization (Department of Census and Statistics, 2020).

Non-timber forest products (NTFPs) serve as vital contributors to economic development and sustainable forest management, playing a crucial role in enhancing household livelihoods. A study conducted in Vietnam extensively examined the growth, development, and trade of NTFPs, revealing key determinants such as forestry experience, labor force size, income sources, and understanding of forestry policies. Notably, certain NTFP groups, particularly those related to yarn and medicines, demonstrated significant income generation and an impact on household reliance. These findings underscore the need for tailored strategies to support NTFP development, including policy interventions to provide financial assistance, expand training opportunities, and enhance productivity (Nguyen *et al*., 2020). Such insights hold relevance for understanding NTFP collection patterns and promoting sustainable livelihoods in Sri Lanka.

Globally, studies underscore the critical role of NTFPs in sustaining local livelihoods and promoting environmental conservation. For instance, in Quan Pan, Plateau State, Nigeria, it was found that income from non-timber forest products (NTFPs) significantly contributes to household income, particularly in agrarian areas. Factors such as household size, agricultural land size, and gender influence NTFP income. It suggests policymakers include the NTFP sector in forest conservation to support forest-dependent communities (Vihi *et al., 2023*).

Similarly, in Peru's Ucayali region, forests serve as vital sources of income for rural communities. This highlights the economic significance of forests and non-timber forest products (NTFPs) for rural communities, highlighting the challenges they face (Lopez-Feldman *et al*., 2015). These insights emphasize the necessity of inclusive development efforts

to enhance sustainable livelihood assets, particularly for the most vulnerable forest-dependent groups. Paudel's research in Nepal highlights the economic benefits of community-managed forests, especially for marginalized groups, emphasizing the significance of NTFPs in supporting local livelihoods and environmental sustainability (Paudel, 2017).

Additionally, in northern Bolivia, researchers highlight the diverse livelihood strategies among rural dwellers in tropical forest regions. Their study underscores the need for development efforts to enhance sustainable livelihood assets, particularly for the poorest forest-dependent groups (Zenteno *et al*., 2013). Research in Mabira Central Forest Reserve reveals NTFPs support local livelihoods, contributing up to 40% of household income. Factors influencing dependence include age, gender, and education, suggesting poverty alleviation and women's empowerment policies (Tugume *et al*., 2015).

Non-timber forest products (NTFPs) play a pivotal role in supporting local livelihoods and environmental sustainability, providing crucial benefits such as improving food security, offering an income source, and serving as a safety net for communities. However, despite their significance, there is a notable absence of recent studies on NTFP collection in Sri Lanka. This gap highlights the need to understand the impact of economic crises on NTFP collection and quantify how these crises affect harvesting practices. Therefore, the objectives of the study are to explore the role non-timber forest products play in forest-proximate communities in the dry zone of Sri Lanka and estimate the factors influencing NTFP collection and its contribution to the overall livelihood strategies of the households in the area.

METHODOLOGY

Data Collection

The study focused on non-timber forest products (NTFP) collection in Anuradhapura. District, which has a population of about 311,065 households. Purposively select four divisional secretariats with considerable forest use. A sample of 330 households was chosen using the cluster sampling method, with 324 utilized for analysis. The pilot study was carried out with 25 respondents, and accordingly questionnaire was revised and actual data collection was conducted with 330 households. A semi structured questionnaire was administered face -to- face. Consequently, the study was conducted in Anuradhapura, which has three important attributes. It is situated within an ecological conservation area, has archaeological values, and has a large population. This premise and the historical background, combined with the diverse types of forests available in Anuradhapura, make it appropriate to examine the collection of NTFPs and their socioeconomic implications. Get familiar with a huge population. It gives a perfect opportunity to study the NTFP.

Statistical Analysis

A probit model was used in a prior study to predict families' willingness to pay for NTFPs.Age, marital status, education, religion, and the perceived values of forests and conservation were the hypothesis control factors in a sample of 357 households and sample was selected (Kuwawenaruwa and Lokina, 2010). Achieving successful and positive outcomes in earlier research, the current study employs a probit model to investigate factors influencing NTFP collection, utilizing its ability to handle binary dependent variables and examine socio-economic and demographic factors. Data analysis was conducted using the Statistical Package for the Social Sciences (SPSS) version 27. The probit model used for the analysis is represented by Equation (1).

$$(P)Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 \ldots + \epsilon \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

Y is the non-timber forest product collection.1= yes, 0 = otherwise. This analysis included several explanatory variables (X_1 to X_8) to capture various socio-economic aspects potentially affecting forest collection. These variables encompass age (X_1), gender(X_2), education level (X_3), number of employees in the household (X_4), distance to the forest (X_5), household income (X_6), income specifically from the household head (X_7), and farming practices (X_8), $\beta_\circ$, β_1, β_2, β_3 ,which are coefficients. ϵ is the error.

There are three dummy variables that make up the education variable. EDU1 denotes homes with only a primary education, EDU2 describes up to ordinary level education (O/L), and EDU3 displays complete O/L and higher education levels. Measure the ultimate presence of farm income in homes as well. 0 in the absence of farm revenue and 1 in the event that it exists. The non-timber forest products (NTFPs) variable, which equals 1 if a household participates in NTFP collection and 0 otherwise, was also included in the analysis. This study employs a probit model to analyze factors influencing NTFP collection, effectively handling binary dependent variables and analyzing socio-economic and demographic factors.

RESULTS AND DISCUSSION

Descriptive Statistic of the Sample

In all, 324 participants filled out the questionnaire that helped with the collection of non-timer forest products. The study carried out showed that, with participants' mean age being 47 years, slightly more females (55.2%) were than males (44.8%). Concerning education levels, about half of the respondents had received their education up to the O/L or higher (40.1%). While (28.1%) had only primary education, (31.8%) of the respondents had education up to O/L (Table 1). In general, it was established that households possessed 1.51 persons with an average gross household income of Rs. 57,583. The mean income of the household heads was Rs. 42,836, which was slightly lower. Most of the households (83.3%) identified as having farm income, but (16.7%) did not. Regarding NTFP collection, (56.8%) of respondents, while (43.2%) did not.

Table 1. Socio-economic characteristics

Variables	Mean	Freq	Pct. %
Age	47		
Gender			
Female		179	55.2
Male		145	44.8
Education			
Primary education		91	28.1
Up to O/L		103	31.8
Complete O/L		130	40.1
Employee	1.51		
Household income	57583		
Household head's income	42836		
Farm income			
Yes			
No		270	83.3
		54	16.7
NTFP Use			
Yes		184	56.8
No		140	43.2

Freq: -Frequency, Pct.%: - Percentage

Figure 1 illustrates the NTFP consumption profile according to occupations and income categories. The largest percentage of NTFP consumers is attributed to income (Rs. 21, 000-40, 000). at (29.6%), followed by Income 3 (Rs. 41,000–60,000) and Income 4 (Rs. 61,000–80,000) at (13.9%), followed by Income 5 (Rs. 81,000–100,000) and Income 6 (above Rs. 100,000) still have relatively decent though lower consumption rates at (12.3%) and (4.9%), respectively. Additionally, (16.7%) of respondents under (OCC 2), which are those with non-farming occupations, consume NTFPs. More to the point, (83.3%) of respondents stated that they get their income from farming (OCC1), thus suggesting a possible link between the occupation and consumption of NTFPs. The findings above also underscore the relevance of demographic characteristics in managing NTFP consumption patterns.

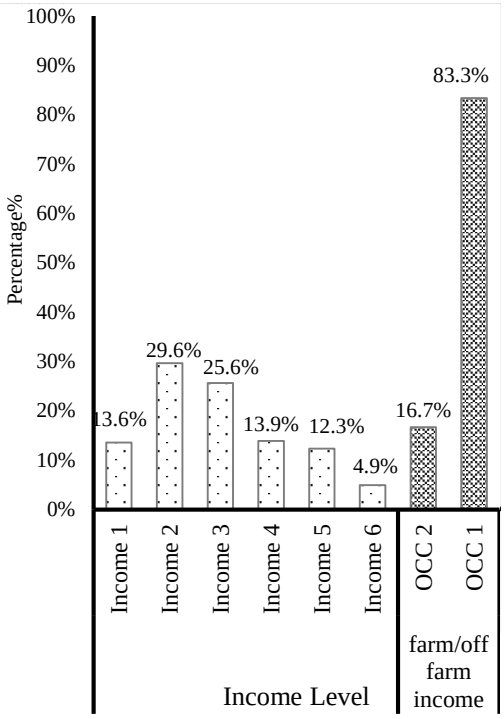

Figure 1. Consumption of NTFP by occupation and income level

OCC1: -farm income, OCC2: -non-farm income, Income 1: - Rs.0-20000, Income 2: - 21000-40000, Income 3: - 41000-60000, Income 4: - 61000-80000, Income 5: - 81000-10000, Income 6: - above 100000.

Probit Model Estimation

The probit model estimation results indicate several significant factors influencing household participation in various activities. Notably, the age (AGE) of the household head, gender (GEN), and various levels of education (EDU1, EDU2, and EDU3) did not show significant effects. The coefficients were -0.008 ($p = 0.532$) for AGE, -0.524 ($p = 0.119$) for GEN, -0.029 ($p = 0.957$) for EDU1, -0.133 ($p = 0.766$) for EDU2, and -0.442 ($p = 0.353$) for EDU3. Farm income (FARM) also showed an insignificant effect (0.032, $p = 0.938$). These results suggest that age, gender, education levels, and farm income do not significantly influence household participation in these livelihood activities. Among the variables, several significantly affect the probability of participation. First, household income (HHI) has a significant negative coefficient (-1.235), $p = (0.013)$, indicating that as household income increases, the probability of participation in certain livelihood activities decreases. This suggests that higher-income households

diversify their income sources away from these activities due to better opportunities elsewhere. Higher-income households likely access more lucrative or less labor-intensive sources, reducing their reliance on NTFP collection. This shift may result from better employment opportunities, improved market access, or investment in higher-return activities. Additionally, higher income levels may correlate with urbanization trends and increased environmental awareness and conservation efforts.

Conversely, the household head's income (HHHI) exhibits a significant positive relationship (1.311), p = (0.007) with a higher probability of participation. This implies that a higher income earned by the household head increases the likelihood of engaging in these activities, highlighting the importance of the household head's economic contribution. It may be that even with higher overall household income, individuals may still engage in NTFP collection to supplement their primary income source. Also, in some communities, NTFP collection is deeply ingrained in cultural and traditional practices. Also, maybe higher income levels will afford individuals the resources necessary for engaging in NTFP collection activities, such as transportation and equipment.

According to previous expectations and research studies, it was hypothesized that people who live closer to forests have a higher level of forest dependency because the resources are more easily accessible physically. However, research findings showed a positive correlation between the physical distance of residences and the amount of forest dependency. In other words, it was determined that there was an increase of (0. 515) for every kilometer that the distance was increased. Contrary to the hypothesis that awareness should rise with decreasing distance from the forest since access to it would be simpler, this association was statistically significant (P > [Z] = 0.054, Z = 1.92) (Tugume *et al*., 2015).Similarly, in the current study, there was a positive relationship between distance to the forest and dependency on forests, with a coefficient of 5.001 and a P value of <0.01, indicating that for each unit increase in distance, there was a corresponding increase in dependency on forests. The positive correlation between distance to the forest and NTFP collection suggests that households farther from the forest rely more on NTFP for income, possibly due to limited alternative resources. Fewer regulations and lower income levels among households located farther away could also contribute to this reliance. Households near the forest may avoid non-timber forest product (NTFP) collection due to concerns about forest preservation, fearing it may harm the ecosystem. This reluctance reflects their environmental awareness, influencing their involvement in NTFP activities compared to those farther from the forest. The number of employed household members (NEM) approaches significance with a positive coefficient (0.441, p = 0.055), indicating that an increase in the number of employed members marginally raises the probability of participation in these activities. This could reflect the collective effort of households to maximize income through various means. Maybe households with more employed members still engage in NTFP collection as a means of supplementing their income. NTFP collection may provide an additional source of revenue. Also, they may have a greater capacity to allocate time and resources to NTFP collection activities.

Parameter estimates of probit model is shown in Table 2.

Table 2.Parameter estimates of probit model

Variable	Coefficient	SE	P. Value
Constant	-3.004	2.647	.257
AGE	-.008	.013	.532
GEN	-.524	.335	.119
EDU1	-.029	.540	.957
EDU2	-.133	.448	.766
EDU3	-.442	.475	.353
NEM	.441	.229	.055*
HHI	-1.235	.496	.013*
HHHI	1.311	.482	.007*
FARM	.032	.407	.938
Distance	5.001	.734	<0.01*

GEN: -Gender, EDU1: -primary education level, EDU2: -Up to O/L, EDU3: -Complete O/L, NEM: -Number of employees in home, HHI: -Household income, HHHI: -Household head income. FARM: -farm income or non-farm income -yes=1, N0=0., Log

*HHI and HHHI value used to estimation. Significant level *P <0.05, SE: - Standard error*

CONCLUSIONS

In conclusion, this study investigates 56.8% of respondents engaging in NTFP use. On the parameters of age, educational level, and gender, no impact was observed, while household income, head of household income, number of employees, and distance towards the forest were also significantly affecting the NTFF collection. The specifics of socio-economic factors influencing NTFP use are described, and the necessity of specificity for further interventions is stressed, with a focus on improving the utilization of sustainable forest practices and on the support of local communities' income.

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Food Security Management in South Asia: Influence of Economic Factors on Food Availability and Access

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ABSTRACT

Food security management in South Asian countries is a multifaceted challenge that encompasses various interconnected factors, including food security, malnutrition, Gross Domestic Production (GDP). This study examines food security management in South Asian countries from 2012 to 2022, focusing on the interplay between malnutrition, GDP, and food trade. Descriptive analysis reveals significant variability in malnutrition indicators, such as stunting and wasting among children under five, across the region. The Food Production Index and GDP data show economic growth but an uneven distribution of food security benefits. The Spearman's rank correlation matrix highlights strong positive correlations between the number of people undernourished and the number of people moderately and severely food insecure. However, the correlation between undernourishment and the prevalence of moderate and severe food insecurity is weak, suggesting other influencing factors. Quantile regression reveals that higher food production significantly reduces undernourishment at lower quantiles, while increased GDP and food imports elevate it. At the median, food production, GDP, and exports impact undernourishment, but at the 75th percentile, economic factors have no significant effect. These findings underscore the need for comprehensive policies that address economic and nutritional disparities as well as trade to improve food security outcomes in South Asia.

KEYWORDS: Economic factors, Food security, Quantile regression, South asia, Spearman's rank correlation

INTRODUCTION

Food security, as defined at the 1996 World Food Summit and reiterated in 2009, is achieved when all people have continuous physical and economic access to adequate, safe, and nutritious food to meet their dietary needs for an active and healthy life. The four pillars of food security are availability, access, utilization, and stability. In Sri Lanka, significant progress has been made in enhancing food availability through increased agricultural productivity and diversification efforts (Department of Census and Statistics, 2021). However, disparities in food access continue, notably among the elderly and rural populations, despite improvements; this is influenced by factors such as income, market prices, and social safety nets (FAO, 2008; World Food Program, 2021).

As of 2020, global food security remains a critical issue, with significant disparities in food access across regions. According to the Food and Agriculture Organization (FAO, 2021), approximately 811 million people worldwide are undernourished, lacking sufficient dietary energy on a regular basis. The Global Nutrition Report (2020) indicates that nearly 2 billion people suffer from various forms of malnutrition, including undernutrition and obesity, which impede health and productivity. Conflicts, climate-related disasters, economic downturns, and the Covid-19 pandemic have exacerbated food insecurity, affecting over 2 billion people globally (FAO, 2021). Child malnutrition is particularly alarming, with UNICEF (2021) reporting about 149 million children under five stunted and 45 million wasted. These statistics underscore the urgent need for comprehensive actions to combat the root causes of hunger, malnutrition, and food insecurity worldwide.

Food security management in South Asian countries is a multifaceted challenge that encompasses various interconnected factors, including food security, malnutrition, Gross Domestic Production (GDP). Achieving sustainable food security requires addressing not only the availability and accessibility of food but also the underlying determinants of malnutrition, such as inadequate access to nutritious food, poor healthcare, and sanitation facilities. Additionally, the socioeconomic context plays a crucial role in shaping food security outcomes. Therefore, effective food security management strategies must adopt a holistic approach that addresses both immediate food needs and underlying structural factors contributing to food insecurity and malnutrition. Strengthening food trade in South Asia can improve food security by ensuring a steady supply of diverse and nutritious foods. Increased food trade in South Asia can contribute to improved food security by expanding access to a wider variety of food products. Strengthened trade agreements and infrastructure developments can bolster the availability of nutritious foods, fostering better nutritional outcomes and enhancing the overall

health and well-being of the region's inhabitants (World Bank, 2019; FAO, 2020).

Sri Lanka has made significant strides in improving food security, yet challenges remain, particularly in access and utilization. Recent data shows 4.9% of the population is undernourished, with malnutrition among children still a concern: 17.3% experience stunting, 15.1% are underweight, and 9.2% suffer from wasting. Additionally, 8.9% of households face food insecurity, disproportionately affecting rural areas and vulnerable groups.

Economic factors such as GDP and food trade significantly influence food security in South Asia. Higher GDP often correlates with improved food availability and access due to increased resources for agricultural investment and food imports. Enhanced food trade in South Asia can boost regional food security by ensuring a more reliable supply of diverse food products. Efficient trade policies and infrastructure improvements facilitate access to nutritious foods, helping to stabilize prices and availability, thereby supporting overall nutritional health in the region.

A literature review on food security management in South Asia must consider the substantial influence of economic factors such as GDP and the Food Production Index (FPI) on food availability and access. GDP growth directly impacts household income levels, enabling better access to food through increased purchasing power. Meanwhile, the FPI reflects agricultural productivity and food self-sufficiency, crucial for maintaining consistent food supply. Studies show that higher GDP and FPI correlate with improved food security outcomes, yet disparities persist due to unequal distribution and regional variations. Investigating these relationships is essential to develop targeted policies that enhance food security across diverse socio-economic contexts in South Asia. Therefore, the main objective of the study was to explore the influence of economic indicators on food security management. The specific objective was to analyze how economic factors including trade influence the level of malnutrition in South Asia.

METHODOLOGY

Data Collection

This study aimed to assess food security by analyzing various related variables, focusing on data availability and relevance to food insecurity. Secondary data were sourced from reputable organizations to ensure reliability and comprehensiveness. Particularly, data were accessed from the FAOSTAT and World Bank databases, covering the period from 2012 to 2022. These sources provided extensive information on multiple dimensions of food security, and stability. The selection of variables prioritized those with the greatest data availability and the strongest interrelation with food insecurity.

Measures

Data were retrieved from FAOSTAT and World Bank databases, covering the period from 2012 to 2022. The variable selection focused on those with extensive data availability and significant relevance to the dimensions of food security, including availability, access, utilization, and stability. This approach ensured a robust dataset, enabling comprehensive analysis of factors influencing food security.

Data Analysis

The analysis of food security management in South Asian countries was developed with descriptive statistical data analysis, Spearman’s Rank Correlation Matrix and Quantile Regression from 2012 to 2022. The statistical information was obtained from the FAOSTAT and World Bank database for the variables presented in disaggregated across South Asian countries and over the period of 2012 to 2022.

Descriptive Statistics

Descriptive statistics offer a concise summary of data, enabling researchers to understand and communicate essential features of their dataset. Key metrics include the mean, representing the average value and central tendency, while the minimum and maximum values indicate the range, highlighting the smallest and largest observations. The number of observations (N) reflects the sample size, providing context to the statistical power and representativeness of the results.

Spearman’s Rank Correlation Matrix

Spearman’s Rank Correlation Matrix is a non-parametric tool used in research to measure the strength and direction of association between two ranked variables. Unlike Pearson's correlation, Spearman’s correlation does not assume a linear relationship or normal distribution of the data, making it ideal for ordinal data or non-linear relationships.

The matrix displays correlation coefficients ranging from -1 to 1, where values close to 1 indicate strong positive correlation values close to -1 signify a strong negative correlation, and values around 0 suggest no correlation. This matrix helps researchers

understand and visualize the monotonic relationships between multiple variables, aiding in the identification of potential patterns and insights within the dataset without the constraints of parametric assumptions.

Quantile Regression

Quantile regression is a statistical technique that estimates the relationship between independent variables and specific percentiles (quantiles) of the dependent variable, providing a more comprehensive analysis than mean regression. In food security research, it helps uncover how different factors, such as Food Production Index, GDP, Inflation Consumer Price, Food Import and Food Export, impact various points in the distribution of food access or nutrition levels. This approach is particularly valuable for identifying effects on vulnerable populations, revealing disparities that average models might overlook, and informing targeted policy measures to enhance food security for those most at risk.

Level of Undernourishment = f (Food Production Index + GDP + Inflation + Food Exports + Food Imports + ϵ) ····· (1)

The model predicts undernourished people via quantile regression. Using regression coefficients across different quantiles (0.25, 0.5, 0.75), equations show how independent variables (Food Production Index, GDP, Inflation, Food Exports, Food Imports) affect undernourishment. The error term (ϵ) represents the disparity between actual and predicted values.

RESULTS AND DISCUSSION

Descriptive Statistical Analysis

The analysis of food security-related variables in South Asian countries from 2012 to 2022 unveils a complex landscape marked by diverse challenges. While the mean percentage of children under five who are stunted indicates a concerning prevalence (34.38%) with moderate variability, the lower mean for children affected by wasting (5.96%) belies significant positive skewness, suggesting concentrated high rates in select nations. Moderate agricultural output, as indicated by the food production index (mean=94.45), contrasts with highly skewed GDP figures, reflecting the influence of larger economies.

Considerable variability and positive skewness in inflation rates signal periods of economic instability. Despite moderate mean levels, trade-related variables exhibit substantial variability and skewness, underscoring the intricate economic dynamics affecting food security. Moreover, the high variability and positive skewness observed in the number of undernourished individuals and that experiencing food insecurity highlight profound disparities across South Asian countries, emphasizing the multifaceted nature of the region's food security challenges.

Comparative Study of Food Insecurity in South Asia (2014 to 2020)

The data presented highlights the trends in the number of moderately or severely food insecure people in five South Asian countries from 2014 to 2020 (Figure 1). Afghanistan shows a dramatic rise, especially post 2018, reaching about 100 million by 2020, indicating a severe worsening of food insecurity. Bangladesh's food insecurity consistently

increases, reaching around 50 million. Pakistan's numbers are relatively stable, fluctuating between 30-35 million. Nepal and Sri Lanka exhibit the lowest figures, with Nepal staying between 10-15million and Sri Lanka below 10 million, showing minor fluctuations this comparison underscores significant disparities, with Afghanistan facing the most severe increase and Sri Lanka the least.

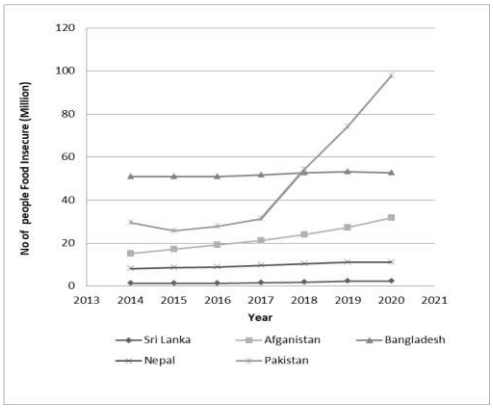

Figure 1. Number of people moderately or severely food insecure in South Asia

Spearman's Rank Correlation Matrix

The Spearman's rank correlation matrix for food security indicators in South Asia from 2012 to 2022 reveals significant relationships between undernourishment and food insecurity (Table 1). A robust positive correlation ($r = 0.844^{**}$, $p < 0.01$) between the number of undernourished individuals and the number of moderately or severely food insecure people underscores the strong linkage between inadequate nutrition and broader food insecurity.

Table 1. Spearman's rank correlation matrix for several forms of prevalence of undernourishment in South Asia over the period of 2012 to 2022

	No of People Undernourished (Million)	No of Moderately or Severely Food Insecure People (Million)	Prevalence of Moderate and Severe Food Insecurity (%)
No of People Under nourished (Million)	1.000	0.844**	0.073
No of Moderately or Severely Food Insecure People (Million)	0.844**	1.000	0.360*
Prevalence of Moderate and Severe Food Insecurity (%)	0.073	0.360*	1.000

Correlation is significant at the 0.01 level (2-tailed).
*Levels of significance: *p<0.05, **p<0.01*

Additionally, a moderate positive correlation ($r = 0.360$, $p < 0.05$) exists between the number of moderately or severely food insecure individuals and the prevalence of moderate and severe food insecurity, indicating a connection, albeit weaker, between these metrics indicating a connection, albeit weaker, between these metrics.

However, the correlation between the number of undernourished individuals and the prevalence of moderate and severe food insecurity is weak and statistically insignificant ($r = 0.073$, $p = 0.680$), suggesting that factors other than undernourishment might influence food insecurity prevalence. These findings highlight the multifaceted nature of food security in South Asia, where higher numbers of undernourished individuals correlate with more food-insecure people, but other variables also influence food insecurity. Effective policy interventions must target both undernourishment and the broader issue of food insecurity.

Quantile Regression

The quantile regression analysis of undernourishment in South Asian countries, averaged over three years, provides nuanced insights at the 25th, 50th (median), and 75th percentiles (Table 2). At the 25th percentile, a higher food production index significantly reduces undernourishment by 0.214 million ($p < 0.001$), while increased GDP correlates with a 0.005 million rise in undernourishment ($p < 0.001$), suggesting wealth inequality effects. The overall positive relationship between GDP and undernourishment suggests that as GDP increases, the number of undernourished people also increases at the 0.25 and 0.5 quantiles. This could be due to unequal wealth distribution, where economic growth doesn't necessarily translate to improved nutrition for the lower quantiles. When comparison of by Guiné *et al.* (2021) the analysis shows that the positive and significant coefficients at lower quantiles (0.10, 0.20) indicate that worldwide, an initial increase in GDP may lead to a rise in the number of undernourished people. This phenomenon could be attributed to increasing inequality or the fact that the early stages of economic growth often fail to benefit the poorest segments of society.

Inflation reduces undernourishment by 0.309 million ($p = 0.012$), and higher reliance on food imports increases undernourishment by 1.090 million ($p < 0.001$), with no substantial impact from food exports ($p = 0.356$). At the median, the Food Production Index reduces undernourishment by 0.346 million ($p < 0.001$), and GDP shows a slight increase in undernourishment (0.006 million, $p = 0.016$). Inflation is not significant ($p = 0.872$), but increased food exports (0.133 million, $p = 0.018$) and food imports (1.296 million, $p = 0.001$) are significantly associated with higher undernourishment. At the 75th percentile, none of the variables significantly impact undernourishment, as indicated by high p-values and low t-values, highlighting that the relationships observed at lower quantiles do not hold for higher levels of undernourishment. This analysis underscores the varying impacts of economic factors on different segments of the undernourished population, emphasizing targeted policy interventions.

CONCLUSIONS

Food security management in South Asia demands a multifaceted approach. Descriptive statistics highlight a high stunting rate (34.38%)

Table 2. Parameter estimates of the quantile

Number of people undernourished (millions) (3-year average)	Coefficient	SE	t	P > |t|
	Quantile 0.25			
Food Production Index	-0.214	0.046	-4.55	0.000
GDP (Current US$) Billion	0.005	0.001	4.022	0.000
Inflation Consumer Price (Annual %)	-0.309	0.119	-2.57	0.012
Food Exports (%of Merchandise Exports)	0.027	0.028	0.929	0.356
Food Imports (%of Merchandise Imports)	1.090	0.203	5.353	0.000
	Quantile 0.5			
Food Production Index	-0.346	0.089	-3.85	0.000
GDP (Current US$) Billion	0.006	0.002	2.46	0.016
Inflation Consumer Price (Annual %)	0.037	0.229	0.162	0.872
Food Exports (%of Merchandise Exports)	0.133	0.055	2.414	0.018
Food Imports (%of Merchandise Imports)	1.296	0.389	3.325	0.001
	Quantile 0.75			
Food Production Index	-0.224	1.492	-0.150	0.881
GDP (Current US$) Billion	.0396	0.039	0.033	0.973
Inflation Consumer Price (Annual %)	-0.177	3.81	-0.047	0.963
Food Exports (%of Merchandise Exports)	0.032	0.918	0.035	0.972
Food Imports (%of Merchandise Imports)	1.308	6.476	0.202	0.840

a. Dependent Variable: No of People Undernourished (Million)
b. Model: (Intercept), Food Production Index, GDP (Current US$) Billion, Inflation Consumer Price (Annual %), Food Exports (% of Merchandise Exports), Food Imports (% of Merchandise Imports)
*Level of significance: *p<0.05, **p<0.01*

and strong correlation (r = 0.844) between undernourishment and food insecurity, it is clear that enhancing food availability is pivotal. The findings from quantile regression, indicating that increases in the food production index significantly reduce undernourishment, particularly at the 25th (0.214 million, $p < 0.001$) and 50th (0.346 million, $p < 0.001$) percentiles, suggest that improving agricultural productivity can have a direct and beneficial impact on food security. Therefore, policy interventions should prioritize agricultural development, tailored specifically to enhance food production capacities.

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Factors Influencing Academic Performance of First-Year Agriculture Undergraduates in State Universities in Sri Lanka

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ABSTRACT

The academic performance of agriculture undergraduates in state universities in Sri Lanka represents a vital cohort of the country's economic sustainability. Poor academic performance has an impact on dropout rates and career opportunities. In addressing this problem, prioritizing first-year undergraduates is very important. Hence, the objective of this study is to identify how factors including home environment, study habits, learning skills, hardworking ability, academic interaction, and perceptions about the agriculture degree programme influence the academic performance of first-year agriculture undergraduates in state universities in Sri Lanka. The academic performance of undergraduates is measured by their grade point average (GPA). A structured questionnaire survey was conducted to gather primary data from a sample of 300 agriculture undergraduates who were selected using simple random sampling, from four randomly selected universities proportionately. Descriptive statistics were used to analyse the university entry point factors, while Cronbach's alpha reliability coefficient was used to evaluate the reliability of each factor. Confirmatory Factor Analysis (CFA) was done using Analysis of Moment Structure (AMOS) in the SPSS 26 version. The findings revealed that the factor 'learning skills' is the significant (P<0.001) and positive factor that influences academic performance. These findings are helpful for first-year undergraduates, academics, policymakers, and parents to identify the factors that should be developed and improved to enhance the academic performance of students.

KEYWORDS: Academic performance, Agriculture undergraduates, Factors, First-year, State universities

INTRODUCTION

Since agriculture plays a dominant role in the economy of Sri Lanka, proper attention should be given to agriculture undergraduates because they represent a promising cohort with great potential for ensuring the sustainability and resilience of the agriculture sector.

The Sri Lankan government offers fully-funded free education to university students who are recognised as the "cream of the nation" due to their outstanding academic performance in G.C.E. Advanced Level examination, expecting to optimise their academic performance to ensure a positive return on investment.

However, after enrolling in the university, there is a notable heterogeneity in academic performance among the students admitted to the same faculty and university, even though all of them have fulfilled the required cut-off marks for admission. These variations lead to lower grade attainment, thus elevating dropout rates, repeats, graduating with just a general pass, etc.

Good academic performance can lead to better academic opportunities, such as scholarships and it can also serve as a standard for employers, especially when evaluating fresh graduates for job opportunities. Poor academic performance at the university may contribute to adverse effects such as increased stress levels, limited employment opportunities, and stunted economic development in the country. This highlights the importance of evaluating factors affecting the academic performance of agriculture undergraduates in the country.

Meer *et al.,* (2018) elaborate that most of the higher education institutions in the world recognise that first-year students should be the prime focus of any retention strategy because many students are overwhelmed by the transition from school to university and do not necessarily understand what is expected of them.

Academic performance can be defined as the measurable performance outcomes reflecting the extent to which a person has attained specific goals in an educational setting. Grade Point Average (GPA) is considered the dependent variable to measure the academic performance of the students (Sandika *et al.*, 2012; Wijesinghe and Abeynayake, 2020). GPA is the credit-weighted arithmetic mean of the grade point values.

Numerous global studies have explored factors affecting the academic performance of undergraduates. However, there is a notable gap in research specifically targeting agriculture undergraduates, especially in Sri Lanka.

This gap becomes even more pronounced during the ongoing economic crisis, which significantly impacts the mental, academic, and socio-economic well-being of undergraduates. Therefore, this study aims to address this gap and contribute valuable insights into these unexplored aspects.

Kapur (2018) has mentioned that parental and home environment factors significantly impact academic achievement, with both positive and negative factors influencing students' success. According to Rabia *et al.* (2017), there is a significant relationship between study habits and academic performance of students. Time management, student attendance at lectures, active learning, and library usage have a significant and positive relationship with academic performance (Fernando, 2017). According to Priyadarshana and Kumari (2020), lecture attendance and time spent outside the university are significant factors when evaluating academic performance. Plecha *et al.* (2002) found that it is significant that diverse peer interaction and student-faculty interaction may play a key role in the development of academic self-confidence in students. Perceptions about the agriculture degree programme can also influence academic performance by impacting student motivation, future plans, and satisfaction.

Hence, the main objective of this research is to identify how the factors including home environment, study habits, learning skills, hardworking ability, academic interaction and perceptions about the agriculture degree programme influence the academic performance of first-year agriculture undergraduates in state universities in Sri Lanka.

METHODOLOGY

The study was mainly based on a quantitative research approach using the survey method.

Conceptual Framework

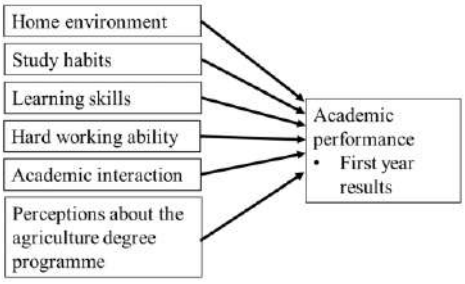

Figure 1. Proposed conceptual framework

Data Collection

A pre-tested structured questionnaire survey was conducted to collect primary data. The selected population for this study was the undergraduates of the 2019/20 batch in the agriculture faculties in state universities in Sri Lanka. Out of the eight universities offering agriculture degree programs, four universities were randomly selected i.e., Rajarata University of Sri Lanka, Sabaragamuwa University of Sri Lanka, University of Peradeniya and Wayamba University of Sri Lanka. Data were collected from a sample of 300 agriculture undergraduates who were selected proportionately across the four selected universities, using simple random sampling.

Measures

The questionnaire consisted of three sections. The first section was about university entry point factors. The next section was about the academic performance measured by the semester-based first-year GPAs of the undergraduates. These sections were developed using multiple-choice questions and dichotomous questions. The third section was developed based on six factors including home environment, study habits, learning skills, hardworking ability, academic interaction, and perceptions about the agriculture degree programme. A total of twenty-eight statements were used to assess those factors, utilising a five-point Likert scale. The scale ranges from 1 to 5, where 1 was denoted "strongly disagree" and 5 was denoted "strongly agree".

Data Analysis

Descriptive statistics were used to analyse the university entry point factors, while Cronbach's alpha reliability coefficient was used to evaluate the reliability of each factor. Confirmatory Factor Analysis (CFA) was employed to evaluate the validity of the measurement model. To examine the proposed model, structural equation modelling (SEM) was used, employing the Analysis of Momentum Structure (AMOS) in SPSS 26 version. The measurement model evaluation was first carried out before conducting the SEM.

RESULTS AND DISCUSSION

Descriptive Statistics

University entry point factors were assessed through descriptive statistics, and the results are mentioned in Table 1.

Table 1. Descriptive statistics of university entry point factors

Parameter	Category	Percentage (%)
District-based for university selection	Advantaged	73.3
	Disadvantaged	26.7
University selected A/L attempt	1	29.3
	2	41.3
	3	29.3
District of the school attended for A/L	Advantaged	75
	Disadvantaged	25
English qualification in the O/L exam	A	40.7
	B	27.7
	C	30.7
	S	1.0
	W	-
English qualification in the A/L exam	A	19.0
	B	23.3
	C	31.7
	S	23.0
	W	3.0
Expected faculty to enter after A/L exam	Medicine	35.7
	Dental	5.3
	Veterinary	2.3
	Agriculture	36.7
	Any other	20.0
Happiness to enter into the Faculty of Agriculture	Happy	86.7
	Not happy	13.3
Father's education	Up to post graduate	3.3
	Up to graduate	13.3
	Up to A/L	57.0
	Up to O/L	22.7
	Grade 5	3.7
Mother's education	Up to post graduate	3.3
	Up to graduate	11.7
	Up to A/L	66.0
	Up to O/L	17.3
	Grade 5	1.7

Reliability Statistics

Cronbach' alpha was employed to assess internal consistency, with a threshold of 0.7 indicating acceptability (Hair *et al*., 1998). All factors exhibited internal consistency above this threshold, signifying acceptable consistency within their indicators (Table 2).

Table 2. Cronbach's alpha values

Factors	Cronbach's alpha
Home environment	0.866
Study habits	0.821
Learning skills	0.708
Hard-working ability	0.703
Academic interaction	0.889
Perceptions about the agriculture degree programme	0.860

Exploratory Factor Analysis (EFA)

The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.865 (>0.60), which was above the acceptable level.

The *p*-values of Bartlett's test of sphericity were less than 0.05, suggesting that factor analysis is appropriate for the data.

Confirmatory Factor Analysis (CFA)

The model used 28 indicators, all of which exhibited sufficient fit with high factor loadings (greater than 0.05) and significance (at p=0.05). Table 3 presents the estimated results, indicating that all standardised estimates are statistically significant.

Table 3. Results of the confirmatory factor analysis

Construct	Estimate	*p*-value
Home Environment (HE)		
HE1	0.817	***
HE2	0.723	***
HE3	0.873	***
HE4	0.763	***
Study Habits (SH)		
SH1	0.690	***
SH2	0.834	***
SH3	0.735	***
SH4	0.551	***
SH5	0.673	***
Learning Skills (LS)		
LS1	0.604	***
LS2	0.567	***
LS3	0.625	***
LS4	0.667	***
Hard Working Ability (HWA)		
HWA1	0.534	***
HWA2	0.795	***
HWA3	0.656	***
Academic Interaction (AI)		
AI1	0.659	***
AI2	0.704	***
AI3	0.875	***
AI4	0.633	***
AI5	0.839	***
AI6	0.845	***
Perceptions about the Agriculture Degree Programme (PADP)		
PADP1	0.628	***
PADP2	0.747	***
PADP3	0.760	***
PADP4	0.670	***
PADP5	0.769	***
PADP6	0.724	***

*Levels of statistical significance, ***P<0.001*

Findings revealed that the family encouragement indicator (HE3) has the highest factor loading (0.873) for the home environment factor. Strictly following a scheduled time plan for studies (SH2) has the highest factor loading (0.834) for the study habits factor. LS4 has the highest factor

loading (0.667) for the learning skills factor, indicating the ability to write in exams to express real meaning. HWA2 has the highest factor loading (0.795) for the hard-working ability factor, indicating that spending at least 5 hours a day on subject matter learning outside of classroom participation is significant. AI3 has the highest factor loading (0.875) for the academic interaction factor, indicating that academic staff being closer to students is important. The PADP5 indicator has the highest factor loading (0.769) for perceptions about the agriculture degree programme, indicating the belief in becoming a financially stable person with the job received after graduation.

Table 4 illustrates the fit indices of the measurement model, which showed good model fit as the data fell within the recommended values.

Table 4. Model fit indices of the measurement model

Indices	Recommended value	Attained value
Chi-square		791.018
df		384
p-value	>0.05	0.000
CMIN/DF	<3	2.060
RMSEA	<0.08	0.060
CFI	>0.9	0.900
IFI	>0.9	0.901

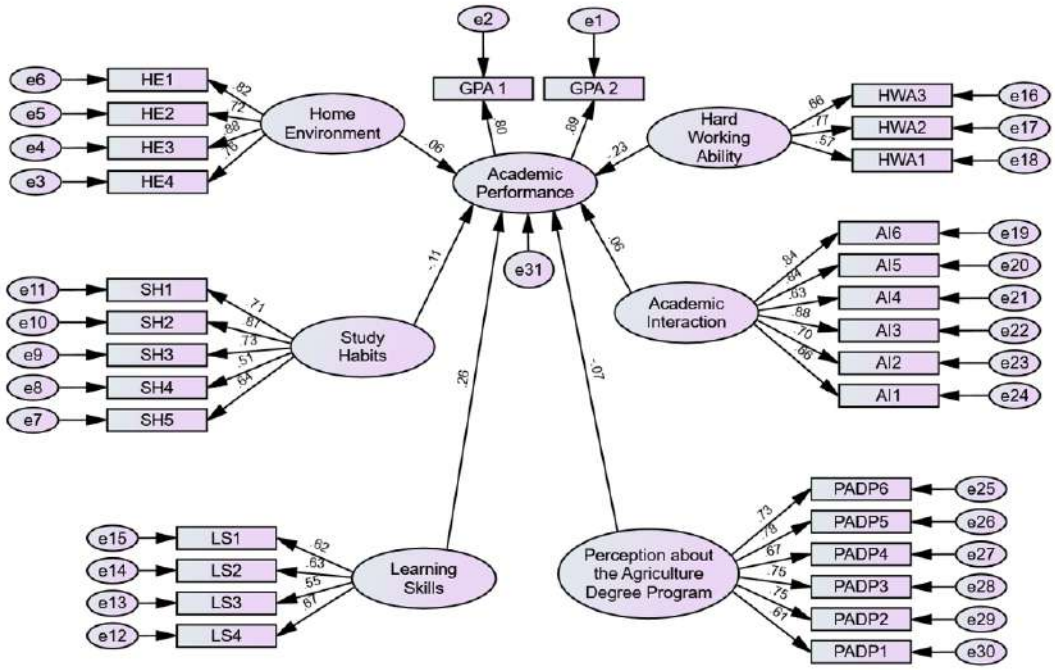

Figure 2. Structured relationship between academic performance and factor

Structured Equation Model (SEM)

SEM was used to test the hypothesised model (Figure 2). Standardised regression weight analysis shows that (Table 5) the academic performance of first-year agriculture undergraduates in state universities in Sri Lanka is significantly and positively influenced by learning skills. The factor of learning skills represents, having positive attitude to learn new things in relation to studies (LS1), having high presentation skills (LS2), reading extra material for all the courses (LS3), and writing ability in exams to express real meaning is high (LS4). Home environment, study habits, hard-working ability, academic interaction, and perceptions about the agriculture degree programme did not significantly impact academic performance.

Table 5. Standardized regression weights

Relationship	Estimate	*p*-value
Academic performance <--- Home environment	0.034	0.371
Academic performance <--- Study habits	-0.062	0.094
Academic performance <--- Learning skills	0.191	***
Academic performance <--- Hard working ability	-0.158	0.002
Academic performance <--- Academic interaction	0.034	0.304
Academic performance Perception about the Agriculture Degree Program	-0.043	0.265

*Levels of statistical significance, **P<0.01, ***P<0.001*

Therefore, it can be concluded that Sri Lankan first-year agriculture undergraduates' academic performance is primarily driven by their learning skills, with other factors like home environment, study habits, hard-working ability, academic interaction, and perceptions about the agriculture degree programme having no significant impact.

CONCLUSIONS

The study revealed that the academic performance of first-year agriculture undergraduates in Sri Lankan state universities is mainly influenced by their learning skills, while other factors such as home environment, study habits, hard-working ability, academic interaction, and perceptions of the agriculture degree programme do not significantly impact their performance.

According to the results, improving learning skills positively impacts the academic performance of agriculture undergraduates; hence, having a positive attitude towards new things in relation to studies, high presentation skills, reading extra materials for courses, and writing ability in exams to express real meaning should be improved.

These findings would be useful for first-year undergraduates, university academics, policymakers, and parents to identify the factors that should be developed and improved to enhance the academic performance of students**.**

The study was done only considering first-year undergraduates; hence, further studies are required to enhance the academic performance of all other-year undergraduates as well.

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Value Chain Analysis of Palmyrah (*Borassus flabellifer*) Sap Based Products in Jaffna District, Sri Lanka

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ABSTRACT

The Asian Palmyrah (*Borassus flabellifer*) is vital in Sri Lankan northern regions. With its numerous uses and adaptability, the palmyrah offers exciting possibilities for industry development. Its potential mirrors the success story of the coconut industry. However, limited studies have focused on discussing the unique value-addition opportunities in the palmyrah sap-based productions in the Jaffna District. Thus, the primary objective of this study is to identify and map the actors in the value chain for the fermented products of toddy, bottled toddy, and palmyrah arrack. Also, the non-fermented product of jaggery. Furthermore, profitability was analyzed by calculating each level's value addition and gross profit margin percentages. Further SWOT analysis was done for this industry. In total, 62 actors were drawn purposively, and pre-tested semi-structured questionnaire was used to collect the necessary primary data from each actor. The study concluded that tappers obtained high gross profit margins of around 95.5% because their tapping costs were low and spread out over the entire season. All exporters gained higher gross profit margins (bottled toddy 42.86%, palmyrah arrack 20.8%, jaggery 32.84%) than their processors (bottled toddy 39.75%, palmyrah arrack 4.47%, jaggery around 25.94%). However, retailers enjoyed a high gross profit margin of 41.41% in the jaggery industry. The future of the palmyrah sap-based industry is at risk due to the challenging nature and social status of the tapper profession, deterring the younger generation from entering the field.

KEYWORDS: Jaffna, Palmyrah sap-based industry, Value addition, Value chain

INTRODUCTION

Deeply rooted in Sri Lankan tradition, the palmyrah (*Borassus flabellifer*) thrives in the Northern region (Nareshkumar *et al*., 2019). It is a wonder tree that provides a variety of products based on sap-based, pulp-based, tuber-based, leaf-based, fiber-based, and timber-based products. It is known as "*Karpaha Veruksham*" because all its parts are economically important as raw materials for various industries. Palmyrah is a remarkable but not fully utilized natural resource in Sri Lanka's Northern Province. Expanding the palmyrah industry may significantly benefit the province's economy. Products made from palmyrah are mainly produced using traditional techniques. Due to the long war situation in northern Sri Lanka, the palmyrah industry was highly affected. However, the industry is bouncing back (Jayatissa *et al*., 2017).

According to Smart (2019), the significant decline in the number of palmyrah trees, from an estimated 11 million to a current range of eight to nine million, suggests that the sector is not growing. Further evidence of stagnation lies in the low tapping rate, with only about 5% of trees currently utilized. This 95% untapped potential highlights a substantial opportunity to increase the commercial use of palmyrah trees and boost production. However, sap-based products derived from palmyrah, such as jaggery, toddy, bottled toddy, and palmyrah arrack, are declining due to a significant decrease in the number of tappers who harvest the sap. This decline significantly challenges the livelihoods of individuals and communities dependent on the palmyrah value chain.

Insufficient linkages between tappers and processing units, the low social status associated with tapping jobs, the scattered nature of actors within the supply chain, and the lack of cost estimation records contribute to the industry's decline (Shaliny, 2013). These interconnected issues threaten the sustainability of the palmyrah sap-based industry in the Jaffna district, adversely affecting the livelihoods of tappers, processors, and other stakeholders involved in the value chain.

Value chain analysis is a critical tool for understanding the palmyra industry and identifying potential areas for improvement. It maps the production, processing, and distribution stages, highlighting the added value at each stage and identifying bottlenecks and inefficiencies (Trienekens, 2011). Previous studies have investigated palmyrah products within the broader context of Sri Lanka. However, those studies have not examined the unique characteristics and significance of sap-

based products in Jaffna in detail. This study aims to identify and map the actors involved in the value chain of sap-based products, calculate the value added, and determine the gross profit margins for each actor within the chain. Additionally, the study explores the potential and constraints of the industry.

METHODOLOGY

Selection of the Study Area

This study concentrated in the Jaffna district in Sri Lanka, which is known for its abundant palmyrah trees and significant sap production industry (Smart, 2019).

The study was conducted using mixed methods, which included both qualitative and quantitative data. It followed a process consisting of five main steps: identifying sectors of palmyrah sap-based products in Jaffna, identifying key actors and the supply chain within these sectors, collecting primary data from these actors, mapping the value chain, and computation of value additions (VA) and gross profit margins (GPM).

Sample Selection and Data Collection

The study used purposive sampling to identify sectors of palmyrah sap-based products in the Jaffna district. A total of 62 actors were purposively selected. For fermented products, such as toddy, bottled toddy, and palmyrah arrack, the distribution included tappers (n=16), processors of toddy and bottled toddy (n=4), bottled toddy exporters (n=1), distillery processors (n=2), agents (n=2), sellers (n=3), and arrack exporter (n=1). In the non-fermented product of jaggery, tappers (n=11), processors (n=6) (Comprising two from Palm Development Co-operative Society – PDCS and four from Palmyrah Development Board – PDB), agents (n=3), Multi-Trade Centre (n=1), the seller from the Multi-Purpose Co-operative Society – MPCS (n=1), wholesalers (n=3), retailers (n=3), processors from a private company (n=2) and exporter from a private company (n=1). Additionally, key informants (n=2), one from PDCS and the other from PDB.

Pre-tested semi-structured questionnaire was utilized to collect necessary information from each actor within the value chain.

Data Analysis

Computations were made to examine the amounts of value additions and gross profit margin percentages at each stage of the value chain. A SWOT analysis helped to identify the value chain's gaps and improvement points.

The amount of VA was measured using the equation 1.

$$VA = Selling\ Price\ of\ Unit - Unit\ Cost \ldots\ldots (1)$$

The unit for fermented sap, toddy, and arrack is one bottle, equivalent to 750 ml, whereas, for bottled toddy, one bottle equals 625 ml. For non-fermented sap and treacle, one bottle is also 750 ml; for jaggery, the unit measurement is 1 kg.

The GPM percentage of each actor along the chain was computed using Equation 2.

$$GPM\% = \frac{TR - TVC}{TR} \times 100 \ldots\ldots (2)$$

TR is the total revenue (Rs/Unit), and TVC is the total variable cost (Rs/Unit).

RESULTS AND DISCUSSION

Value Chain Map

Figure 1 illustrates the value chain map for fermented sap-based products. Sandy, well-drained soil, seeds, and dry conditions were the primary inputs. Typically, tappers did not own the palmyrah trees they tapped; instead, they accessed trees owned by landowners, who charged them an annual rental fee.

Tappers visited each tree twice daily, in the morning and evening, to collect the accumulated sap. A healthy palmyrah tree produced, on average, between five to six liters of sap per day. On average, a tapper collected approximately 32.25 liters of sap daily from six trees. Membership in the local society was mandatory for each tapper because the palmyrah sap was perishable and needed to be transported quickly to the society's processing facilities. The PDCS was responsible for purchasing the fermented sap.

Tappers were not allowed to sell the fermented sap directly; hence, they had to hand over all the fermented sap they collected to PDCS. The natural fermentation of toddy was an uncontrolled process involving various microorganisms. Initially, just after being collected from the tree, the toddy contained an alcohol percentage of one to two. This percentage could increase up to four percent over time. Taverns, managed by the PDCS, served as the outlets for selling toddy directly to consumers. A portion of the toddy was allocated for producing bottled toddy, which taverns sold during the off-season. The sap collection season lasted from February to July. After bottling and selling toddy through taverns, any surplus toddy was sent to distillery processors for the production of palmyrah arrack.

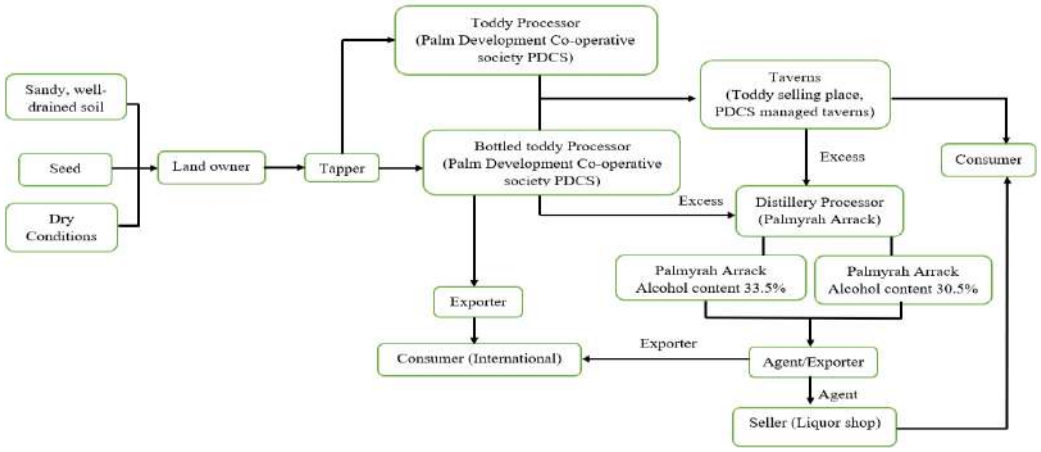

Figure 1. Value chain map for Toddy, Bottled Toddy and Palmyrah Arrack

The distillery processors created palmyrah arrack with alcohol content levels of 33.5% and 30.5% through further distillation. The distillery processors bought excess toddy from the PDCSs based on its alcohol content without having a direct link with the tappers. When the inventory was ready for sale, the distillery processor connected with an agent. The agent facilitated the sale of arrack to liquor stores and also exported palmyrah arrack to international markets, specifically to the United Kingdom (UK) and Australia. Some private companies exported bottled toddy with the help of PDCSs. Their exports were primarily directed to France, Canada, and Dubai.

Figure 2 illustrates the value chain for the production of a non-fermented sap-based product of jaggery. The relationships among inputs, landowners, and tappers aligned with those observed in the fermented products' value chain. However, in this scenario, tappers utilized lime in the collection pots to prevent the fermentation of sap. Given this context, there were no restrictions on selling sap due to its non-fermented and alcohol-free nature. Consequently, tappers also produced jaggery as a cottage industry, which became well-known in the *Thellipalai* area of Jaffna. PDCS and PDB purchased non-fermented sap from tappers and processed it into jaggery on a large scale. From 10 liters of sap, they produced jaggery blocks weighing between 900-950 g. PDCSs produced a significant amount of jaggery. PDB also bought jaggery from PDCSs and utilized it for its sales process. Most of the jaggery produced by PDCS was distributed to its sales outlets (Palm City) and MPCS. PDB had its own sales outlets, known as *katpaham*. Currently, there are two *katpahams* in Jaffna.

Private companies also produced jaggery by purchasing sap from tappers. They sold it through their own sales outlets. These companies were critical actors in exporting jaggery, utilizing both their produce and purchases from PDCS and PDB for this purpose. Their main export markets included Australia, France, Germany, the UK, and Canada. Agents purchased treacle from tappers. Treacle served as an intermediate product in the jaggery production process. They sold to Multi-trade centers, wholesalers, and retailers, who in turn sold directly to consumers.

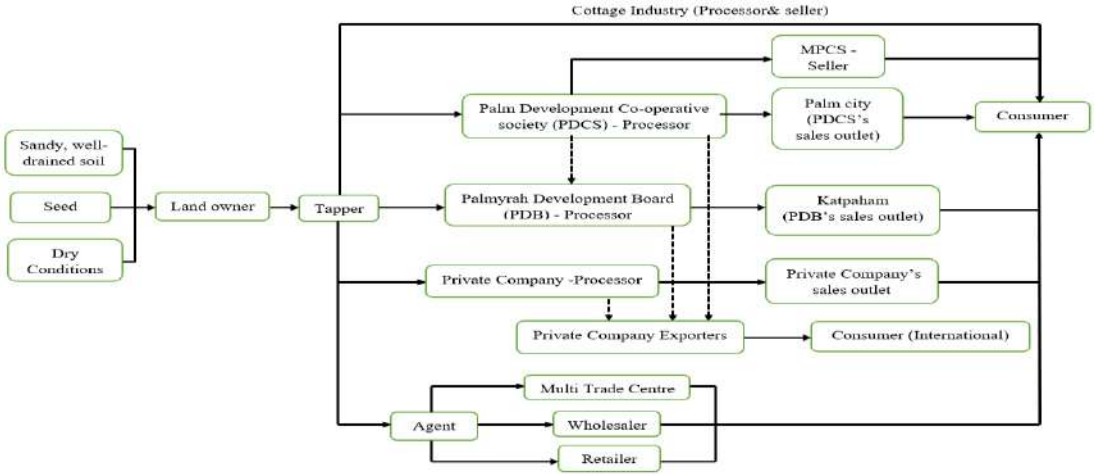

Figure 2. Value chain map for Jaggery

Value additions and profitability

Table 1 compares the different amounts of Average Value Addition (AVA) and Average Gross Profit Margin percentages (AGPM) achieved by various actors in the value chain of toddy, bottled toddy, and palmyrah arrack.

Table 1. Value additions and gross profit margin percentages

Actor	AVA	AGPM
Tapper	102.79	95.62
Toddy Processor	22.91	11.45
Bottled toddy Processor	79.5	39.75
Bottled toddy Exporter	900	42.86
DIS Pro (33.5% PA)	118.72	4.47
Agent (33.5% PA)	21.87	0.78
Seller (LS- 33.5% PA)	132.98	3.67
DIS Pro (30.5% PA)	120	4.96
Agent (30.5% PA)	25.5	0.98
Seller (LS- 30.5% PA)	102.4	3.1
Exporter (33.5% PA)	1091.95	20.8

DIS Pro: Distillery Processor, PA: Palmyrah Arrack, LS: Liquor shop.

Tappers added an average value of Rs. 102.79 to each 750 ml of fresh toddy and obtained 95.62% of the average gross profit margin. The primary expenses for tappers were the rent paid to landowners and the cost of equipment. These costs were spread out over the entire season, resulting in a reduced cost per unit. Toddy processors added Rs. 22.91 AVA and gained 11.45% AGPM, while bottled toddy processors added Rs. 79.5 AVA and gained 39.75% AGPM. They provided value by offering quality toddy and services even during the off-season.

For 33.5% palmyrah arrack, distillery processors added Rs. 118.72 AVA and gained 4.47% AGPM. For 30.5%, they added Rs. 120 AVA and gained 4.96% AGPM. Distillery processors enhance the value of their spirits through the continuous distillation process.

Exporters of bottled toddy added approximately Rs. 900 AVA, resulting in a 42.86% AGPM. In comparison, exporters of palmyrah arrack (33.5%) added approximately Rs. 1091.95 AVA, resulting in a 20.8% AGPM. They added value by paving the way and providing natural toddy and palm arrack to international markets. Agents handling palmyrah arrack (33.5%) added Rs. 21.87 AVA and achieved a 0.78% AGPM, whereas palmyrah arrack (30.5%) added Rs. 25.5 AVA and achieved a 0.98% AGPM. These were relatively low AGPM percentages. Despite this, they manage approximately 30,000 bottles per month. They added value by ensuring the bottles were transported safely to liquor stores and the necessary approvals were obtained swiftly. Liquor shop sellers handling palmyrah arrack (33.5%) added Rs. 132.98 AVA and achieved a 3.67% AGPM, while those selling palmyrah arrack (30.5%) added Rs. 102.4 AVA and achieved a 3.1% AGPM. They enhanced their services significantly by focusing on continuous distribution to their target consumers.

Table 2 compares the different amounts of AVA and AGPM percentages performed by various actors in the jaggery value chain.

Table 2. Value additions and gross profit margin percentages

Actor	AVA	AGPM
Tapper 1	970	34.64
Tapper 2	124.11	95.47
Tapper 3	124.07	95.44
Tapper 4	400	40
PDCS Processor	410	18.22
PDB Processor	676.22	28.18
Agent	55	8.26
MPCS - Seller	160	9.3
Multi-Trade Center	200	20
Wholesaler	200	18
Retailer	644	41.41
PC Processor	880	31.43
PC Exporters	2121.85	32.84

Tapper 1: Cottage Industry, Tapper 2: Supplying sap to PDCS, Tapper 3: Supplying sap to PDB, Tapper 4: Supplying treacle to agent, PC: Private Company.

Cottage industry tappers added Rs. 970 AVA to 1kg of jaggery and obtained 34.64% of the AGPM. The jaggery produced in cottage industries is distinctive because it uses sap from a single palmyra tree, unlike larger-scale jaggery manufacturers who mix sap from different trees. Tappers who supply non-fermented sap to the PDCS added Rs. 124.11 AVA and gained 95.47% AGPM for 750ml of sap. Similarly, tappers supplying to the PDB added Rs. 124.07 AVA and an AGPM of 95.44%. It is important to note that both the PDCS and PDB purchased sap at the same price as the tappers.

In another distribution channel, tappers sold treacle to agents. They added Rs. 400 AVA and 40% AGPM for 750 ml of treacle. The value addition comes from heating the sap to create an intermediate form of treacle, which is then safely bottled for distribution. This method yields a higher AGPM compared to the cottage industry approach. The PDCS processor added Rs. 410 AVA and gained 18.22% AGPM, while the PDB processor added Rs. 676.22 AVA and gained 28.18% AGPM for 1kg of jaggery. The value was enhanced through the production of high-quality jaggery and proper packaging and

labeling. Agents added Rs. 55 AVA and 8.26% AGPM for 1 kg of jaggery. Agents added sugar and flour into the mixture, extending the product's shelf life and increasing its quantity. It is primarily available in the local market.

MPCS sellers added Rs. 160 AVA and 9.3% AGPM, while multi-trade centers added Rs. 200 AVA and 20% AGPM. Both added value by further labeling and packaging, and multi-trade centers provided a superior shopping environment to their customers. Retailers achieved a high AGPM of 41.41% by adding Rs. 644 AVA, while wholesalers added Rs. 200 AVA and 18% AGPM. They created added value through packaging, labeling, and selling the jaggery in the public market.

A private company processor added Rs. 880 AVA and achieved a higher AGPM of 31.43% compared to the PDB. They enhanced value through the production of high-quality jaggery and by improving customers' shopping experiences through their sales outlets. Private company exporters achieved a higher AVA of Rs. 2121.85 and an AGPM of 32.84%. They enhanced value by introducing quality sealed bottled jaggery to international markets.

SWOT Analysis

Jaffna boasted a deep-rooted tradition of extracting and processing palmyrah sap, providing a solid foundation for the industry. Its cultural significance ensured steady local demand. In Jaffna, the toddy's image is negative, with potential consumers preferring it in restaurants and liquor stores rather than the taverns, and language barriers exist for tourists and Sinhalese.

The sap-based products garnered interest from tourists and demand in foreign markets. Solid brand identities should have been developed for these palmyrah sap products, emphasizing their uniqueness, cultural significance, and potential health benefits. Exporters at Ceylon distilleries might have considered palmyrah arrack as a possible export product. Concentrating solely on local markets and the absence of established channels for broader distribution could have hindered the industry's growth and profitability. Tappers reported that their profession carried inherent risks, and the smell of toddy on their person often led to social ostracization. This stigma made the younger generation hesitant to pursue toddy tapping as a career, putting the sustainability of this traditional industry at risk.

CONCLUSIONS

The analyzed data implies that tappers obtain high AGPM percentages, but their AVA is shallow. Compared to other tappers, tappers who supply treacle to agents have a high AVA. All exporters typically enjoyed higher AVA than other actors in the value chain. Bottled toddy exporters gained a higher AGPM than the processor and arrack exporters. Thus, we can conclude that all exporters gained higher AGPM than their processors. Compared to jaggery exporters, cottage industry tappers enjoyed higher AGPM. However, retailers enjoyed a higher AGPM in the jaggery industry.

The backbone of the palmyrah sap-based industry is its tappers. However, these skilled workers face significant challenges during the collection process, which not only makes the profession challenging but also socially unappealing. If the younger generation is unwilling to take up this critical role, the industry's future will be uncertain.

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Exploring the Non-Market Value of Hikkaduwa Coral Reef: A Contingent Valuation Study of Option, Bequest, and Existence Values

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ABSTRACT

The Hikkaduwa Coral Reef, a critical biodiversity hotspot, necessitates dedicated conservation efforts due to its immense ecological and non-market values. This study employed the contingent valuation method to quantify the non-use values of the reef, focusing specifically on option, bequest, and existence values. Data were collected from 370 visitors at Hikkaduwa Marine National Park through surveys, ensuring informed responses regarding their willingness to pay (WTP) for its conservation. The analysis revealed that visitors were willing to pay an average of Rs. 5,569.10 beyond the base payment of Rs. 4,500 to conserve the reef's non-economic values. Tobit regression analysis further identified that option value and existence value are more significant predictors of WTP than bequest value. These findings highlight the critical role of non-market values in justifying and guiding sustainable management practices for coral reef ecosystems. By elucidating the hidden economic significance of the Hikkaduwa Coral Reef's non-use values, this research helps to understand its total economic value. This supports the formulation of robust conservation policies aimed at ensuring the reef's long-term survival and benefiting future generations.

KEYWORDS: Contingent Valuation Method, Environmental Economics, Hikkaduwa Coral Reef, Non-use Values, Willingness-to-pay (WTP)

INTRODUCTION

Marine National Park Hikkaduwa (MNPH) in Sri Lanka, established in 2002 under the Fauna and Flora Protection Ordinance, conserves a biodiverse fringing coral reef along the southern coast. Covering 101.58 hectares, MNPH is one of three National Marine Parks in Sri Lanka, renowned for its rich marine ecosystem (Ministry of Wildlife and Forest Resources Conservation, 2023). These shallow reefs attract both local and foreign tourists, significantly contributing to national income through boat service revenues, making it a major tourist destination on the southern coast. The importance of marine biodiversity extends beyond ecological benefits to include significant economic contributions. The local tourist industry, Sri Lanka's third-largest source of foreign revenue, has grown annually by 22% over the past four years (Sri Lanka Tourism Development Authority, 2019). Coral reefs, as indispensable ecosystems, provide a wide array of ecological services, from supporting marine biodiversity to offering coastal protection (Cesar *et al.,* 2003).

Despite their significance, coral reefs face numerous challenges. At MNPH, coral bleaching and inadequate facilities have led to a decline in visitation (Jayaratne *et al*., 2022). Current research on coral reef conservation often focuses on their use values, primarily through cultural services like recreation and provisioning services like fisheries, neglecting the crucial non-use values.

Non-use values, including option (preserving the possibility of future use), bequest (leaving the reef for future generations), and existence values (the inherent satisfaction of knowing the reef exists), represent the intrinsic worth of coral reefs even when not directly utilized. Although less explored, these values are essential for a comprehensive understanding of coral reefs' economic importance (Barbier *et al*., 2014).

Traditionally, the economic valuation of coral reefs focused on use values like recreation and tourism (Cesar *et al.,* 2003). However, recent studies highlight the necessity of investigating non-use values, encompassing option, bequest, and existence values (Barbier *et al.,* 2014). These non-use values are essential for understanding the full economic significance of coral reefs. Although several valuation studies have been conducted on coral habitats in Sri Lanka, there is a research gap in understanding the non-use values of the Hikkaduwa Coral Reef. Addressing this gap is crucial, as this area holds great significance for the Sri Lankan economy, both as a source of tourism revenue and for its broader ecological importance.

This research filled this gap by employing the Contingent Valuation Method (CVM) to quantify the WTP for the non-use values held by visitors. By revealing the hidden economic significance of the Hikkaduwa Coral Reef, this study contributes to stronger conservation efforts and sustainable management practices,

ensuring its long-term survival for future generations.

METHODOLOGY

Contingent Valuation Method (CVM)

Non-use values, which cannot be measured directly through market information, pose a challenge in economic valuation. To estimate these values, such as those associated with conservation efforts, methods like the CVM are employed. CVM utilizes surveys to gauge individuals' WTP for specific conservation scenarios, providing insights into their non-use values. Studies like those by van Beukering *et al*. (2007) and White *et al*. (2009) successfully applied CVM to estimate non-use values for coral reefs in different regions, demonstrating its potential for the Hikkaduwa reef. CVM stands out as a powerful tool for capturing the non-use values of environmental goods, allowing researchers to understand the preferences and values held by visitors (Mitchell and Carson, 1989). CVM involves presenting respondents with hypothetical statements about WTP for the non-use values associated with MNPH.

The survey included eight statements regarding the meanings and importance of these non-use values: (1) "Preserving coral reefs offers potential benefits or resources for the future"; (2) "Coral reef conservation promises valuable future discoveries or resources"; (3) "Protecting coral reefs represents future opportunities for scientific or economic benefits"; (4) "Coral reefs are a precious natural heritage to be passed on to future generations"; (5) "Protecting coral reefs is essential for the sake of future generations, so they can experience and benefit from these ecosystems as we do today"; (6) "Coral reefs hold intrinsic value as part of Earth's biodiversity for future generation"; (7) "Coral reefs hold value simply by existing, contributing to our country's beauty and diversity", and (8) "Coral reefs' existence is fundamental to maintaining the balance and health of marine ecosystems". These statements are categorized as follows: statements 1, 2, and 3 indicate option value; statements 4, 5, and 6 represent bequest value; and statements 7 and 8 represent existence value.

Estimating the WTP for Non-Use Values

The ticket price for observing the coral reefs via a glass-bottom boat at MNPH is Rs. 4500 per ticket. To estimate the mean WTP for conservation efforts of non-use values, visitors were first asked whether they would be willing to contribute any additional amount if that additional amount were to be used to protect non-use values. Respondents who agreed were then prompted to select their maximum WTP from a set of 11 options, starting from Rs. 4725 (a 5% increment from the base price of Rs. 4500) and increasing up to Rs. 9000 (a 100% increment), with each option reflecting a 5% increase from the base price. The data collected from a sample size of 370 respondents were then used to calculate the mean WTP, ensuring that the estimates reflect visitors' actual economic value placed on conserving non-use values at MNPH. By incorporating a broad range of increment options, the survey aims to capture a comprehensive view of visitors' WTP, thereby providing valuable insights into the economic support for conservation efforts beyond direct recreational use.

Estimating the Marginal Implicit Prices of Option, Bequest, and Existence Values

First, a factor analysis was conducted to identify underlying relationships among the statements provided to respondents representing the three non-use values under consideration. The resultant factors were then examined and factor scores were predicted, which were then used as the variables representing the respondents' perception on option, bequest and existence values in the subsequent analysis. Given the bounded nature of WTP responses (ranging from Rs. 4,500 to Rs. 9,000), the Tobit model was employed to accommodate this censored nature of the dependent variable in the analysis. The Tobit regression model used was as follows:

$$WTP_i = \beta_0 + \sum_{j=2}^{3} \beta_j D_{ji}^{Inc} + \sum_{k=2}^{2} \beta_k D_{ki}^{Edu} + \beta_A Age_i + \beta_G Gender_i + \beta_{Fs} FS_i + \beta_{AW} Awareness_i + \beta_v Visits_i + \sum_{l=2}^{4} \beta_l D_{li}^{Cons} + \alpha_1 Option_i + \alpha_2 Bequest_i + \alpha_3 Existence_i + \varepsilon$$

Where,

WTP_i is chosen WTP value by ith visitor, β is regression coefficients, D_{ji}^{Inc} is dummy variable representing monthly family income category of ith visitor, D_{ki}^{Edu} is dummy variable representing highest education level of the ith visitor, Age is the age of the ith visitor, Gender is the gender of the ith visitor, FS is number of family members of ith visitor, $Awareness_i$ is dummy variable representing awareness of other coral reefs that can be visited instead of Hikkaduwa Coral Reef, $Visits_i$ is number of previous visits of the ith visitor, D_{li}^{Cons} is dummy variable representing ith visitor's concern about the future of MNPH, $Option_i$, $Bequest_i$, $Existence_i$, α_1, α_2 and α_3 are marginal implicit prices of option, bequest and existence values, and ε is the disturbance term.

Collection of Data

Data were collected from 370 visitors who had directly experienced the Hikkaduwa Coral Reef through glass-bottom boat tours at the MNPH. The data collection involved face-to-face interviews using a standard questionnaire conducted between mid-February and late March 2024. Visitors, selected randomly, were invited to participate voluntarily in a survey aimed at assessing their WTP for the coral reef's non-use values. Prior to data collection, a meaningful conversation was held with the wildlife officer at MNPH to understand the current ticket pricing mechanism and how the revenue is distributed among different groups.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1 presents the socio-demographic characteristics of the sampled visitors. The majority were females (52%), with the largest age group being 21-30 years old (37%). Income categories Rs. 101,000 - 150,000 and Rs. 201,000 - 250,000 each had 19.7% of respondents, the highest among all. Half of the respondents had attained higher education (51%), and most had families comprising 3 to 5 members.

Table 1.Socio-demographic characteristics of the visitors

Variable	Visitors	Percentage (%)
Gender		
Male	177	47.8
Female	193	52.2
Age (years)		
≤ 20	20	5.4
21-30	137	37.0
31-40	127	34.3
41-50	62	16.8
>50	24	6.5
Income (Rs.)		
≤ 50,000	10	2.7
51,000-100,000	38	10.3
101,000-150,000	73	19.7
151,000-200,000	91	24.6
201,000-250,000	73	19.7
251,000-300,000	31	8.4
301,000-350,000	24	6.5
351,000-400,000	14	3.8
401,000-450,000	9	2.4
451,000-500,000	2	0.5
>500,000	5	1.4
Education Level		
Grade 5	1	0.3
O/Ls	18	4.9
A/Ls	161	43.5
Higher Education	190	51.4
Family Size		
< 3	9	2.4
3-5	257	69.5
> 5	104	28.1

According to Figure 1, the majority of visitors were from the Colombo district (23%), followed by Galle (18%) and Kandy (12%) districts.

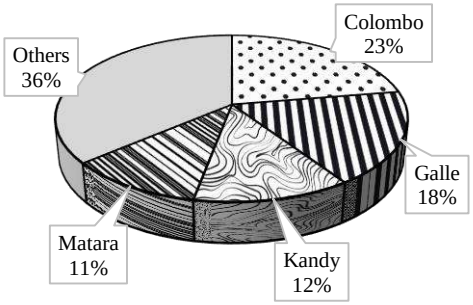

Figure 1. Point of origin of visitors

WTP of Visitors towards Non-Use Values

According to the survey findings, there is a strong willingness among MNPH visitors to contribute financially to conserve the coral reef's non-use values. Out of 370 respondents, 326 visitors (88.1%) expressed willingness to support the preservation of the reef's option, bequest, and existence values. Conversely, only 44 respondents (11.9%) declined such contribution. This overwhelming positive response underscores the high value that visitors place on the long-term conservation and protection of the Hikkaduwa Coral Reef, reflecting its significant non-use value.

Table 2 captures the specific amounts these willing respondents are prepared to pay and shows that the mean WTP is Rs. 5569.10. The standard deviation indicates some variability in the amounts respondents are willing to pay, with the minimum payment option being Rs. 4725 and the maximum being Rs. 8100. This data underscores the visitors' commitment to supporting conservation efforts financially.

Table 2. Summary statistics of WTP

Mean WTP	Standard Deviation	Min	Max
5569.095	747.6872	4725	8100

According to the factor analysis results in Table 3, the eight statements regarding non-use values could be grouped into three distinct factors. Statements with higher factor loadings on a particular factor are more strongly associated with that factor. Therefore, statements 1, 2, and 3 have high loadings on Factor 1 (0.7138, 0.7859, and 0.6528, respectively), indicating a strong relationship with Factor 1. These statements are primarily related to perception on option value.

Statements 4, 5, and 6 have high loadings on Factor 2 (0.6197, 0.6191, and 0.4058, respectively), suggesting a strong association with Factor 2. These statements are primarily related to bequest value. Statements 7 and 8 have high loadings on Factor 3 (0.4464 and 0.4707, respectively), indicating a strong relationship with Factor 3. These statements are primarily related to existence value. Therefore, the predicted factor scores for these three factors were included as option (Factor 1), bequest (Factor 2) and existence (Factor 3) values in the Tobit regression to obtain the marginal willingness to pay (implicit prices).

Table 3. Rotated factor loadings

Variable (Statement)	Factor 1	Factor 2	Factor 3
1	0.7138	0.2013	0.0956
2	0.7859	0.1284	0.1378
3	0.6528	0.2854	0.2270
4	0.2761	0.6197	0.1423
5	0.1961	0.6191	0.0980
6	0.2787	0.4058	0.2950
7	0.2749	0.1957	0.4464
8	0.3519	0.1884	0.4707

The result of the Tobit model is in Table 4. Since the WTP has a lower limit of Rs. 4,500 and an upper limit of Rs. 9,000, the Tobit model was censored from both left and right sides as discussed under methodology. According to the Chi-Square test results, the model was statistically significant with its 326 observations.

The Impact of Perception on Option, Bequest and Existence Values on WTP

The three variables of interest here, the option, bequest and existence show statistical significance, with positive coefficients indicating their importance on WTP. The implicit prices for option, bequest and existence are Rs. 115.66, Rs. 43.61 and Rs. 106.16 respectively. This imply that respondents are willing to pay more to preserve MNPH based on their perception of these non-use values. Specifically, one standard deviation increases in the perception score of the option value, the willingness to pay increases by Rs. 155.66. Out of the three values, consumers, place more emphasis on the option values as its coefficient is higher. That is respondents, value preserving the possibility of future use of the site more. This is further highlighted by the significance of the dummy variables relating to the level of concern that respondents feel regarding the future of the coral reef. For instance, those very concerned about the reef's future are willing to contribute Rs. 663.57 more than those with no concern.

The Impact of Socio-Economic Variables on the WTP

According to the results, income has a positive effect on the WTP as both income dummy variables show positive signs with significance (Togridou *et al.*, 2006). Respondents with medium income (Rs. 200,000-Rs. 400,000) and high income (more than Rs. 400,000) showed significant increases in WTP by Rs. 490.59 and Rs. 1121.52, respectively, compared to those with lower income (< Rs. 200,000). Similar findings have also been observed in previous studies. For instance, Wang and Jia (2012) found that higher income levels positively influenced public perception and attitude towards environmental initiatives. Education up to O/Ls and higher education levels were associated with significant increases in WTP (Rs. 414.29 and Rs. 403.11, respectively) compared to those with education up to grade 5. Previous studies also report similar findings in relation to WTP for ecosystem services and levels of education (Thuy *et al.*, 2012; Mensah and Azhar, 2020). The regression output also highlighted that gender plays a role in the WTP, where, male respondents exhibited a significant increase in WTP by Rs. 90.23 compared to female respondents.

CONCLUSIONS

This research elucidates the significant factors influencing the WTP of visitors for the conservation of the Hikkaduwa Coral Reef's non-use values. Higher income and education levels, along with greater concern for future conditions, emerge as crucial determinants of WTP. Additionally, option and existence values also significantly affect WTP. The analysis indicates that the non-use benefits perceived by visitors far exceed the current boat service fee, suggesting that the present pricing system underestimates the true value of these benefits. Based on the findings, an increment in the boat service fee to Rs. 5500-5600 for local visitors is recommended. The proposed fee increase should be directed solely towards conservation efforts, enhancing the reef's sustainability. Overall, this research highlights the economic significance of the reef's non-use values and provides actionable insights for policymakers to formulate robust conservation strategies, ensuring the long-term survival of the Hikkaduwa Coral Reef for future generations.

Table 4. Tobit Regression

WTP	Coefficients	Robust Standard Error	t statistics	P>[t]
Income2	490.595	81.264	6.04	0.000
Income3	1121.521	217.481	5.16	0.000
Awareness	79.148	52.731	1.50	0.134
Visits	92.235	58.103	1.59	0.113
Concern2	137.637	130.916	1.05	0.294
Concern3	509.689	111.066	4.59	0.000
Concern4	663.568	192.587	3.45	0.001
Option Value	115.663	46.291	2.50	0.013
Bequest Value	43.606	23.809	1.83	0.068
Existence Value	106.164	33.219	3.20	0.002
Education2	414.286	181.285	2.29	0.023
Education3	294.923	170.911	1.73	0.085
Education4	403.108	152.990	2.63	0.009
Age	-23.168	46.076	-0.50	0.615
Male	90.227	34.517	2.61	0.009
FS	63.044	92.496	0.68	0.496
Constant	4172.573	245.756	16.98	0.000

Income2-Medium Income (Rs.200,000-Rs.400,000), Income3-High Income (>Rs.400,000), Concern2- Somewhat Concern, Concern3-Moderately Concern, Concern4-Very Concern, Education2-O/Ls, Education3-A/Ls, Education4- Higher Education.
Model Statistics:
Log pseudolikelihood: -2536.6496, F(16, 311) = 1325.84, Pseudo R2 = 0.0315
lower limit = Rs. 4,500, upper limit = Rs. 9,000
Standard Error adjusted for 20 clusters in district

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Evaluation of the Perceived Climate-Related Risk and Driving Factors for Adoption of Climate Smart Agricultural Practices among Farmers in the Kurunegala District in Sri Lanka

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ABSTRACT

Climate change is a significant challenge faced by the agriculture sector. In Sri Lanka, Kurunegala district has been recognized as one of the most climate-vulnerable areas, especially for droughts. Therefore, this study aimed to evaluate the perceived climate-related risk, along with the driving factors that influence adoption of Climate Smart Agricultural (CSA) practices of farmers in Kurunegala district. A total of 250 farmers in Kurunegala, were recruited as the study sample, using the stratified random sampling approach. A pre-tested interviewer-administered questionnaire was used for primary data collection. The Climate-related Risk Perception Index (CRRPI) was developed to assess the farmers' perceived risk, while the Binary Logistic Regression (BLR) was used to determine the driving factors behind the adoption of CSA practices. The results showed that droughts (CRRPI=79.2), increased incidence of pests and diseases (CRRPI=74.3) and floods (CRRPI=54.6) were the most prominent climate-related hazards faced by the studied population. Cultivation of high-yielding crop varieties (17.4%), integrated pest management (17%), membership in farmer organizations and use of micro-finance facilities (16.7%) remained as the mostly adopted CSA practices among the respondents. According to the BLR, income level, crop type, farm size, farming experience, attitudes toward CSA and knowledge of farmers on CSA were identified as the significant driving factors ($p<0.05$) for the adoption of CSA practices. Therefore, elevating the awareness and attitudes of farmers on CSA and capacity building through training can be recommended as essential strategies to promote CSA among the farmers.

KEYWORDS: Climate change, Climate-related risk, Climate smart agriculture, Driving factors, Kurunegala

INTRODUCTION

Climate Change (CC) is a significant long-term change in the expected patterns of average weather over a considering region, observed throughout an extended period of time (IPCC, 2007). At present, CC has been recognized as the most challenging issue faced by many sectors including agriculture, water, health, and tourism, etc. at the global level. The increase in greenhouse gas emissions leading to human-induced greenhouse effect remains as the prime reason behind CC. Significant detrimental impacts of CC have caused unpredictability in human health, food security, economic activity, natural resources, and physical infrastructure, posing a serious threat to lives and livelihoods, especially among world's poorest and most vulnerable populations (IPCC, 2007).

Climate change is the most serious natural hazard that negatively affects the agricultural production. At present, the overall impact of CC on the global scale agricultural productivity has not been accurately estimated (Gornall *et al*., 2010). However, numerous studies have predicted that most profound and direct impacts of CC over the next few decades will be experienced by agricultural and food systems (Hertel, 2016). Increased seasonal temperatures, irregularities in rainfall seasons, shortened lifespan of plants, frequent occurrence of natural disasters and increased incidence of pests and diseases are some of the major impacts of CC on the agriculture sector. Smallholder farmers are particularly vulnerable to the effects of CC, due to their reliance on agriculture as the main livelihood, their position on marginal land, and their reliance on rain-fed crops (FAO, 2021).

Agriculture sector is the backbone of the economies of many developing countries. In the Sri Lankan context, the agriculture sector has long been a key economic force, contributing significantly to the national economic growth, food security, and employment. At present agriculture sector accounts for around 7% of the national GDP (Gunawardana, 2018). Paddy and other vegetable crops are among the most vulnerable crops to variations in temperature and precipitation in Sri Lanka (De Costa, 2010).

As a response to CC, two major strategies are being used, namely 'Climate Change Adaptation' and 'Climate Change Mitigation'.

Adjustment of the existing systems to withstand or minimize the detrimental impacts caused by CC, or to create beneficial outcomes of the expected changes in CC is known as 'Climate Change Adaptation'. Meanwhile, 'Climate Change Mitigation' refers to the reduction of greenhouse gas emissions as much as possible, while enhancing the sinks of greenhouse gases (IPCC, 2007). In case of agricultural systems, adaptation remains as the best option to face the impacts of CC.

Climate-Smart Agriculture (CSA) can be defined as any strategy capable of addressing the challenges of climate change on agriculture systems and food security by sustainably increasing productivity, bolstering resilience and reducing GHG emissions, while achieving national food security and development goals (FAO, 2010). A variety of agricultural practices such as crop diversification, development of high-yielding varieties, use of efficient irrigation technologies, rainwater harvesting, integrated pest management, adjustment of cropping calendars and smart nutrient management, etc. have been recommended to be followed under CSA (FAO, 2021). However, the adoption of these practices varies across production systems due to socio-demographic characteristics of farmers, economic status, farm characteristics, their knowledge, and attitudes on CSA (Mamun *et al.*, 2021).

Recent studies have evidenced that Kurunegala district is highly vulnerable to CC and is one of the major hotspot areas in Sri Lanka attributed to severe droughts (Samarasinha *et al.*, 2020). However, a limited number of farmers in Kurunegala have shifted towards the adoption of CSA practices and fewer numbers of studies have attempted to investigate the underlying reasons. Therefore, the current study was conducted to assess the perceived climate-related risk and driving factors for CSA among farmers in the Kurunegala District, Sri Lanka.

METHODOLOGY

Study Area and Data Collection

The Kurunegala district was selected as the study area for this study. A total of 250 farmers representing the eight Divisional Secretariat Divisions in the Kurunegala district were recruited based on the random sampling approach. Primary data were collected from February to May 2024 using a pre-tested interviewer administered questionnaire. The survey questionnaire consisted of five main sections; a) socio-demographic characteristics of the respondents, b) farming related information, c) farmer's climate risk perception, d) knowledge of farmers on CSA, and e) adoption level of CSA practices by farmers.

Climate Related Risk Perception Index (CRRPI)

The Climate Related Risk Perception Score (CRRPS) and Climate Related Risk Perception Index (CRRPI) were developed using the Likert scale-based questions on farmer's climate risk perception (Mamun *et al.*, 2021), as shown in equations 1 and 2.

$$CRRPS = CRRP_{vl} \times 1 + CRRP_{l} \times 2 + CRRP_{m} \times 3 + CRRP_{h} \times 4 + CRRP_{vh} \times 5 \quad \text{..... (1)}$$

Where,

$CRRP_{vl}$ = Number of participants with a 'very low perception'

$CRRP_{l}$ = Number of participants with a 'low perception'

$CRRP_{m}$ = Number of participants with a 'medium perception'

$CRRP_{h}$ = Number of participants with a 'high perception'

$CRRP_{vh}$ = Number of participants with a 'very high perception'

CRRPI = (Total CRRPS value) / (respective maximum CRRPS value) x 100 ……. (2)

Statistical Analysis

Descriptive statistics were used to analyze the socio-demographic and farming related information. Based on the number of CSA practices adapted by the farmers, a practice score for CSA was calculated. The farmers who were practicing more than 50% of the identified CSA practices were considered to be the farmers with a satisfactory level of CSA adoption. The Binary Logistic Regression (BLR) analysis was used to determine the driving factors behind the adoption of CSA practices by the farmers in Kurunegala district. Adoption level of CSA practices was considered as the response variable, while the socio-demographic factors, knowledge and attitudes of farmers on CSA were included as the predictor variables in the BLR. The Odds Ratios (OR) and the 95% confidence intervals of OR for significant driving factors were calculated using SPSS (version 23).

RESULTS AND DISCUSSION

Socio-Demographic Characteristics

The socio-demographic information of the farmers is shown in Table 1. Out of the 250 respondents, the majority were males (77.2%), when compared to females (22.8%). The highest percentage of participants was

identified as being in the age group of above 50 years (54.4%), as shown in Table 1. Around 31.6% of the respondents had completed O/L, followed by another 34.4% of farmers who had completed A/L, as their highest education qualification. Meanwhile, 20% of the farmers were having an education level below O/L.

In case of the income source, most of the respondents were engaged in fulltime farming (42%), followed by another 27.2% of respondents engaged in privet-sector jobs (Table 1). Most households had at least two income earning members (54%), while the highest percentage of households (46.4%) had income levels ranging from LKR 25,000 to LKR 50,000 (lower middle).

Table 1. Socio-demographic characteristics of the respondents

Parameter	Category	Percentage (%)
Gender	Male	77.2
	Female	22.8
Age (Years)	26 - 40	10.4
	41 - 50	35.2
	> 50	54.4
Education Level	Below O/L	20.0
	Up to O/L	31.6
	Up to A/L	34.4
	Diploma/ Graduate	13.2
	Postgraduate	0.8
Income Source	Farming	42.0
	Private Sector	27.2
	Government Sector	3.2
	Self-Employment	24.0
	Housewife	2.0
	Retired	1.6
Number of Earning Members	One	28.4
	Two	54.0
	≥ Three	17.6
Income Level (LKR)	< 25,000	4.8
	25,000 - 50,000	46.4
	51,000 - 75,000	32.4
	> 75,000	16.4

Farming Related Information

The farming-related characteristics of the study population are outlined in Table 2. Paddy was identified as the most cultivated crop (55.6%), followed by farmers cultivating both paddy and vegetables (39.2%). Meanwhile, around 3.2% of the respondents were cultivating cash crops (Table 2). Among the respondents, 70.4% were farming in their own land. A relatively higher portion of respondents were cultivating less than one-acre farmlands (52.4%), followed by another 46% cultivating around 1 – 5 acres. The majority of farmers (48.8%) were having more than 15 years of experience, followed by 24% of respondents with around 6 - 10 years of farming experience.

Table 2. Farm characteristics of the participants

Parameter	Category	Percentage (%)
Cultivated Crop Type	Paddy	55.6
	Vegetable	2.0
	Both	39.2
	Cash Crops	3.2
Land ownership	Own	70.4
	Hired	3.6
	Both	26.0
Farm Size (Acres)	< 1	52.4
	1 - 5	46.0
	6 - 10	1.6
Farming Experience (Years)	≤ 5	6.8
	6 - 10	24.0
	11 - 15	20.4
	> 15	48.8

Perceived Climate- Related Risk

Table 3 shows the perceived climate-related risk of farmers, according to nine climatic phenomena, along with the CRRPI and CRRPS scores. Farmers in the Kurunegala district perceived droughts (CRRPI=79.2), increased incidence of pests and diseases (CRRPI=74.3) and floods (CRRPI=54.6) as the most devastating climate related hazards, which agreed with Esham and Garforth (2013). On the contrary, lightning (CRRPI=20.2) and heavy storms (CRRPI=24.3), were identified as the least threatening climate hazards to the studied farming community.

Adoption Level of CSA Practices

The adoption level of different CSA practices by the studied farmers is outlined in Table 4. Survey results showed that the majority of farmers had not adopted CSA practices at a sufficient level. Cultivation of high yielding crop varieties (17.4%), integrated pest management (17%), acquiring membership in farmer organizations and use of micro-finance facilities (16.7%) were the mostly adapted CSA practices by the studied farming community in the Kurunegala district. These findings align with previous studies, which have identified crop rotation, use of improved crop varieties, smart management of fertilizers and application of integrated pest management practices as the mostly adopted CSA practices among farming communities in Bangladesh (Mamun *et al*., 2021).

Table 3. Climate change risk perception of farmers

No	Climatic events	Very High	High	Medium	Low	Very Low	CCRPS	CCRPI	Rank
1	Drought	59	136	41	14	0	990	79.2	1
2	Flood	1	69	81	59	40	682	54.6	3
3	Riverbank erosion	0	1	11	59	179	334	26.7	6
4	Lightning	0	0	0	2	248	252	20.2	8
5	Heavy storms	0	0	0	54	196	304	24.3	7
6	Soil problems	2	32	118	78	20	668	53.4	4
7	Increased pests and diseases	10	160	79	1	0	929	74.3	2
8	Irrigation risks	0	4	28	193	25	511	40.9	5

Table 4. Adoption levels of CSA practices by farmers

No	CSA practices	Percentage %
1	CSA1	8.2
2	CSA2	17.4
3	CSA3	8.5
4	CSA4	11.4
5	CSA5	8.4
6	CSA6	3.3
7	CSA7	5.2
8	CSA8	17.0
9	CSA9	3.2
10	CSA10	16.7
11	CSA11	0.7

Note: CSA1 = Cultivation of drought-resistant crop varieties, CSA2 = Cultivation of high yielding crop varieties, CSA3 = Crop rotation and diversification, CSA4 = Soil conservation measures, CSA5 = Water-saving irrigation techniques, CSA6 = Rainwater harvesting, CSA7= Smart nutrient management, CSA8 = Integrated pest management, CSA9 = Agroforestry practices, CSA10 = Farmer Organizations and Micro-Finance Facilities, CSA = Others.

Barriers against Adoption Level of CSA Practices

According to the results, lack of knowledge and training on CSA (mean=3.3; mode=4), limited support received from the government (mean=3.3; mode=3) and poor support received from the extension officers (mean=3.2; mode=3) were identified as the major barriers faced by farmers, while adopting CSA practices (Table 5).

Table 5. Barriers against adoption levels of CSA practices

Challenges	Mean	Mode
Poor financial capacity	3.0	3
Lack of knowledge and training on CSA	3.3	4
Limited support received from the government	3.3	3
Poor support received from the extension officers	3.2	3
Limited access to resources	3.1	3
Institutional and policy constraints	2.3	2
Social and cultural factors	2.6	3

A recent review conducted by Esham and Garforth (2013) has also emphasized that inadequate knowledge and training are the primary obstacles against adoption of CSA practices in Sri Lanka.

Driving Factors behind Adoption of CSA Practices

As suggested by the results of BLR, income level, crop type, farm size, farming experience, attitudes, and knowledge of farmers on CSA were recognized as the significant ($p<0.05$) driving factors behind adoption of CSA (Table 6). The adoption level for CSA practices increased with the income level of farmers getting elevated, as evidenced by the increasing OR corresponding to higher income levels. Farmers with an income level of more than 75,000 LKR denoted a significantly higher tendency to adopt CSA practices (OR=12.14; CI=1.44-22.45), when compared to low income receiving farmers. It was noted that farmers cultivating both paddy and vegetables denoted a significantly higher degree of CSA adoption (OR=9.002; CI= 3.61-15.45). The tendency of CSA adoption denoted significantly increasing trends, with the increasing farm size and farming experience, as shown in Table 6. Farmers with higher level of attitudes (OR=10.45; CI=4.81-28.71) and knowledge (OR=23.31; CI=15.32-45.14) on CSA also reported a significantly higher adoption level of CSA.

CONCLUSIONS

Farmers in Kurunegala district perceived droughts, increased pest and disease incidence, and floods as the major climate related hazards. Despite recognizing these threats, farmers had not adopted CSA practices at a sufficient level, primarily due to inadequate knowledge, limited government support and poor support from extension officers. Cultivation of high-yielding crop varieties and integrated pest management were the mostly adopted CSA practices. Meanwhile, income level, crop type, farm size, farming experience,

Table 6. Driving factors behind adoption of CSA practices

Parameter		P value	Odds Ratio	95% C.I. for OR	
				Lower	Upper
Income Level	< 25,000	0.003	Reference		
	25,000 - 50,000		1.52	1.25	3.21
	51,000 - 75,000		6.41	3.95	8.07
	> 75,000		12.14	1.44	22.45
Crop Type	Paddy	0.001	Reference		
	vegetable		7.43	2.99	12.98
	both		9.00	3.61	15.45
	cash crops		3.96	1.58	6.83
Farm Size (acre)	< 1	0.006	Reference		
	1 - 5		4.11	1.74	7.73
	6 - 10		9.56	5.70	23.59
Farming Experience (years)	≤ 5	0.013	Reference		
	6 - 10		1.42	1.05	3.09
	11 -15		5.12	2.59	8.36
	>15		8.19	3.99	17.71
Attitudes on CSA	Moderate	0.001	Reference		
	High		10.44	4.81	28.71
Knowledge on CSA	Low	0.008	Reference		
	Moderate		3.06	1.67	9.91
	High		23.31	5.32	45.14

attitudes on CSA and knowledge of farmers on CSA were identified as the significant driving factors that influenced farmers to adopt CSA practices. Therefore, it is essential to implement strategies to make the farmers aware of the climate risks and provide more knowledge and training about CSA practices.

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The Expected Role and Current Status of Use of Key Performance Indicators on Performance Evaluation of Firms Operating in the Agri-Food Processing Sector of Sri Lanka

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ABSTRACT

Key Performance Indicators (KPIs) are expected to act as decision-making tools to enhance operational efficiency; ensure product quality and safety; optimize supply chain management, and foster sustainable practices. However, the question remains whether KPIs have been properly used in agri-food processing firms in Sri Lanka in this regard. In light of this, this research was designed to investigate this economic problem in the context of these firms, where understanding the gaps between the 'expected roles' and the 'current practices' was of key interest. A series of semi-structured interviews were conducted with the top-level managers attached to a set of firms (n=10) representing the sector through an Online Video Conference System and with the support of a structured interview guide containing 10 inquiries covering critical aspects related to KPIs, including the company size, technological capabilities, and market orientation, etc. The opinions of managers, which were expressed in the form of "attitudinal statements" were recorded and evaluated using the Thematic Analysis method with the assistance of MAXQDA, a qualitative data analysis software. The outcome of the analysis has, on the whole, disclosed five major themes, namely: (1) KPI Adoption; (2) Performance for value-added foods; (3) Stakeholder integration; (4) Performance expectations, and (5) Digitalization of KPIs. It concludes that a systematic and scheduled-based monitoring mechanism, preferably digitalized, must be in place to minimize the significant gaps that exist in the operational systems of firms in the agri-food processing sector, irrespective of their size and other characteristics like market orientation and regulatory environment.

KEYWORDS: Agri-Food processing sector, Key performance indicators (KPIs), Performance evaluation, Stakeholder perceptions

INTRODUCTION

Agri-food processing in any country plays a vital role in its economy by contributing significantly to employment, income generation, and overall economic development (CTCN, 2023).

The economic significance of the agri-food processing sector in Sri Lanka has also been well recognized (FAO, 2019). Through the conversion of raw agricultural production into value-added products, large-scale industries in this sector considerably contribute to GDP and drive economic growth. In the first quarter of 2020, the share of agriculture in Sri Lanka's GDP was around 7.3 percent, and the sector provides livelihood and security to around 30 percent of the population (DCS, 2020).

Key Performance Indicators (KPIs) are essential tools heavily used by contemporary businesses to measure and evaluate the success of their strategic goals and operational performance. These quantifiable metrics enable companies to track their progress, make informed decisions, and align their efforts with overarching objectives.

KPIs span diverse areas, from financial performance and customer satisfaction to employee productivity and sustainability targets. KPIs have evolved beyond basic measurements, incorporating advanced data analytics and real-time monitoring to provide a holistic view of organizational health. Businesses continue to refine their KPI frameworks, leveraging digital technology to enhance accuracy and relevance, and adapting them to the dynamic nature of markets and industries (Prabhu and Aithal, 2023).

According to Velimirović *et al*. (2011), KPIs are measurable goals that have a greater capacity to generate insights. To optimize this capacity, performance measurement systems require to adoption of standard procedures that warrant the facilitation of good management practices.

While there have been studies on the agri-food sector in Sri Lanka, there is a notable research gap concerning a comprehensive evaluation of the current status of KPIs specifically tailored to the agri-food processing sector. Therefore, this study aimed to bridge this gap by providing a detailed qualitative analysis of KPIs relevant to the performance evaluation of the agri-food processing sector in Sri Lanka.

METHODOLOGY

Conceptual and Theoretical Framework

The process of identifying and exploring the effective and efficient use of KPIs begins with formulating the specific research questions: (1) What is the current status of implementation of KPIs in the context of performance evaluation of firms in the agri-food processing sector of Sri Lanka, and how can it be improved in their future performance strategies?, and (2) How are these firms utilizing Digital KPIs to track and monitor their strategic goals and what can it be it's the effect of so on firm performance?.

A qualitative interview is a method in which the interviewer directs the interviewee to answer specific research questions. Semi-structured interviews streamline the scope of the interview with narrower topics that were facilitated through specific questions asked from all participants (Sullivan-Bolyai and Boya, 2021). In such an approach, the "attitudinal statements" deriving from the experts, in this particular case the utilization of KPIs of performance management of the agri-food sector in Sri Lanka, can be used to extract and group them into various codes, categories, sub-themes, and themes in a hierarchical order to find answers to the research questions. (Abeysiriwardana and Jayasinghe-Mudalige, 2021a, 2021b).

Data Collection and Analysis

In view of finding answers to the above research questions, a systematic empirical research methodology was followed starting from the collection of primary data using a series of semi-structured qualitative interviews (n=10) to which the Purposeful and Snowball Sampling were adopted (Abeysiriwardana and Jayasinghe-Mudalige, 2022a, 2022b).

The assistance of an online video conferencing facility was obtained in this respect to contact individual managers between the ages of 30 and 55 years (Eaton, 2020), from the firms operating in the agri-food processing sector in Sri Lanka.

An ethical consent form was provided before conducting the interviews. Voluntarily interested managers completed the consent form to take part in the interview. The consent form included an overview of the research project, participants' voluntary consent, and information about the participants (Fernandez, 2018).

Thematic analysis has been employed to analyze the coded documents to reveal insights into the system under investigation (Braun and Clarke, 2006).

The thematic analysis generates themes that are related to the construct to be captured, and based on some levels of patterned response or meaning within the data set. The six phases were as follows (Braun and Clarke, 2006): (1) Familiarizing with the data; (2) Generating initial coding; (3) Searching for themes; (4) Reviewing themes; (5) Defining and naming themes, and (6) Producing the report.

The audio-recorded interview data were manually transcribed into text files using software and the text files were fed into a computer-aided data analysis software program called MAXQDA. It provides tools for coding, organizing, and analyzing qualitative data and derives comprehensive relationships between the concepts presented behind the codes systematically and easily.

Data were analyzed to answer the research questions, leading to the identification of five key themes. These themes were developed based on the responses to the interview questions formulated based on the research questions, providing insights into the research findings.

The five themes are (1) Agri-Food Production; (2) Company Performance; (3) Digitalization of KPIs; (4) Sustainable Decision-making, and (5) Performance Evaluation, which elaborate the nature of each company's performance dynamics. To understand the potential relationships between the data and information gathered, these were finalized by narrowing down and refining the sub-themes, categories, and codes. Codes were linked into meaningful groups that formed the basis of thematic categories.

RESULTS AND DISCUSSION

By coding data about managers' experiences in the agri-food sector, researchers could ensure that no significant detail about the use of KPIs in those firms was overlooked, capturing the full complexity of the relationship between firm performance and KPI. Based on the five themes, a deeper analysis of the code details revealed insights that could significantly aid theory development. The tools in MAXQDA further supported the validation of these results such as managers' trust in using KPIs to measure the performance of the most critical success factors in the agri-food sector development.

The word cloud tool in MAXQDA displays word frequency in textual data. Commonly occurring words are displayed in varying sizes based on their frequency, allowing researchers to quickly identify significant terms and patterns within the data.

According to (Figure 1): it is evident that research question 1 is thoroughly addressed, as indicated by the frequent recurrence of terms such as “Agriculture” (represented by a group of words such as “agriculture”, “agri”, and “sector”), and “KPIs” (represented by a group of words such as “kpi”, “kpis”, etc.).

Figure 1. Word cloud for KPIs in performance evaluation

Managers in Agri-Food Processing Firms prioritize KPIs to effectively manage and monitor performance within the production sector.

The code relations browser graphically helps researchers visualize and analyze the connections between different codes applied to the data. This visualization tool presents coded segments as nodes, with lines or arrows representing the relationships or connections between them. The graphical representation provided (Figure 2): indicates numerous recurring relationships among coded segments that can be frequently observed. “Agri-food sector” and “Food production” (4 times), “Sustainability”, and “Value-Added Foods” (4 times). “Top level” and “Customer Satisfaction” (3 times). “PESTLE Analysis” and “SWOT Analysis” (3 times).

The importance of these relationships that were derived from the data associated with ideas expressed by managers of Agri-Food firms provides answers to research questions one and two. Furthermore, some codes with weak interactions of one-time relationships could be identified.

They were “Inventory Turnover” and “KPIs Cycle”, “Certification” and “Fix KPIs”, “Social Responsibility”, “Disclosure Frameworks”, “KPI Insights” and “Traceability” and “Order Fulfillment” and “Response Time” and “Product Rates” and were identified based on responses to questions 2. It appears that leaders in the agri-food sector have not made significant efforts to address performance evaluation, by comparing the current status of company performance, with sustainable production practices.

The third output of the analysis, the single case model graphically illustrates a structured framework for organizing, coding, and analyzing data related to individual cases. Figure 3 illustrates the potential views on performance management of the Top-Level Managers of the firms. The entities of the current status of KPIs and performance of the organization context could be used to identify the significant relationships between the interview and the relevant entities by the thickness of the respective lines.

The codes “Performance Evaluation”, “Value Addition, “Product Differentiation”, “Technology Adoption”, “Food Security” and “Brand Perception” are dominant and play the main role in the performance evaluation in Agri-Food Sector. This provides answers for both the first and second research questions.

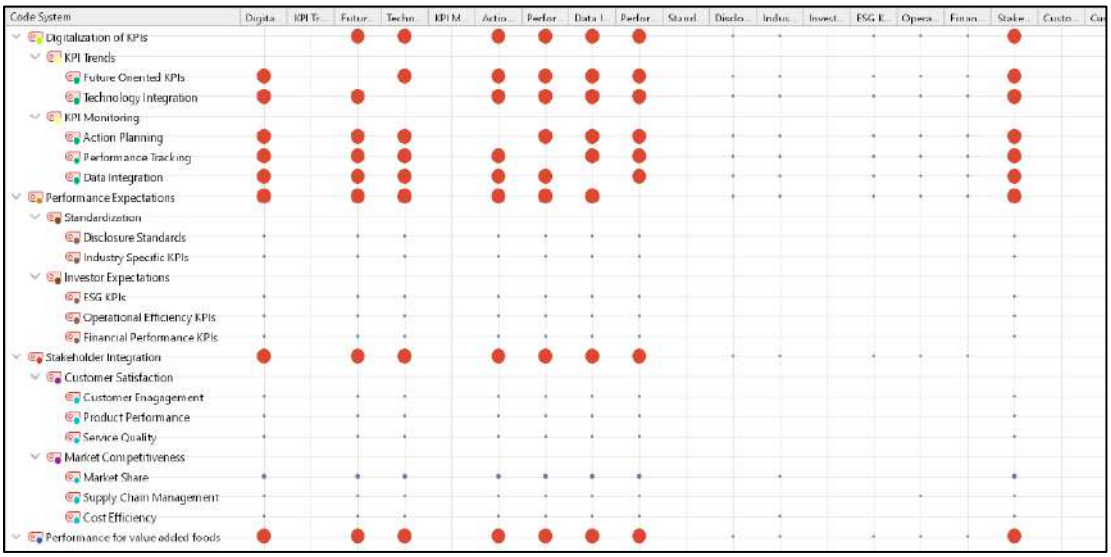

Figure 2. Part of code relations browser for KPIs and its use in the Agri-Food Processing Sector

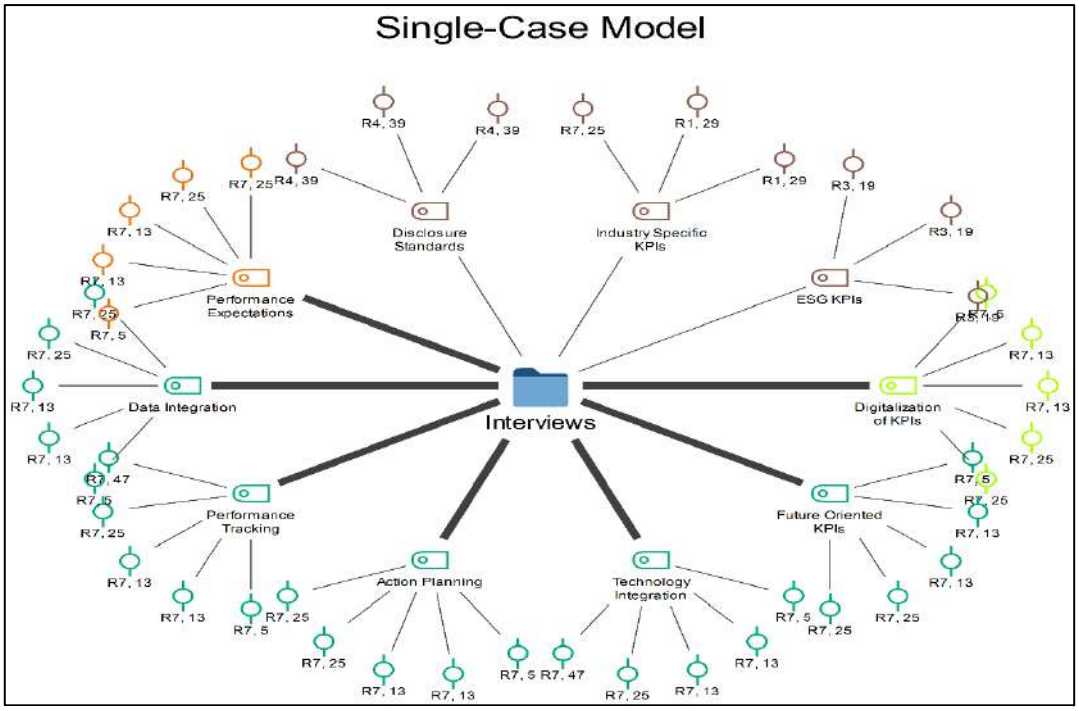

Figure 3. Single Case Model (coded segments)

The code map visually represents the relationships and connections between different codes and themes within qualitative data analysis. It organizes and displays the coding structure hierarchically, allowing researchers to visualize patterns and connections within their data. Through nodes and lines, it illustrates how codes relate to each other and helps in understanding the complexity of the analyzed data.

Figure 4 shows the relationship between "Performance for Value-Added Foods" and "Performance Expectations". It also shows some interrelationships between the codes of KPI Adoption and Performance for Value Added Foods. However, only a few interrelationships could be found between the themes of "KPI Adoption" and "Stakeholder Perceptions".

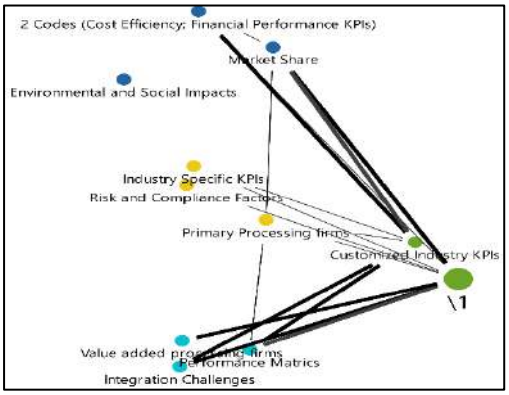

Figure 4. Code Map (Relationship between "Performance for Value-Added Foods" and "Performance Expectations)

According to the analysis, there are some significant frequencies could be seen in "Performance for Value-Added Foods" over the other codes with respect to the themes of KPI Adoption and Performance Expectations. This implies that the experts shared their views basically according to the industry-specific KPIs and for the development of value addition of foods.

They believe that the performance evaluation of the Agri-Food Processing Sector in Sri Lanka should focus on its value-added properties to the food. Thus, this study provides evidence-based solutions to the two research questions of interest by demonstrating significant relationships.

CONCLUSIONS

This research provides critical insights into the sector's future development by recommending management of its performance by KPIs which is an effective decision-making tool. The top-level management has identified "Performance for Value-Added Foods" as a significant factor for the advancement of the agri-food sector. The analysis indicates that the adoption of KPIs, aligned with performance expectations and stakeholder perceptions, plays a vital role in managing and enhancing the sector's performance. These elements are particularly significant for developing countries like Sri Lanka, where strategic KPI implementation can drive good performance management practices.

The findings suggest that focusing on performance for value-added foods and aligning performance expectations with strategic goals will pave the way for a well-developed and successful agri-food sector. This focus not only addresses current performance challenges but also sets a foundation for sustainable growth and competitiveness in the global market.

Upon closer inspection, the analysis reveals that themes such as the “Digitalization of KPIs”, “Stakeholder Integration”, and “Performance Expectations” are instrumental in guiding organizations toward achieving distinct paths, goals, objectives, and targets. The financial and operational efficiency of KPIs, along with their proper maintenance and management within firms, are critical for enhancing production and developing new digital platforms, enabling firms to compete in the global market.

The analysis highlights that a digital environment, facilitated by tools like "PESTLE Analysis”, "SWOT Analysis”, "Fix KPIs” and "Transparency of KPIs” are essential for fostering innovation. These elements, as suggested by the managers, are necessary for driving the success of the agri-food processing sector. Therefore, the adoption of KPIs is not merely a tool for evaluation but a strategic asset for future development in Sri Lanka's Agri-food processing sector.

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Economic Valuation of Provisioning Services of Village Tank Cascade in Palugaswewa Divisional Secretariat: A Discrete Choice Experiment

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ABSTRACT

Sri Lanka is well known for its hydraulic civilization, and the village tank cascade systems (VTCS) are part of that heritage of the country. It was integral to the nation's long-term agricultural sustainability. These systems demonstrate an advanced approach to water management in the recycling and reusing of water through a network of interconnected tanks, ranging from small to large known as VTCS. The primary function of these village tanks has been to irrigate dry lowland plains, particularly for paddy farming during the main cultivation seasons. This study focused on valuing the provisioning service of the Bellankadawala tank cascade system which consists of 150 participants. The purpose of the study was to value the provisioning services using a choice experiment through attributes and their levels. The Conditional Logit Model was used as the analytical tool and the findings revealed that the villagers would need to be a significant willingness to accept (WTA) to maintain or restore the tank system. The highest compensation requirement was observed for ensuring sufficient water for cultivation, specifically for both *Maha* and *Yala* seasons, with a staggering marginal willingness to pay (MWTP) value of Rs. 61,290.56. This highlights the economic burden perceived by the villagers and the association of the people with the tank and its environs has ensured the sustainability of the systems in the past.

KEYWORDS: Cascade ecology, Ecosystem services, Provisioning services, Village tank cascade

INTRODUCTION

The small tank cascade system in Sri Lanka was designed through accrued traditional knowledge, worked satisfactorily for more than two thousand years, and continues to operate as the foundation of water management for cultivation in the dry zone of Sri Lanka (Panabokke, 2004). Tank cascade systems (TCSs) offer a smart approach to water management that goes beyond basic water storage infrastructure. Rather than acting as a water collection, tanks are interconnected by a series of small to large tanks that recycle and reuse water across the ecosystem. This emphasizes that water tanks are man-made ecosystems more than just storage structures that utilize various natural resources to provide diverse functions and services.

A village tank cascade system is made-up of various components that each serve a distinct purpose and contribute to ecosystem services. It was designed with different important zones where each zone contributes a specific function or significance. The major zones such as tank bund and tank body, a path to cultivated lands/paddy fields, upper catchment, and residential area (hamlet) consist of several other sub-areas (Geekiyanage and Pushpakumara, 2013). Among them some important unique features of a TCSs from upstream to downstream are catchment forest (*mukalana*), riparian/retention zone (*thaulla*), interceptor (*kattakaduwa*), tree belt (*gasgommana*), check dams (*potawetiya*), soil ridges (*iswetiya*), tank bund/dam, sluice gate (*biso kotuwa*), and paddy fields.

The village tank cascade is vital for human well-being since it provides essential ecosystem services. The TCS ecosystem comprises watershed forests, aquatic habitats, diverse land uses, and advanced water management systems. The system of tanks and water management facilities interconnect to make the ecosystem function properly and support essential aspects and processes that guarantee the well-being of the villages. It is supported by providing provisioning, regulating, supporting, and cultural benefits (TEEB, 2010). Among various natural ecosystems, identifying ecosystem services from the perspectives of inhabitants is vital for research development on sustainable use and management of natural resources.

Water from VTCS is primarily utilized for irrigation, allowing villages to grow a range of crops including paddy, vegetables (pumpkin, long beans, bitter gourd, and snake gourd), cowpea, finger millet, maize, and chili (Somarathne *et al*., 2005). As an outcome of such a system, it guaranteed uninterrupted cultivation in both the wet season (*Maha*) and the dry season (*Yala*). Tank water also meets household needs, drinking water, bathing, and provides water for livestock. Small tanks within forested regions provide drinking water for wildlife and aid in silt deposition. Villagers also rely on these ecosystems for fishing, gathering

medicinal plants, grazing cattle, collecting reeds, collecting fuel wood, flowers for worshiping, selling and collecting materials for crafting and pottery that are deposited in the retention area. Also, services provided by the catchment forest, shrubs were utilized as medicinal herbs for indigenous medicine (Geekiyanage and Pushpakumara, 2013).

Madduma Bandara (1985) introduced the concept of tank cascades to describe the interconnected network of small tanks and vast reservoirs that remain in Sri Lanka today. His research revealed that these tanks were intentionally designed and strategically placed across the landscape to capture rainwater from specific micro catchment areas efficiently. Individual tanks are part of larger systems or units known as 'cascades' that are hydrologically and socioeconomically interconnected.

Over the previous few centuries, these networks have been neglected and gradually deteriorated due to a lack of traditional governance and management mechanisms, poor regular maintenance, and contemporary irrigation attempts that overlooked their interconnection (Madduma Bandara, 1985). When integrity is broken down, the small tank cascade systems cannot deliver crucial ecological functions and sociocultural advantages. It impacts life on earth more generally and depends on the outputs and benefits of healthy and functioning ecosystems. Dissanayake *et al*. (2021) categorized and highlighted the benefits that are being generated by cascade tank systems and it is further important to evaluate the value of these ecosystem services.

This research aims to assess the economic value of provisioning services separately which is provided by village tank cascade from the previous categorizations of ecosystem services. By accurately quantifying the value of these services, it can highlight the importance of the village tank cascade system and promote efforts for their restoration to their original condition.

METHODOLOGY

Study Area

The healthy landscapes project targets multiple village tank cascade systems in the Palugaswewa and Thirappane Divisional Secretariats of the Anuradhapura District in the North Central Province of Sri Lanka. . This study is mainly implemented in the Palugaswewa DS at the Bellankadawala tank cascade system. The sample size was 150 participants which organized into 5 distinct blocks and questions were asked from 30 respondents in each block.

Questionnaire Design

Data were collected using a well structured questionnaire with designed choice cards. The discrete choice experiment (DCE) method was chosen for this valuation, as the level of detail from the attributes selection is better suited for the expected outcomes of this project. The questionnaire consisted of four segments. In the first part, several questions were asked concerning basic socio-demographic information about the respondents (personal/family details, household income, and education). The second segment tested the knowledge of the information about VTCSs, their functions, and ecosystem services and checked the keyword-based knowledge testing which those terms have ever been heard before. Next, the third segment was about the perception of the informants about VTCS and the importance they conceded to its ecological preservation and restoration. The fourth segment evaluated the current status of the ecosystem services arising from the village tank. Finally, answering to the choice experiment segment and nine choice sets were presented to the respondents.

Identification of Attributes and Levels

The most important attributes and their levels regarding the experiment were identified based on the review of studies and through focus group discussions done in the studied area. Here, the provisioning services are classified into five different attributes and each attribute contains three levels, and they are combined into choice sets with the price attribute which have five levels. Price attribute was selected with the aim of getting monetary value for the non-marketable services which provided by the village tank. The chosen attributes and their levels are given in Table 1. The first versions of the survey were presented as a pilot survey to 10 respondents representing the Thumbikulama area, in order to draft the final version based on their reactions and feedback. Choice cards were prepared using the chosen attributes and their levels. Nine choice cards were presented in one block and there were 45 choice cards with five blocking effects and as a result of that, each choice card had two alternatives. Data collection was done using nine choice sets supported by a structured questionnaire, as the level of detail from the attributes selection is better suited for the expected outcomes of this study.

Table 1. Attributes and their levels

Attributes	Levels
Supply water for cultivation	Insufficient for *Maha* to cultivate (InfM) Sufficient only *Maha* to cultivate (SufM) Sufficient for both *Yala* & *Maha* (SufMY)
Supply water for Other purposes	Available year around (12m) Available only for 10 months (10m) Available 8 months or less (8m)
Supply drinking water from the tank	Cannot be used for human consumption but animals (Noh) Can be used with purification (Hwp) Can use directly (Hwop)
Supply nonfood products	Very few (vew) Available, do not meet the demand (avnodim) Meet the demand (avydim)
Supply food products	Highly available (hav), moderately available (mav), Law availability (lav)
Expenditure(Rs.)	2000, 4000, 6000, 9000, 12000

Theoretical Framework

Choice experiment (CE) is a non-market valuation technique used to estimate values of each attribute of a given choice. It relies on two main theories. Micro economically how an individual's consumption decisions depend on the utility gained by the attributes of the consumed goods was explained by the Lancaster theory (Lancaster, 1996) and random utility theory (McFadden, 1974) which explains the dominance judgment made between pairs of offering which each alternative (i) in the choice set, thus has utility level represented by;

$$Ui = Vi + \in i \text{----------(1)}$$

Ui= Utility of the i^{th} alternative
Vi= Objective component of i^{th} alternative
$\in$i = Error component

Marginal welfare measures that seek for a change in any of the attributes known as marginal willingness to pay (MWTP), estimated by using the ratio of the coefficient (β) of the respective attribute and the monetary attribute,

$$MWTP = -1\left(\frac{\beta\ attribute}{\beta monetory\ attribute}\right)\text{---(2)}$$

RESULTS AND DISCUSSION

Descriptive Statistics of the Sample

As depicted in Table 2, gender distribution shows higher proportion of females (56.7%) compared to males (43.3%). The majority belong to age the 26- 50 years old (56.4%), with the remaining participants distributed among the 10-25 age group (8.7%), 41-50 age group (20.8%), and those over 50 (35.6%).

Most of the participants are married (88.6%), while 35.6% are non-married. In terms of education, 42% have completed up to O/L, followed by those with education up to Grade 7 (21.3%). Smaller participants have attained higher education levels.

Employment data reveal that 68% are engaged in farming, highlighting the agricultural focus of the studied area. This high level of engagement in farming emphasizes the critical importance of having an effective and reliable water system to support their farming activities. Other employment sectors include 6% in the private sector, 4% in government jobs, 4.7% in self-employed, and 17.3% are unemployed. Notably, a significant portion of is not formally employed category (17.3%) consists of most females who actively engage in farming activities with their families.

Regarding monthly income, the majority of respondents (66%) earn between Rs.25,000-50,000, 21.3% have an income of less than Rs.25,000, while 12.7% earn between Rs.50,000-100,000.

Table 2. Demographic characteristics of the sample

Variable	Category	Percentage (%)
Gender	Male	43.3
	Female	56.7
Age	10-25	8.7
	26-50	35.6
	41-50	20.8
	>50	35.6
Civil Status	Married	88.6
	Non married	35.6
Level of Education	No formal education	8
	Up to 7	21.3
	Up to O/L	42
	Up to A/L	7.3
	Pass A/L	4
	Degree	1.3
	Postgraduate	4
	Other	12
Employment	Private	6
	Gov.	4
	Self empl.	4.7
	Farming	68
	Non	17.3
Monthly Income	<25000	21.3
	25000-50000	66
	50000-100000	12.7

Analysis of Data

CE design and statistical analyses were conducted using package support. CE from statistical R software (Aizaki, 2012). The Conditional Logit model was employed to analyze responses to CE questions and in R can be conducted using the function clogit in the package survival (Therneau, 2015).

$$V_{in}=ASC+bSufM\cdot SufM_{in}+bSufMY\cdot SufMY_{in}+bX10m\cdot X10m_{in}+bX12m\cdot X12m_{in}+bHwp.Hwp_{in}+bHwop\cdot Hwop_{in}+bavnodim.avnodim_{in}+bavydim\cdot avydim_{in}+bmav\cdot mav_{in}+bhav\cdot hav_{in}+bprice\cdot price_{in}$$

Outcomes of the Choice Experiment

According to the results of CL model (Table 3), ten out of nine levels of provisioning services considered in the analysis (Water sufficient for *Maha*, Suf. For *Maha* and *Yala*, water for other purposes in 10 and 12 months, drinking water with purification and without purification, providing nonfood products without fulfilling the demand, and moderately and highly available food products) were significant at 95% significant levels. Significance implies that those attributes were important to the respondents when they chose. The sign of the individual parameter demonstrates the positive or negative effect of a characteristic on the total utility of respondents. Here all the attribute levels show positive signs. A positive coefficient for an attribute suggests that an increase in that attribute leads to an increase in the utility (preference) associated with the choice option. Price like cost attribute indicates a positive coefficient. It might indicate a willingness to accept higher levels of cost.

Table 3. Conditional Logit estimates for attributes of choice experiment

Attribute	levels	coefficient	P-value
Water for cultivation	SufM	0.477	0.000
	SufMY	1.630	0.000
Other purposes	10m	0.170	0.047
	12m	0.234	0.000
Drinking	Hwp	0.491	0.007
	Hwop	1.009	0.000
Nonfood products	avnodim	0.366	0.000
	avydim	0.413	0.000
Food products	mav	0.067	0.502
	hav	0.550	0.000
Price		0.000	0.007

**P<0.05*

The aim of the analysis was to value the provisioning services gained through the village tank cascade system. Here (Table 4) benefits were valued in terms of currency since it would be understandable to every person. MWTP values were calculated based on base level attributes, including water insufficient for *Maha*, providing water for 8 months, drinking water for animals only, few amounts of non-food products, and low availability of food products.

Table 4. MWTP Values by the respondents

Attribute	levels	MWTP
Water for cultivation	SufM	-17943.68
	SufMY	-61290.56
Water for Other purposes	10m	-6405.16
	12m	-8810.57
Drinking	Hwp	-18464.39
	Hwop	-37935.90
Nonfood products	avnodim	-13764.73
	avydim	-15518.54
Food products	mav	-2499.47
	hav	-20686.85

MWTP=Marginal Willingness to Pay

Methodologically, the study consists of a choice experiment exploring the willingness of villages about provisioning services of village tank cascade system. According to the findings output shows that negative MWTP values unexpectedly. The negative values in the MWTP column indicate that instead of being willing to pay for these services, the villagers would need to be compensated (willingness to accept) to maintain or restore the tank system.

Among the attributes examined, the highest compensation requirement was observed for ensuring sufficient water for cultivation, specifically for both *Maha* and *Yala* seasons, with a staggering MWTP value of Rs. 61,290.56. This suggests that villagers would demand this amount to accept the highest of water provision level and to agree to restore and maintain the village tank cascade.

Following closely is the attribute related to providing drinking water without purification level, which resulted in a required compensation of Rs. 37,935.90. This substantial compensation need underscores the reluctance of villagers to bear the costs associated with maintaining the tank system.

Furthermore, the provision of food products with high availability in the tank cascade environment also elicited a notable compensation demand, with villagers indicating a need of Rs. 20,686.85 to accept this attribute and support the maintenance of the tank system.

These findings indicate that villagers perceive a significant economic burden associated with maintaining the tank system, necessitating significant compensation to secure their cooperation and participation in restoration operations.

CONCLUSIONS

The outcome of the study revealed that results did not show a willingness to pay for the restoration and maintenance of the village tank cascade system. Instead, they exhibit a willingness to accept compensation for these services. The negative MWTP values across various services under the provisioning need substantial compensation from the government or other relevant parties to gain the villager's agreement for the restoration and maintenance efforts. This highlights the economic burden perceived by the villagers and suggests that policy interventions should focus on providing adequate compensation to encourage the restoration and maintenance of these services. Historically, the association of the people with the tank and its environs has ensured the system's sustainability, which is a crucial aspect to consider in these interventions.

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Factors Influencing Purchase Intention of Mushroom in the Kurunegala District, Sri Lanka

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ABSTRACT

Mushrooms, which are also known as "vegan meat," have high nutritional value and health benefits. Sri Lanka's mushroom industry is still developing but will have a promising future. This study was focused on analyzing how product factors, price attitude, availability, health consciousness, labelling, packaging, and subjective norms influence the mushroom purchase intention of consumers. Primary data were gathered through a questionnaire survey by means of a face-to-face interview. The sample consisted of 400 consumers selected from supermarkets and retail shops covering three divisional secretariats in Kurunegala district. Respondents were selected by systematic sampling. The data were analyzed using confirmatory factor analysis via AMOS in SPSS 26 version. The results revealed that price attitude, availability, and labelling are the main factors influencing consumers' mushroom purchase intention. Also, results show that product factors, health consciousness, and packaging have positive and insignificant effects on consumer intention to purchase mushrooms. The findings of this research study provide valuable insights for marketers, mushroom producers, vendors, certifiers, policymakers, and research institutions to implement necessary product improvements and better strategies to develop the mushroom industry in Sri Lanka.

KEYWORDS: Consumers, Factors, Mushroom, Purchase intention

INTRODUCTION

Mushroom is a nutritional powerhouse packed with a delicious taste and a long list of nutrients. Mushroom is considered sustainable alternate protein sources rich in protein as well as fibre, vitamins, minerals, and antioxidants. Mushroom helps to prevent various life-threatening diseases such as cancer, Alzheimer's, hypertension, and stroke (Valverde *et al.,* 2015). Accordingly, mushroom can be a nutritious choice for consumers seeking low-sodium and low-fat diets or wanting to reduce or substitute meat intake due to their rich content of high-quality protein (González *et al.,* 2020; Schweiggert-Weisz *et al.,* 2020). Increasing mushroom consumption is important for Sri Lankans in order to fulfill nutritional deficiencies, especially the protein requirement in the diet. However, the mushroom industry in Sri Lanka is still a developing agribusiness, and the current market offers a limited number of mushroom varieties and products (Thilakarathna *et al.,* 2017).

Purchase intention refers to the process of determining the factors that impact a consumer's decision to buy a particular product. According to Shah (2021), taste is the most crucial factor that influences a consumer's purchase intention for mushroom. Price is one of the top three factors influencing the purchase intention of mushroom, mushroom products, and mushroom supplements (Lim *et al.,* 2023). Shirur *et al.* (2014) showed that colour, size, and shape of mushroom are the most influential factors when buying mushroom, and price is the least influential factor among tested factors. Kumar and Babu (2014) found that the availability of a product significantly influences consumers' purchase intentions. A study has shown that consumers' awareness of the health benefits of mushroom significantly influences their buying decisions (Jiang *et al.,* 2015).

According to Jeddi (2010), a label serves as a highly influential quality indicator that directly impacts consumer purchasing decisions. Chakrabarti (2019) stated that mushrooms containing genetically modified organism (GMO) labels are discounted, whereas non-GMO-labelled mushroom designations are given little value. Recent studies have highlighted that the third most important factor in mushroom buying decisions is its packaging (Shah, 2021). Visual and functional features of packaging influence consumers' decisions to buy a product (Rahimniya *et al.,* 2012). Wang *et al.* (2020) showed that subjective norms have a significant impact on product purchase intention.

Studying consumers and their behaviour is a crucial task for marketers and growers. However, there is not sufficient research conducted in Sri Lanka regarding factors influencing consumers' purchase intentions of mushroom. Therefore, the purpose of this study is to investigate how product factors, price attitude, availability, health consciousness, labelling, packaging, and subjective norms influence consumers' purchase intention for mushroom in the Kurunegala district of Sri

Lanka. These findings will help to develop effective strategies and policies that meet consumer expectations and improve the purchase intention of mushroom within the country.

METHODOLOGY

Conceptual Framework

The proposed conceptual framework (Figure 1) explains the relationships among product factors, price attitude, availability, health consciousness, labelling, packaging, and subjective norms on the purchase intention of mushroom.

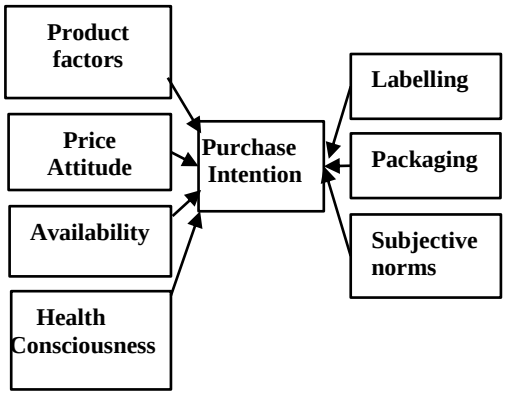

Figure 1. Proposed conceptual framework

Data Collection

Primary data were gathered from 400 consumers through a structured questionnaire by conducting face-to-face interviews. This study was administered at randomly selected supermarkets and retail shops from randomly selected three divisional secretariat divisions in Kurunegala district, through the multistage sampling method. Consumers were selected based on systematic sampling by interviewing each third customer who arrived at the selected places.

Measures

The questionnaire consisted of eight factors in addition to demographic factors, namely product factors, price attitude, availability, health consciousness, labelling, packaging, subjective norms, and purchase intention. The consumer's purchase intention was used as the dependent variable. A total of 35 indicators were used to measure these factors and purchase intention. All indicators were assessed on a 5-point Likert-type scale, ranging from 1 to 5, where 1 was denoted "strongly disagree" and 5 was denoted "strongly agree."

Data Analysis

The demographic factors of respondents were analysed using descriptive statistics, and Cronbach's alpha reliability coefficient was used to calculate the reliability value of the factors. To evaluate the validity of the measurement model, confirmatory factor analysis was used. Structural Equation Modelling (SEM) was employed to examine the proposed model by using Analysis of Moment Structure (AMOS) in SPSS 26. The significance levels and the relationships between independent and dependent variables were determined using p values and factor loading values.

RESULTS AND DISCUSSION

Descriptive Statistics of the Sample

The majority of the respondents were women (52.8%), and 47.3% were men in the studied population (Table 1). The population contained 41.5%, 35.8%, and 22.8% in the age groups of 16-30, 31-50, and above 50, respectively. The majority of the sample was employed (61.5%), and 38.5% were unemployed. In terms of education level, 18.3% of people had completed up to the O/L examination, while others had passed above that level. Most individuals (37.5%) in this surveyed sample had passed the A/L examination. 36.5% of the majority of respondents belonged to the LKR. 25001-50000 income category. From the population, 27.3%, 21.5%, and 14.8% belonged to the LKR 50001-100000, less than or equal to LKR 25000, and above LKR 100000 income groups, respectively. Among the sample population, 87.3% of the respondents were Sinhalese.

Table1.Socio-demographic characteristics

Parameter	Category	Percentage (%)
Gender	Male	47.3
	Female	52.8
Age	16-30 years	41.5
	31-50 years	35.8
	51 and above	22.8
Employment Status	Unemployed	38.5
	Employed	61.5
Educational Level	O/L	18.3
	A/L	37.5
	Diploma	20.5
	Degree	23.8
Monthly Income	<=25000	21.5
	25001-50000	36.5
	50001-100000	27.3
	>100000	14.8
Ethnicity	Sinhalese	87.3
	Muslim	9.3
	Tamil	2.8
	Other	0.8

Reliability Statistics

To evaluate internal consistency, Cronbach's alpha was measured. According to Taber (2018), when Cronbach's alpha is higher than 0.7, it is acceptable. All factors showed internal consistency exceeding the above threshold, implying that their indicators maintain acceptable levels of consistency (Table 2).

Table 2. Cronbach's alpha values of the factors

Factor	Cronbach's alpha
Product factors	0.754
Price Attitude	0.740
Availability	0.716
Health consciousness	0.743
Labelling	0.778
Packaging	0.756
Subjective norms	0.760
Purchase intention	0.817

Confirmatory Factor Analysis (CFA) Results

The model initially used 35 indicators, but it showed that the model fit was insufficient to continue with the same set of indicators. As a result, four indicators, including PA1, PA4, AV5, and HC3, were removed because they had low factor loadings (below 0.05) and were insignificant (at p = 0.05). Table 3 presents the re-estimated results after removing the above four indicators, showing that all standardized estimates are statistically significant.

According to the factor loading values, the PF1 indicator has the highest factor loading (0.690) towards the product factors, which represents the good taste of mushroom. The PA2 indicator has the highest factor loading (0.852) for the price attitude, indicating the price is affordable for mushrooms compared to other protein sources. The AV2 indicator has the highest factor loading (0.749) towards availability, indicating the poor availability of mushroom creates a barrier to purchase. The HC1 indicator has the highest factor loading (0.861) towards health consciousness, representing that mushroom is healthier to consume. The LA3 indicator has the highest factor loading (0.759) for labelling, indicating a preference for purchasing mushroom products with labels that contain details about certification, such as organic, non-GMO, and other relevant certifications. The PK1 indicator has the highest factor loading (0.750) for packaging, representing the preference for purchasing mushroom packaging that allows consumers to see mushrooms through the package. The SN1 indicator has the highest factor loading (0.832) towards subjective norms, indicating the influence of the people around the consumer. Finally, the PI1 indicator has the highest factor loading value (0.782) towards purchase intention, reflecting the preference for purchasing mushroom as a habit.

Table 3. AMOS outputs of confirmatory factor analysis

Construct	Estimates of item
Product Factors	
PF1	0.690***
PF2	0.565***
PF3	0.654***
PF4	0.528***
PF5	0.527***
PF6	0.512***
Price Attitude	
PA2	0.852***
PA3	0.691***
PA5	0.631***
Availability	
AV1	0.645***
AV2	0.749***
AV3	0.653***
AV4	0.683***
Health Consciousness	
HC1	0.861***
HC2	0.701***
HC4	0.627***
Labelling	
LA1	0.726***
LA2	0.720***
LA3	0.759***
Packaging	
PK1	0.750***
PK2	0.705***
PK3	0.684***
Subjective Norms	
SN1	0.832***
SN2	0.586***
SN3	0.626***
SN4	0.627***
Purchase Intention	
PI1	0.782***
PI2	0.667***
PI3	0.643***
PI4	0.625***
PI5	0.677***

*Levels of statistical significance, ***P<0.001*

Relationship between Variables

Standardized regression weight analysis shows that (Table 4) consumers' intention to purchase mushroom is positively and significantly influenced by price-related attitudes, availability, and labelling of mushroom. Price attitude was found to be a significant factor, which was measured by using three indicators, i.e., affordable price for mushroom, preferring to buy mushroom due to the low price, and having good value for the price.

Availability was found to be another significant factor that influences the purchase intention of mushroom. There are four indicators under availability, and out of those indicators, the most influencing indicator was poor availability as a barrier to purchasing mushroom. The factor of labelling highly influences the purchase intention of mushrooms. The study assessed labelling using three indicators, which evaluated the preference for purchasing mushroom products with labels that contain details about mushroom variety in the packaging, quality labelling, and certifications such as organic, non-GMO, and other relevant certifications. Therefore, it demonstrates that labelling mushroom creates a significant and positive image on consumers' intention to purchase mushroom.

The subjective norms show an insignificant and negative effect on consumer purchase intention for mushrooms. Product factors, health consciousness, and packaging have positive effects on consumers' intention to buy mushroom. But their influences are insignificant. Therefore, it can be concluded that Sri Lankan consumers tend to purchase mushroom based on their price-related attitudes, availability, and labelling.

Table 4. Standardize regression weights

Relationship		Estimate
Purchase intention	Product factor	0.094
Purchase intention	Price Attitude	0.212***
Purchase intention	Availability	0.254***
Purchase intention	Health consciousness	0.143
Purchase intention	Labelling	0.266***
Purchase intention	Packaging	0.070
Purchase intention	Subjective norms	-0.063

*Levels of statistical significance, ***P<0.001*

The structural equation model represents the relationships between factors and indicators (Figure 2).

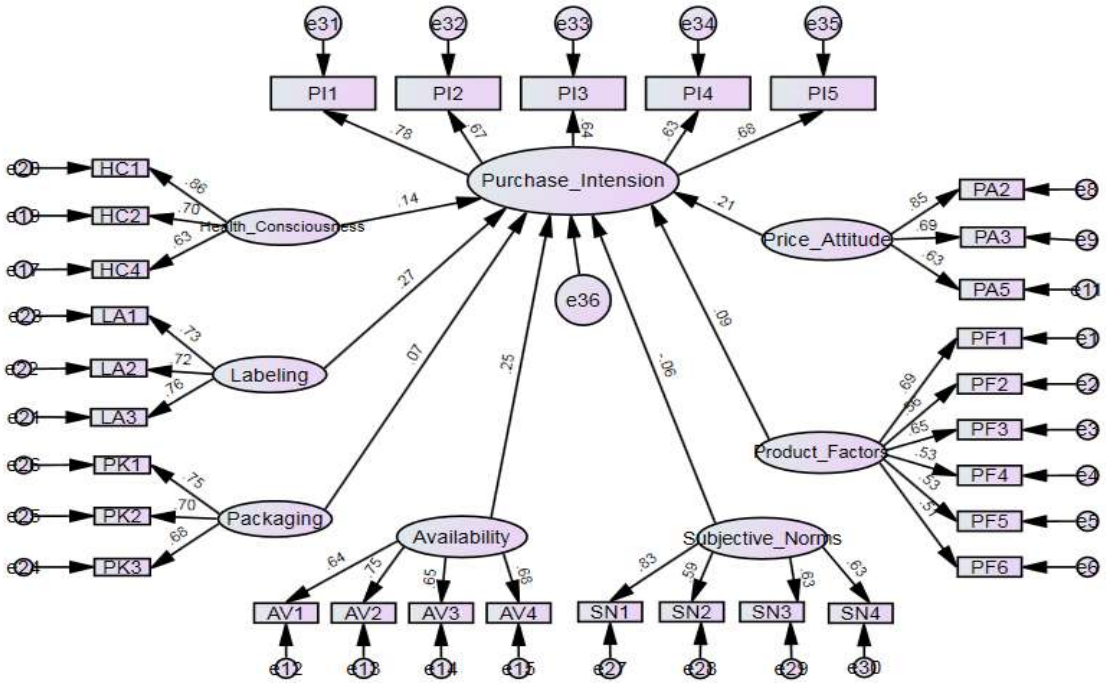

Figure 2.Structural relationship between purchase intention and factors

PF: Product factors, PF1: Taste, PF2: Texture, PF3: Meaty flavor, PF4: Considerable quality protein content, PF5: High nutrient content, PF6: Convenient to use, PA: Price attitude, PA2: Affordability of price, PA3: Low price, PA5: Value for the price, AV: Availability, AV1: Availability of the product, AV2: poor availability, AV3: Visit another place to purchase, AV4: Seek to purchase anyhow, HC: Health consciousness, HC1: Believing healthier to consume, HC2: No health risk, HC4: Containing natural plant based ingredients, LA: Labelling, LA1: Details about specific variety, LA2: Information about overall quality, LA3: Information about certifications, PK: Packaging, PK1: Packages that allows to see the mushroom clearly, PK2: Packages that can pack mushroom long periods of time, PK3: Preferences for eco-friendly packaging, SN: Subjective norms, SN1: Influence of the people around the consumer, SN2: Family influence, SN3: Friends influence, SN4: Research findings influence, PI: Purchase intention, PI1: Prefer to purchase as a habit, PF2: Like to purchase usually, PI3: Strong desire to purchase all the time, PI4: Like to buy forever, PI5: Recommend others to purchase

CONCLUSIONS

The study revealed that consumers tend to buy mushroom based on price, availability, and labelling. Consumer retention can be increased if producers can increase mushroom supply continuously, avoiding any shortage. Therefore, producers should focus on increasing mushroom availability in markets, and the government can support this by providing financial incentives, investing in infrastructure development, promoting research and development, encouraging the use of innovative technologies, and implementing regulations and policies that support the production of mushrooms in the country. Consumers have a positive image regarding the price attitude of mushrooms; hence, producers can maintain the existing price level or develop pricing strategies to increase consumer retention. In terms of labelling, mushroom labels should include details about the packing date, expiry date, and certification, such as organic, non-GMO, and other relevant certifications. Also, labels should provide information about the specific variety and overall quality of the mushroom in the packaging.

Then, it is essential to provide a proper label on the mushroom package to enhance the mushroom purchase intention. Overall, these findings and recommendations can help producers, marketers, investors, certifiers, and policymakers develop effective strategies and policies that meet consumer expectations and improve the mushroom industry in Sri Lanka.

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Evaluating the Intrinsic Worth of Green Spaces: A Comprehensive Analysis through Land Value Assessment in Colombo District, Sri Lanka

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ABSTRACT

Green spaces significantly enhance urban environments by providing ecological, social, and economic benefits to residents. This study investigates the total value of available green spaces in Colombo District, Sri Lanka by employing a hedonic pricing model and remote sensing techniques. Facilitating a comprehensive assessment of green space extent and distribution, spatial analysis techniques in Google Earth Engine were used to calculate the Normalized Difference Vegetation Index (NDVI) for each Grama Niladhari (GN) Division. The marginal implicit value of green spaces and the total value of green spaces in selected Divisional Secretariat (DS) divisions were calculated using the real residential land values and NDVI derived from satellite imagery for a three-year period through pooled regression analysis. Results indicate a significant positive relationship between green spaces and real land values, in which the marginal implicit price of green space is obtained as Rs. 70.58 in 2023 Rupees. Findings underscore the benefits and importance of greenery in urban areas not only in enhancing the environmental quality for residents but also in contributing to green space conservation and enhancement strategies for sustainable urban development.

KEYWORDS: Google earth engine, Green spaces, Hedonic model, Land prices, Marginal implicit price

INTRODUCTION

Green spaces contribute significantly to urban areas, making substantial impacts on the environment, aesthetics, social dynamics, and economy, all of which contribute to the health and well-being of residents (Senanayake *et al*., 2013). Franco and Macdonald (2018) identify green spaces as green amenities that range from planted street trees, manicured parks and gardens, natural forests, and green infrastructure such as green walls and roofs. Environmentally, green spaces benefit people by providing various ecosystem services like improved landscapes, air pollution abatement, noise reduction, soil conservation, and mitigation of the heat island effect while also affecting the physical and mental health and overall quality of life of people (Bertram and Rehdanz, 2015; Taylor and Hochuli, 2017). Beyond their environmental contributions, green spaces generate economic benefits by enhancing land values and fostering tourism, while simultaneously fostering social connections and encouraging healthy lifestyles.

Understanding the true value of green spaces is a key aspect in the urban context since they provide multiple ecosystem services to city residents and are often their only places to spend time in a natural environment. As a method of measuring the value of these urban green amenities, hedonic pricing models are widely used in the fields of urban and environmental economics (Rosen, 1974). General hedonic pricing approach assumes that the buyer of a property is paying for the amenities and services provided by the surrounding environment in addition to the property itself. This model can be employed when estimating the marginal implicit prices or the willingness to pay (WTP) of various characteristics bound with a property. Existing literature shows that numerous studies have used hedonic pricing approaches to measure the value of green spaces (Crompton, 2001) and most of these studies suggest that the presence of green spaces has a positive impact on property values (Sander *et al*., 2010; Siriwardena *et al.*, 2016).

Recent studies have emphasized on the variety of green spaces and the heterogeneity in the preferences associated with them. According to Barrio and Loureiro (2010), who conducted a broad survey of studies on the value of greenery, people's WTP for greenery varies depending on the type of greenery, the residential environment, and the characteristics of the people. Czembrowski and Kronenberg (2016) classified green spaces into several categories by type, use, and size and showed that each dimension has different impacts while Panduro *et al.* (2018) found that heterogeneous preferences for the same type of green space depend on the socioeconomic and demographic characteristics of people.

Only a few studies in the past have examined the impact of tree cover on property values by generating data through sight counts of trees. For instance, Donovan and Butry (2010) counted street trees during a field survey to find that street trees within 100 feet significantly increased property prices, while Pandit *et al*. (2013) found beneficial impacts of broadleaf trees by identifying them from aerial images. However, such visual identification methods are very costly, making it difficult to target large areas or multiple regions resulting in small sample sizes and missing data while not revealing the hidden greenery. Thus, remote sensing with high-resolution aerial or satellite imagery has been used in recent years (Franco and Macdonald, 2018).

This study investigates the inherent value of green spaces by calculating the extent of greenery using the Normalized Difference Vegetation Index (NDVI) obtained from high-resolution satellite imagery and combining them with real land values to provide insights into the value of greenery. The analysis covers the area of Colombo District, one of the highly commercialized districts in Sri Lanka. With its rapid urban development, the presence of green spaces has become pivotal. Using a hedonic analysis, this research emphasizes the total value given to the ecosystem services provided by green spaces.

METHODOLOGY

Study Area

The study area covers Colombo District which is located in the Western Coast of Sri Lanka covering a total land area of 699 km^2. Colombo consists of 13 Divisional Secretariat (DS) Divisions and 557 Grama Niladhari (GN) Divisions. The sample unit of this study is a GN Division and 63 GN divisions were selected from 7 DS divisions based on their availability and demand for residential lands and also on their urbaneness since the available greenery becomes relatively high with the remoteness of the area resulting in outliers. Selected DS divisions were Colombo, Sri Jayawardenapura Kotte, Thimbirigasyaya, Dehiwala, Moratuwa, Kolonnawa and Rathmalana.

Land Price Data

Average bare land prices of residential lands per perch for the selected GN divisions were obtained from the Government Valuation Department for the years 2021, 2022 and 2023. Hence, these average land prices are nominal values, they were divided by the Colombo Price Index (CPI) to obtain the real land values. This adjustment was done to remove the inflation over the years as there are multiple years involved in the dataset.

Green Space Extraction

Atmospherically corrected Landsat 8 satellite imagery was used in acquiring the extent of green spaces in Google Earth Engine (GEE). GEE is a cloud-based platform that consists of multi-source massive amounts of satellite data (Xie *et al.*, 2019). Satellite images were filtered in GEE by location and the date range (January 1st to December 31st) for the years 2021, 2022, and 2023. Visualization parameters were then defined to create NDVI image data using red (R) and near-infrared (NIR) spectral bands to extract green-covered areas. NDVI is calculated as in equation 1.

$$NDVI = \frac{(NIR-R)}{(NIR+R)} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

and it is used as a relative indicator of greenness (Franco and Macdonald, 2018), because plants absorb visible (red) light during photosynthesis and plant cell structures reflect near-infrared light. In general, NDVI value close to 1 represents rich greenery, while NDVI value close to -1 represents a water area. Thus, pixels with high NDVI values were focused and the data was processed by changing the threshold value to produce the most appropriate identification of green coverage (Kuroda and Sugasawa, 2022).

Using the spatial analysis techniques employed within GEE to process Landsat 8 imagery, a mean NDVI image was obtained to alleviate the effect of clouds. Mean NDVI was calculated for each GN division from the computed Landsat NDVI images. Green-covered areas were then extracted by masking the NDVI image with a 0.2 threshold, because non-vegetation such as built up areas, and water have NDVI values less than 0.19, whereas the vegetation region containing green cover such as ground, shrubs, and trees, etc. have a NDVI value higher than 0.19 (Aryal *et al.*, 2022). The processed NDVI data was used in pixel area calculations to quantify the total green extent in perches within each GN division facilitating a comprehensive assessment of green space distribution within the study area.

Other Control Variables

A variety of other attributes that can affect land values were identified as the control variables for this study including population, easy access to transport facilities such as availability of bus stands and availability of railway stations, availability of hospital, availability of schools, availability of banks, prevalence of drugs as a menace and occurrence

of disasters like canal over flooding and pollution due to industries. Data for these variables were obtained from the Department of Census and Statistics (DCS) published for the year 2020.

The most recent update of DCS shows population data for the year 2012. Using the population growth rate published by the World Bank Statistics for every year, population for each year was calculated. Growth rates were identified as 1.08%, 0.11% and 0.28% for 2021, 2022, and 2023, respectively.

Statistical Analysis

Hedonic model was used in estimating the marginal implicit price of green spaces. The estimation equation is,

$$V_i = \beta_1 G_i + \beta_2 P_i + \beta_3 B_i + \beta_4 R_i + \beta_5 H_i + \beta_6 S_i + \beta_7 Ba_i + \beta_8 Co_i + \beta_9 D_i + \beta_{10} Y_{2021i} + \beta_{11} Y_{2022i} + \beta_{12} Y_{2023i} + \varepsilon \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where, V_i is the real land value in Rupees (dependent variable) and G_i is the green extent in perches (independent variable) for the i^{th} GN division. β_1 to β_{12} represent coefficients of the variables and P_i, B_i, R_i, H_i, S_i, Ba_i, Co_i, and D_i represent the control variables. Y_{2021i}, Y_{2022i} and Y_{2023i} are the intercept dummies for 2021, 2022, and 2023. Ɛ is the error term. Since the dependent variable is in monetary units, it was deflated using the consumer price index (CPI) with the base year 2021.

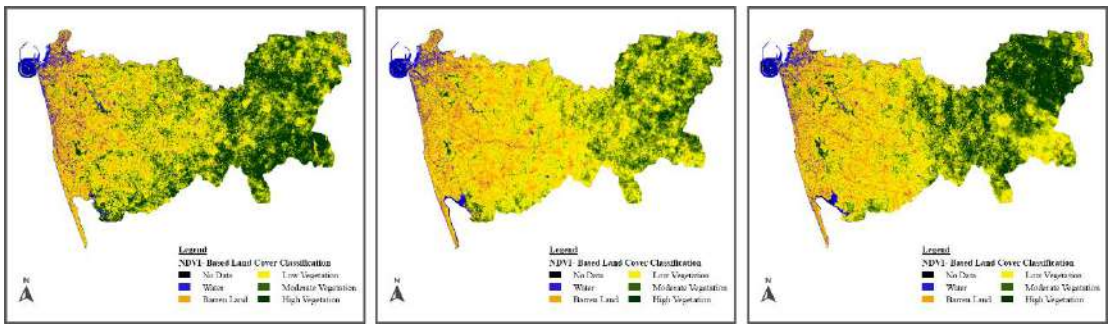
For the interpretation and estimation of the marginal implicit price of green spaces, a linear functional form is applied in the Hedonic model. A pooled regression was used for the panel data with year dummies in STATA software for the estimation.

RESULTS AND DISCUSSION

Green Spaces

Through the processing of mean NDVI data, three maps were developed to display the NDVI-based land cover classification (Figure 1) for the years 2021, 2022 and 2023 using GEE. In this research, areas that have a mean NDVI above 0.2 were considered as areas with vegetation. According to Aryal *et al.* (2022), regions with vegetation were again classified as shrubs and trees, where 0.19 to 0.5 was given for shrubs and 0.5 to 1.0 for trees. Shrubs and trees were further classified as healthy and stressed whereas, 0.19 to 0.4 were classified as stressed shrubs while 0.4 and 0.5 were classified as healthy shrubs, also 0.5 to 0.6 were categorized into stressed trees and 0.6 to 1.0 were categorized into healthy trees. Using these threshold NDVI values, the land area of the Colombo district was classified as areas with no data, water, barren land, low vegetation, moderate vegetation and high vegetation.

The maps in Figure 1 reveal that out of the whole area of the Colombo district, green spaces comprised of 18.95%, 19.18% and 19.11% area in the years 2021, 2022 and 2023, respectively. Unplanned settlements near economic centers in the Colombo district are the main reason for the scarcity of green spaces in some GN divisions (Senanayake *et al.*, 2013). World Health Organization (WHO) has established green space per capita standard values highlighting the importance of green spaces in an urban environment. According to WHO, the minimum amount of green space required per capita for healthy living is 9.5 m^2/person. In this study, green space per capita values were obtained as 53.41 m^2/person, 54.11 m^2/person, and 54.29 m^2/person for 2021, 2022 and 2023, respectively. These values are relatively higher than the WHO recommended standard value. Previous studies explain these high values by indicating how green space per capita value is relatively high in the Colombo district when compared with other South Asian cities such as Mumbai where the green space per capita is less than 1m^2 (Kuchelmeister, 1998).



(A) **(B)** **(C)**

Figure 1: NDVI-Based Land Cover Classification. *(A) Mean NDVI-based land cover classification for the year 2021; (B) Mean NDVI-based land cover classification for the year 2022; (C) Mean NDVI-based land cover classification for the year 2023. NDVI- Normalized Difference Vegetation Index*

Marginal Implicit Price and Total Value of Green Spaces

In this study, a pooled regression analysis was employed to evaluate the total value of green spaces through assessing real land values in selected GN divisions of Colombo district for a three-year time period. Since time invariant variables are present in the model, a pooled regression with time (year) dummies was estimated. The observed coefficient of determination (adjusted R-squared) value is 0.81 meaning that 81% of the variation in real land value is explained by the model. Year dummy variables were incorporated to this model to capture temporal variations and to isolate the marginal implicit price of green spaces from other time-specific factors that might influence land values, such as economic conditions, policy changes, or market trends.

The results (Table 1) show that regression coefficient for the green space was estimated as 0.071. The p-value associated with the coefficient of green spaces was less than 0.05 and hence significant at 5% error level. The positive coefficient between green space and real land value is the implicit value of green space in the land value. This highlights the fact that greenery available within a specific GN division significantly increases the real land value associated with the residential lands of that area.

Table 1. Results of pooled regression analysis

Variable	Coefficient	p-value
Green space	0.071*	0.000
Population	-0.187*	0.000
Availability of bus stand	2006.668*	0.000
Availability of railway station	2500.456*	0.000
Availability of hospital	3014.237*	0.000
Availability of schools	328.615	0.467
Availability of bank	1256.297*	0.011
Prevalence of drugs	-1045.428*	0.020
Occurrence of canal over flooding	-776..405	0.108
Pollution due to industries	-1142.685*	0.013
Year 1 dummy	3686.47*	0.000
Year 2 dummy	2247.088*	0.002
Year 3 dummy	1950.512*	0.007

**p<0.05, Adjusted R-squared- 0.81*

These findings align with prior research highlighting the positive association between the extent of Green Spaces and Land Prices (Sander *et al*., 2010; Barrio and Loureiro, 2010). With each additional perch of green space, the real land value will be increased by Rs. 0.071. The relevant nominal value of this value in 2023 prices is Rs. 70.58, which is the marginal implicit price of green spaces. People tend to place more importance on their living environment by paying a high price when purchasing the ownership of a property concerning all the amenities, especially, green spaces present in that area.

Using the marginal implicit price of green spaces, the total value of greenery available within each DS division was calculated (Table 2). These values were obtained by multiplying the extent of total greenery available within a DS division by the nominal value of the marginal implicit price of green spaces. The results show how DS divisions like Kolonnawa, Thimbirigasyaya and Moratuwa have a higher extent of greenery which gives a higher total value for the green space in that area while Dehiwala, Rathmalana and Colombo divisions have relatively less greenery which gives those areas a relatively lower value for the green spaces.

Table 2. The total value of greenery in DS divisions

DS Division	Total Value in 2023 LKR
Colombo	37,252,494.30
Sri Jayawardenapura Kotte	44,322,037.26
Thimbirigasyaya	56,995,879.99
Dehiwala	22,715,231.42
Moratuwa	47,692,825.70
Kolonnawa	68,826,756.55
Rathmalana	33,871,513.07

Considering the other control variables incorporated in the study, availability of a bus stand, railway station, hospitals, and bank shows a significant positive relationship with real land values but the availability of schools does not show a significant effect even though it has a positive relationship with the land value. Kuroda and Sugasawa (2022) explains this incident as when individuals entering into a purchase agreement of a property with a higher price and longer ownership period, they place more importance on their living environment, while those entering into a less expensive and easier agreements like rentals are more likely to place importance on accessibility to commercial areas, workplaces, schools, etc. Similarly, the study shows how people tend to place more importance on their living environment including the available green spaces and the ecosystem services provided by them, hence increasing the value of the residential lands.

Other control variables like population showed a significant negative impact on land values, highlighting the challenges of urban density while prevalence of drugs and occurrence of disasters like canal over flooding

and pollution due to industries have a negative effect on real land values, since people prefer not to live in areas with such catastrophes.

CONCLUSIONS

The eco system services that green spaces provide to residents has attracted interest in a variety of fields. While many studies have analyzed the value of various aspects of greenery, this study provides a comprehensive analysis of the intrinsic value of green spaces in Colombo District, Sri Lanka by employing a hedonic pricing model and remote sensing techniques, demonstrating a positive significant relationship between green space and real land value. Marginal implicit price of green space was derived as Rs. 70.58/ perch and this value was employed in estimating the total value of greenery in specific regions, where divisions like Kolonnawa and Thimbirigasyaya with extensive green cover showed the highest total value of greenery.

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Willingness to Pay for Crop Insurance Schemes among Paddy Farmers in Sri Lanka: A Case Study in Kurunegala District

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ABSTRACT

Climate change poses significant risks to the production of agriculture. Crop insurance is one of the risk management approaches widely used by farmers to increase their resilience against crop losses caused by many reasons, including climate change. However, farmers in Sri Lanka denotes a limited acceptance of crop insurance schemes. This study aimed to investigate the perceptions and Willingness to Pay (WTP) for crop insurance schemes among the paddy farmers in Kurunegala district. A total of 248 paddy farmers from the Kurunegala district were recruited as the study sample using the stratified random sampling approach. A pre-tested structured questionnaire and choice cards were used for primary data collection. Descriptive statistics and the Conditional Logit Model (CLM) were used to analyze data. Around 77.8% of respondents were males engaged in paddy farming, while the majority (62.5%) received an income of Rs. 50,000 to 75,000. According to the results, the claim form filling process should be made easy (mean=4.64), and all crops must be notified under crop insurance (mean=4.57), which were among the main perceptions influencing farmer's views toward crop insurance. The analysis of the choice card data indicated that farmers have a high Marginal Willingness to Pay (MWTP) for attributes ensuring coverage in the absence of hazards, reflecting a strong preference for comprehensive insurance schemes. However, the assessment method for crop damage revealed a negative coefficient (-13.4; $p<0.001$), suggesting a need for improvement in loss assessment procedures to enhance the appeal of insurance schemes. Overall, findings emphasize the significance of implementing responsive crop insurance schemes to enhance climate resilience and ensure the viability of paddy production.

KEYWORDS: Choice experiment, Climate change, Crop insurance, Index-based, Willingness to pay

INTRODUCTION

According to the United Nations Framework Conservation on Climate Change (UNFCCC, 2008), any change that is caused directly or indirectly by anthropogenic activities, which changes the composition of global atmosphere over a long period of time, could be defined as Climate Change (CC). At present, CC has caused significant impacts such as rising atmospheric temperatures, changing precipitation patterns, sea level rise, frequent occurrence of extreme natural disasters such as hurricanes, floods, and droughts. Climate change is the most serious environmental threat that adversely affects agricultural productivity by disrupting crop cycles, hindering the growth and development of the crops, reducing yields, inducing thermal stress, and increasing the occurrence of pests and diseases (Enete and Amusa, 2010; Knutson *et al.*, 2010). Several studies have predicted that farmers in South Asia and Sub-Saharan Africa may face substantial production losses due to the CC, thereby intensifying the risk perceptions and limiting investment in high value, thereby creating a poverty trap.

Agriculture serves as a major pillar of the Sri Lankan economy. Paddy production is one of the main productions and the staple foods in Sri Lanka. Paddy is cultivated in all districts of Sri Lanka, mainly under two monsoon seasons, such as *Yala* and *Maha* seasons. It is estimated that about 708,000 ha of land are under the paddy cultivation. However, farmers have experienced substantial damage and losses in paddy production due to severe climate shocks like droughts and floods over the recent years.

According to the Agricultural and Agrarian Insurance Board (AAIB), droughts have damaged around 58,766 acres of paddy, of which the highest damage is reported in the Kurunegala district (AAIB, 2023). Meanwhile, extensive floods have damaged around 47,000 acres of paddy, directly impacting 20,064 farmers in the 2023 *Maha* season. Therefore, Sri Lanka's paddy cultivation urgently needs sustainable adaptation strategies to mitigate the adverse effects of CC and to sustain food security.

Crop insurance has been proposed as a major CC adaptation strategy, which enables the financial management of risks through transfer to a third party (Binswanger, 2012). Crop insurance is being practiced in more than 70 countries in the world. In 1999, the AAIB was established in Sri Lanka, which is the responsible government agency for undertaking the government crop insurance programmes. In

addition, several private insurance companies such as Ceylinco General Insurance and Sanasa General Insurance have introduced crop insurance schemes in Sri Lanka. The government of Sri Lanka has also understood the importance of crop insurance schemes and decided to provide free agricultural insurance covering six types of crops including paddy, onion, potato, maize, soya bean and chili from the 2018 *Yala* season onwards. In the case of crop damage, Rs. 40,000 per acre is being provided by the AAIB (AAIB, 2023). In the Sri Lankan context, two main types of crop insurance schemes are being practiced as; Standard crop insurance schemes and Index based crop insurance.

The Standard crop insurance refers to a type of insurance coverage designed to protect farmers against financial losses resulting from crop damage or failure due to various perils. The assessment of crop losses is typically based on physical inspections conducted by insurance assessors or adjusters. In contrast, the Index based crop insurance schemes tend to address the limitations in conventional Standard crop insurance, by relying upon specific weather-related parameters (rainfall, temperature, humidity), as a proxy measure of crop losses.

Despite the potential to reduce risks, farmers' demand for insurance remains lower than expected. Previous studies have indicated multiple reasons for this, including financial constraints, unfamiliarity with insurance, low financial literacy, and lack of trust in insurance providers (Binswanger, 2012). While previous studies have provided valuable insights into the mechanisms of crop insurance and their significance, a limited understanding exists on how farmers perceive and engage with these crop insurance programmes, especially in Sri Lanka. Therefore, this study aimed to evaluate the perceptions on crop insurance and to characterize their willingness to accept crop insurance schemes among paddy farmers in the Kurunegala district, Sri Lanka.

METHODOLOGY

Theoretical Framework

Decision maker's perception on various attributes can be assessed using two methods, namely Stated Preference (SP) and Revealed Preference (RP) methods (Berges and Casellas, 2009). This study was based on the SP method. Among numerous SP techniques, the Discrete Choice Experiment (DCE) is one of the most popular techniques. It usually utilizes choice cards, which comprise of predetermined key attributes and respective levels to understand the perceptions of a study population (Mandeville *et al*., 2014). Choice Experiments (CE) can be connected to circumstances, where an individual selects one alternative from a set of alternatives (Aizaki, 2012).

The CE has a theoretical basis with the Lancaster's model of consumer choice (Lancaster, 1966), and Random Utility theory. According to the Lancaster's Consumer Theory, it is assumed that the utility of a product stems from different product attributes. Meanwhile, the Random Utility theory explains the dominance judgments between pairs of offerings (McFadden, 1974), where a rational consumer will maximize the utility added from his/her choice made. This could be represented by equation 1.

$$U\,i = V\,i + \varepsilon\,i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where,

U_i = Utility of the i^{th} alternative
V_i = Objective component of i^{th} alternative
$\mathcal{E}_i$ = Error component

Development of Choice Sets

The most important attributes and their levels regarding the crop insurance schemes were identified based on a literature review and preliminary focus group discussions. Choice cards were prepared using these significant attributes and respective attribute levels. Four attributes, each with two levels were considered (Table 1), each resulting in 16 possible choice profiles. Orthogonalization procedure was carried out using SPSS to identify the main interactions (Figure 1).

Table 1. Attributes and levels

Attributes	Levels
Hazard	Flood Drought
Assessment Method	On field Index based
Premium (per acre per season)	Rs 800 Rs 1000
If No Hazard (per acre)	50% 75%

Study Area and Data Collection

This study was conducted in the Kurunegala district from February to May 2024. A total of 248 paddy farmers representing eight Divisional Secretarial Divisions were selected as the sample. The stratified random sampling approach was used as the sampling technique, where irrigated nature (major and minor irrigated) of paddy cultivation was considered as strata.

Attribute	Option 1	Option 2	None
Hazard			
Assessment Method			
Premium			
If No Hazard			
I would Choose	☐	☐	☐

Figure 1. A sample choice card

Questionnaire Design and Data Collection

A pre-tested interviewer-administered structured questionnaire and a planned set of choice cards were used as the data collection tools. The survey questionnaire consisted of four major sections as, a) socio-demographic data, b) farming-related data, c) farmer awareness on crop insurance schemes, d) perception of farmers toward crop insurance. The choice sets were randomized across questionnaires to avoid order bias.

Statistical Analysis

Descriptive statistics were used to analyze the socio-demographic factors, farming related information and awareness of farmers on crop insurance. A Conditional Logit Model (CLM) was fitted to analyze the data deriving from the CE. Based on the population represented by the sample, indirect utility arising from the crop insurance attributes can be represented as (equation 2),

$$Vi = \beta + \beta_1 ln\ (Z_{Hazard}) + \beta_2 ln\ (Z_{Assessment\ method}) + \beta_3\ ln\ (Z_{Premium}) + \beta_4 ln\ (Z_{If\ no\ hazard}) \ldots (2)$$

where, β refers to a coefficient, the term β_1 *to* β_6 refers to vectors of coefficients associated with the vector of attributes. The Parameters of the model were used to calculate the Marginal Willingness to Pay (MWTP), as indicated in the following equation (equation 3),

$$MWTP = -1\left(\frac{\beta_{attribute}}{\beta_{monetory\ attribute}}\right) \ldots\ldots\ldots\ldots\ldots (3)$$

RESULTS AND DISCUSSION

Socio-Demographic Information

The socio-demographic characteristics of the respondents are given in Table 2. Out of the 248 respondents, the majority of the respondents were males (77.8%), when compared to females (22.2%). Most of the respondents (48.8%) were belonging to the age category of ≥ 61 years. A relatively higher portion of respondents had completed Ordinary Level (O/L) as their highest educational qualification (34.3%). Around 32.7% of the respondents were full time farmers, followed by another 17.7% engaged in self-employments. Most of the respondents were having 3-4 dependents (60.1%) in their families. In case of the total monthly income, 62.5% of respondents were having an income range of Rs.50,000 to Rs.75,000, followed by another 20.2% with an income level of Rs.25,000 to Rs. 50,000 (Table 2).

Table 2. Socio demographic characteristics

Parameter		Percentage (%)
Gender	Female	22.2
	Male	77.8
Age (years)	≤ 30	1.6
	31 - 40	12.5
	45 - 60	37.1
	≥ 61	48.8
Education Level	Illiterate/Up to grade 5	31.0
	O/L	34.3
	A/L	23.8
	Diploma/Degree	10.5
	Post-Graduate	0.4
Employment	Farming	32.7
	Labor	8.5
	Self Employed/ Vendor	17.7
	Government Services	15.7
	Private Sector	11.7
	Housewife	4.8
	Retired	8.9
No. of. dependents	None	6.0
	1 – 2	27.0
	3 – 4	60.1
	> 4	6.9
Monthly Income (Rs)	< 25000	3.2
	25000 - 50000	20.2
	50001 - 75000	62.5
	> 75000	14.1

Farming related Information

Table 3 shows the farming related data of the study sample. The majority of farmers were cultivating their own lands (69.4%). Further, most of the farms had 1-4 acres of crop lands in extent (54.4%). From the total sample, 59.3% of respondents had more than 20 years of farming experience.

Table 3. Farming related data

Parameter	Category	Percentage (%)
Land Ownership	Own	69.4
	Hired	30.6
Extent of Farm Land (Acres)	< 1	39.5
	1 - 4	54.4
	5 - 9	6.0
Farming Experience (Years)	< 5	3.6
	5 - 9	6.5
	10 - 14	10.5
	15 - 19	20.2
	> 20	59.3

Attitudes and Perception on Crop Insurance

Farmer perceptions and attitudes toward crop insurance are summarized in Tables 4 and 5, respectively. The majority of farmers were perceiving that the claim form filling process should be made easy (mean=4.64) and all crops must be notified under crop insurance (mean=4.57). These were the predominant perceptions influencing farmer's views toward crop insurance.

Table 4. Farmer perception toward crop insurance

Pa	Perception					
	SD	D	N	A	SA	M
Ma	00	00	00	620	465	4.38
On	550	408	54	18	09	4.19
Di	07	12	54	668	250	4.00
Al	00	10	30	288	805	4.57
Da	00	00	66	684	275	4.13
Ve	00	00	645	132	00	3.13
Cl	00	00	18	308	825	4.64
As	00	16	54	472	520	4.28

Note: Pa - Parameter, M - Mean, Ma - Crop insurance is mandatory for all farmers, On - Only large farmers can afford, Di - Difficult for small and marginal farmers to meet their loss due to crop insurance, Al - All crops must be notified under crop insurance, Da -Damage caused by fire and wild animal attack must be included, Ve - Very important for the farmers to be educated to protect crop from damage, Cl - Claim form filling process should be made easy, As - Assessment must be done at the individual field level. Score: SD (Strongly Disagree) - 1, D (Disagree) - 2, N (Neutral)- 3, A (Agree)- 4, SA (Strongly Agree) - 5.

In case of the attitudes toward crop insurance, major concerns included the belief that insurance exploits the farmers with a high premium, (mean= 5). However, the fact that the claim process for crop insurance is straightforward and easy to understand was ranked with a mean of 4.62, while dissatisfaction with the service quality received a mean of 4.45.

Table 5. Farmer attitudes toward crop insurance

Pa	Attitudes					
	SD	D	N	A	SA	M
Ins	1240	00	00	00	00	5.00
La	00	00	57	536	475	4.31
Cl	00	00	48	248	850	4.62
Ci	00	00	144	640	200	3.97
Pa	00	00	183	536	265	3.97
Pr	00	00	156	588	245	3.99
Fa	00	00	84	320	700	4.45
Pre	02	00	258	396	305	3.88

Note: Pa - Parameter, M - Mean, Ins - Insurance exploit the farmers with high premium, La - Lack of an organized system disseminated information, Cl - Claim process straightforward and easy, Ci - Crop insurance helps to alleviate financial stress during periods of crop failure or low yields, Pa - Participate in crop insurance are more resilient to impacts of CC, Pr - Promotes long-term sustainability and viability of farming communities, Fa - Farmers express dissatisfaction service quality, Pre - Premium amount should be calculated on the basis of number of risk factors. Score: SD (Strongly Disagree) - 1, D (Disagree) - 2, N (Neutral) - 3, A (Agree) - 4, SA (Strongly Agree) - 5.

Outcomes of the Choice Experiment

Results of the CLM are presented in Table 6. Based on the CLM, all four attributes remained statistically significant ($p<0.05$) at a 95% level of confidence. The coefficients received for hazard, premium and 'if no hazard' attributes were positive, while the coefficient of the assessment method was negative. The positive coefficients of the attributes suggested that those attributes are positively correlated with the utility of farmers. It implies that they are willing to pay more for each attribute of crop insurance to insure their cultivation.

The estimated MWTP values for the significant attributes on crop insurance are included in Table 7. The results revealed that the maximum MWTP was Rs.1435.33 per acre for the 50% level and Rs.1565.33 per acre for the 75% level of the 'no hazard' attribute. This is because, in the absence of a hazard event and subsequent claims, the insurance policy rolls

over to the next year, with the total insured amount constituting, either 50% or 75% of the initial sum insured. Generally, farmers were willing to pay a maximum of Rs.1766.33 per acre per season, as the premium.

Table 6. Estimates of the CL model

Attribute	Levels	Co-efficient	*P* Value
Hazard	Flood	7.784	<0.001
	Drought	8.179	<0.001
Assessment method	On field	-13.623	<0.001
	Index-based	-13.449	<0.001
If No Hazard	50%	12.918	<0.001
	75%	14.088	<0.001
Premium		-0.009	<0.001

Table 7. MWTP values

Attribute	Levels	MWTP (Rs.)
Hazard	Flood	864.89
	Drought	908.78
If no hazard	50%	1435.33
	75%	1565.33

The assessment methods used to assess the crop damage revealed negative coefficient values. This suggests that, as this attribute increases, the amount individuals are willing to pay decreases, or the amount they would need to be compensated for accepting a negative change increase. Despite this being significant ($p<0.05$), these attributes might reduce farmers' willingness to engage in insurance schemes. Further, investigation is needed to understand why these have a negative preference, which will aid to implement an appropriate method.

CONCLUSIONS

The findings of CLM analysis demonstrate that the attributes of CE, hazard, premium, and 'if no hazard' significantly influence the farmers' WTP for crop insurance schemes, with positive coefficients indicating a positive correlation with farmers' utility. This suggests that farmers are willing to invest more in insurance coverage for their crops. In addition, the negative coefficient received for the assessment methods indicates a lower willingness or acceptance. The 'if no hazard' attribute was characterized with the highest coefficient values, which emphasizes the importance of continuity in insurance coverage, especially during hazard-free periods.

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Consumer Willingness-To-Pay for Revealing of Information on Credence Attributes: Assessing the Case of Agri-Food Products in a Supermarket Setting in the Matara Township

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ABSTRACT

In the dynamic environment of consumer preferences and ethical considerations within the agri-food sector, the study of Willingness-To-Pay (WTP) for Credence has become a crucial aspect in understanding purchasing behaviour, particularly in the context of agri-food products such as eggs, milk powder, and rice. These agri-food products represent essential components of a typical Sri Lankan diet. This research was based on mixed method techniques and data for credence attributes of eggs, milk powder, and rice were gathered from consumers (n=320) in the Matara district using a pre-piloted structured questionnaire and choice cards. The WTP for those credence attributes was ascertained using two analytical tools provided by NVivo-14 statistical software, including Choice Experiment (CE), and Conditional Logistic Regression (CLR). The qualitative part of the analysis revealed that the Matara supermarket base justifies the fact that consumers' confidence in the milk powder stems from its credence attribute to faith in "local producers". For eggs and rice, the search attribute of "appearance" was the main concern. The outcome of the analysis to estimate WTP revealed that the Marginal WTP value given by those respondents was highest (Rs.779.16) for "nutritional facts" in milk powder, where the consumers` purchasing decisions were primarily influenced by their belief that local production offers higher nutritional value. Nutrition has also been ranked at the top for eggs and rice. The research provides essential information on appearance, nutritional facts, and producer details that are crucial for policymakers in formulating marketing strategies and consumer safety guidelines for agri-food producers, and consumers.

KEYWORDS: Agri-food sector, Consumer information environment, Credence attributes, Food quality and safety, Willingness-to-pay (WTP)

INTRODUCTION

Consumers are increasingly seeking high-quality, safe, and ethically sourced food, however Credence Attributes, and product features that are not tangible/available within certainty before or at the time of purchase decision such as nutritional fact, place of origin package material, brand name, keepability, standards, and certification, are not easily verifiable. The contemporary agri-food market is witnessing a paradigm shift in consumer expectations, with an increasing emphasis on transparency and ethical considerations in such contexts. This makes informed choices challenging for consumers while producers strive to meet these advancing demands.

Caswell (1998) presented a framework to classify various attributes that contribute to perceived quality of a food. As in most food products, a consumer`s decision to buy agri-food products is influenced by three `groups` of attributes, including (1) Search: (2), Experience, and (3) Credence. Search attributes can be seen and evaluated "before" purchasing. (*e.g.* colour, price). Experience attributes can be evaluated "after" consumption. (e.g. taste. smell). These two can be considered as "observable" characteristics. On this justification, those attributes that cannot be "observed" directly are named "Credence".

Consumers added numerous agri-food products to fulfil their dietary needs and create a balanced meal. Amongst them, rice is generally recognized as a key dietary staple in Sri Lankan households. Over the past few decades, eggs have been one of the major sources of protein in the regular diet of Sri Lankan households (Ranasinghe *et al*, 2017). Milk powder can be used for breakfast drinks or desserts alongside rice-based meals. In addition, consumers are used to add milk powder into their diet as a key source of energy. Supermarkets offering milk powder from trusted local sources, with clear information on processing and quality control can cater to a discerning clientele seeking information on adulteration, nutritional content, and sourcing of milk. Supermarkets are likely a more accessible source of data compared to individual manufacturers.

The study was focused on assessing the potential relationships of various consumer demographic characteristics, and different shopping behaviours on their Willingness-To-Pay (WTP) for those above mentioned three agri-food products, within in established supermarket setting in the township of Matara.

METHODOLOGY

Theoretical Framework

When buying agri-food commodities, consumers request a growing number of features (observable or unobservable) and are ready to pay a price to acquire these characteristics in common. Revealed Preference (RP) and Stated Preference (SP) are two methods to infer consumer attitudes or preferences for a private or public good. While SP involves asking people to express their preferences in hypothetical scenarios, RP uses market or experimental data to investigate consumer preferences through real-life decision-making (Traoré *et al*., 2023). SP method was employed in the research process to estimate Marginal WTP. Choice Experiment (CE) is the commonly used SP method to determine respondents' WTP based on their answers to a fictitious market solicitation.

CE is based on Lancaster`s Theory of consumer choice and the Random Utility Theory. Utilizing the fundamental idea of Random Utility Modelling (RUM) by McFadden (1974), WTP was calculated. Random Utility Theory explains the econometric basis of CE. It explains how a rational decision-maker will maximize the utility gained from his/her choice (McFadden, 1974). Lancaster`s theory (1996) describes how an individual`s consumption decisions depend on the utility gained by attributes of the consumed good, which is the basis for the conceptual framework for RUM. Thus, utility in choice is composed of an error component (e), which represents the unobservable features influencing the consumer's decision, and a deterministic component (V), which represents the observable attributes (McFadden, 1974). Therefore, the ith alternative's utility function can be expressed as:

$$U_i = V_i + \varepsilon_i \cdots\cdots\cdots(1)$$

U_i = Utility of the ith alternative
V_i = Objective component of ith alternative
ε_i = Error component

The Conditional Logistic Model was used to evaluate the responses and subsequently, the Marginal WTP was, calculated by using Equation 2.

$$MWTP = -\left(\beta_{attribute} - \beta_{\substack{monitory \\ attribute}}\right) \cdots (2)$$

Where $\beta_{attribute}$ is the coefficient of the attribute and $\beta_{monitory\ attribute}$ attribute is the coefficient of the monitory attribute in the RUM. Marginal WTP measures is the amount that a respondent is willing to pay for an alternative product but with an attribute level.

Choice Experiment

To find out the value placed on these three agri-food products, Choice Cards were prepared using crucial attributes derived from Caswell`s Classification (Caswell1, 1998). The most important and interesting attributes were selected by a series of focus group discussions and reviewing of the past literature. All possible outcomes were reduced and randomly blocked into eight choice card profiles by an orthogonalization procedure using SPSS version 25 statistical software. Using "Stata" statistical software to estimate the coefficients of variables applied in the empirical model, the coded choices of respondents were used to determine the Marginal WTP for each characteristic (Piyathilaka *et al.,* 2016). The chosen attributes and their levels are given in Table 1. There were three levels: Yes, No, and None. If a particular interviewer liked an attribute, interviewer chose Yes, and if not, they chose No. The interviewer did not consider a particular attribute/did not purchase the agi-food product, interviewer chose the None option.

Table 1. Attributes and levels

Attributes	Levels
1. Nutrition facts	a) Yes
	b) No
	c) None*
2. Place of origin	a) Yes
	b) No
	c) None*
3. Package material	a) Yes
	b) No
	c) None*
4. Brand name	a) Yes
	b) No
	c) None*
5. Keepability	a) Yes
	b) No
	c) None*
6. Standards and certifications	a) Yes
	b) No
	c) None*
7. Price (Rs.)	a) 60-70
	b) 40-50
	c) None*

**Base Level*

Data Collection and Analysis

The mixed method design was used to gain a deeper understanding. More specifically, a qualitatively initiated mixed method was used starting with interviews, followed by a

quantitative survey to verify the findings from the qualitative phase. Then a follow-up quantitative study was conducted to validate the findings of the interviews.

The study was carried out in the Matara district and three supermarkets: Keells Super, Arpico Supercenter, and Cargills Food City were selected from the district. Using systematic approach every 10th customer who visited the supermarket was interviewed from April to May 2024. This method yielded a sample size of 320 respondents.

Primary data collection was done using eight choice sets supported by a structured questionnaire which was randomized across questionnaires to eliminate order biases. After the questionnaire survey, respondents were presented with a choice card and asked to select their most preferred choice out of the two choices given as shown in the sample choice card in Figure 1. Conditional Logistic Regression (CLR) was employed to assess the Marginal WTP value for attributes.

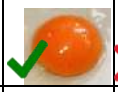
Eggs			
Attribute	Option		
	1	2	3
Nutritional Facts	Yes 	No 	 None
Place of Origin (Producer/Farm)	Yes 	No 	
Package Material	Yes 	No 	
Standards and Certification	No 	Yes 	
Price (Rs.)	60-70	40-50	
	Option		
	01 ☐	02 ☐	03 ☐

Figure 1. Sample choice card

RESULTS AND DISCUSSION

Results of Qualitative Study

A word cloud was generated by using qualitative analysis of interview data using NVivo 14. This cloud showcases the most frequently mentioned terms by consumers across 244 interviews. According to the word cloud, it can be observed consumer choice is more on appearance (Figure 2. (A) and (B)), coming under search attribute for eggs and rice. But in the case of milk powder (Figure 2. (C)) consumers preferred credence attributes such as local production, brand, and nutritional facts. In case of eggs and rice consumers considered credence attributes such as nutritional facts and producer information, only after search attributes.

Results of Quantitative Study

Descriptive Analysis of Respondents

As depicted in Table 2, out of the 320 respondents, a majority of respondents were female (54%) when compared to males (46%) and belonged to the age category of 31–60. Out of the total sample, 33% had diploma-level education. 51% of the total respondents visited supermarkets biweekly, and the most influential factor in supermarket visits was having lots of varieties accounting for 31%.

Table 2. Descriptive statistics of the sample

Parameter	Frequency	Percentage (%)
1. Gender		
a) Male	146	46
b) Female	169	54
2. Age		
a) Under 30	81	26
b) 31-60	120	38
c) 61 and above	114	36
3. Current Professional Status		
a) Student	3	1
b) Unemployed	103	33
c) Employed	123	39
d) Retired	86	27
4. Education Level		
a) GCE O/L	40	13
b) GCE A/L	72	23
c) Diploma	104	33
d)Degree/Higher	99	31
5. Frequency of Supermarket Visits		
a) Daily	5	2
b) Weekly	88	28
c) Biweekly	161	51
d) Monthly	61	19
6. Factors for Supermarket Visits		
a) Cost of good	58	18
b) Proximity	63	20
c) Varieties	98	31
d) Freshness of good	96	30

Outcome of Conditional Logistic Regression

The results obtained from the CLR applied to choice data with six attributes (nutrition facts, place of origin, package material, brand name, keepability, standards, and certification) are given in Table 3. With reference to CE results, had an idea on how the parameters of the equation were important and influenced customers' preference for credence attributes in relation to coefficient values. A positive coefficient for the attributes implies the respondent's WTP for credence attributes.

(A) **(B)** **(C)**

Figure 2. Word cloud for agri-food products. *(A) Eggs; (B) Milk Powder; (C) Rice*

According to the results of the choice experiment, consumers are willing to pay for all credence attributes of eggs. Consumers, however, prefer not to pay for attributes like package material and standards in milk powder and keepability in rice. Marginal WTP analysis revealed that consumers in the Matara district placed the highest value on nutritional facts for all three agri-food products investigated. They expressed a willing to pay a premium of Rs. 779.16 for milk powder, Rs. 42.28 for eggs, and Rs. 67.47 for rice, specifically for attributes related to nutritional content.

CONCLUSIONS

Overall, outcome of the study shows that consumers in Matara supermarket setting are willing to pay for credence attributes as well as search attributes for agri-food products; eggs, milk powder, and rice to fulfil their dietary needs. It was observed that marketers can target premium market segments by emphasizing credence attributes, certifications, ethical practices, and nutritional information on packaging to attract health-conscious consumers. The finding suggests a growing consumer sophistication and a potential market for premium agri-food products that prioritize these credence attributes. Furthermore, the research provides essential information on appearance, nutritional facts, producer details, and other aspects that are crucial for policymakers in formulation marketing strategies and consumer safety guidelines for agri-food producers, and consumers. Additionally, it highlights positive attitudes towards credence attributes, which should be a significant consideration in these agendas.

Table 3. Outcome of choice experiment

Attribute level	Eggs			Milk powder			Rice		
	Co.	P value	MWTP	Co.	P value	MWTP	Co.	P value	MWTP
1. Nutrition Facts									
a) Yes	3.51	0.01	42.28	1.87	0.00	779.16	3.75	0.00	61.47
b) No	-1.75	0.11	-21.08	-0.21	0.65	-87.5	-0.23	0.80	-36.50
2. Place of Origin									
a) Yes	1.74	0.00	20.96	1.61	0.00	666.66	0.06	0.79	0.98
b) No	-2.20	0.00	-26.50	0.21	0.63	87	0.12	0.58	0.12
3. Package Material									
a) Yes	0.27	0.45	3.35	-0.81	0.19	-337.50	0.56	0.05	9.18
b) No	-0.36	0.34	-4.33	-1.37	0.06	-570.83	-0.40	0.16	-63.49
4. Brand Name									
a) Yes	1.01	0.00	12.16	-0.12	0.72	-50	1.27	0.08	20.81
b) No	-1.13	0.01	-13.61	0.04	0.65	16.6	-1.23	0.01	-20.16
5. Keepability									
a) Yes	2.84	0.00	35.5	1.79	0.00	745.83	-0.48	0.05	-7.86
b) No	-2.30	0.01	-29.25	0.06	0.87	25	0.48	0.62	7.86
6. Standards and Certification									
a) Yes	1.07	0.06	1.07	-0.47	0.03	-195.83	0.29	0.56	4.75
b) No	-1.08	0.11	12.98	-0.81	0.02	-337.5	0.86	0.10	14.09
7. Amount able to be paid									
	8.3 $\times 10^{-2}$	0.00		2.4 $\times 10^{-3}$	0.89		6.1 $\times 10^{-2}$	0.00	

**Base level, Co: Coefficient, Eggs: Log pseudolikelihood = -349.49, Pseudo R^2 = 0.4082, Milk Powder: Log pseudolikelihood = -389.20, Pseudo R^2 = 0.34, Rice: Log pseudolikelihood = -477.05, Pseudo R^2 =0.1922*

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Assessing Farmer's Willingness to Pay for Sustainable Agricultural Land Use Practices: A Choice Experiment in the Knuckles Region, Sri Lanka

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ABSTRACT

Knuckles region is one of the most socio-economically and aesthetically valued regions of Sri Lanka, is facing serious environmental threats resulting from unsustainable agricultural practices, deforestation, and climate change and warrants immediate action. This study was aimed at investigating the extent to which farmers in this region utilize sustainable agricultural land use practices and to elicit the value placed by farmers on them. A Discrete Choice Experiment (DCE) was conducted with the farmers in this region, to assess their preferences and Willingness to Pay (WTP) for different environmental attributes such as improvements in water quality, reducing soil erosion in agricultural land, and improvements in carbon balance. The results indicate that there is a strong preference among farmers for substantial reductions in the use of chemical fertilizer, to incorporate a comprehensive soil erosion reduction activity and their likelihood of enhancement of the carbon balance. The highest obtained Marginal Willingness to Pay (MWTP) of Rs.77.78 was for a higher percentage of reduction of chemical fertilizer use indicating that they place a high priority on the improvement of water quality. Farmers are also willing to contribute towards soil erosion reduction activities and carbon balance implying that the farmers long for sustainable environmental solutions. The Total Willingness to Pay was calculated to be Rs. 270.56. These results also suggest the potential for implementing nature-based solutions such as the 'Payment for Ecosystem Services' scheme taking into consideration the needs of the local communities, ensuring long-term environmental health and optimizing agricultural productivity.

KEYWORDS: Agricultural land use, Conditional logit model, Discrete choice experiment, Willingness to pay

INTRODUCTION

The Knuckles Forest region covers an area of approximately 21,000 ha and lies in the districts of Matale and Kandy in central Sri Lanka. It is renowned for its rich biodiversity and its unique ecosystem services. This World Heritage Site holds immense ecological significance, serving as a vital water catchment area, climate regulation, and provision of essential ecosystem services.

The local communities in the Knuckles region depend heavily on natural resources for their livelihood, creating tension between the conservation goals and community needs (Gunatilake, 1994). In recent years, this forest reserve has faced numerous environmental challenges, including water quality degradation, loss of biodiversity and elevated soil erosion, which threatens the ecosystem stability. It is exacerbated by anthropogenic activities such as intensive agriculture, deforestation, illegal logging, rapid population growth, climate change, and the increasing tourism industry in this area. It poses a significant challenge to the environmental stability and the well-being of the community, making it imperative to address the underlying factors that contribute to this phenomenon.

Unsustainable agricultural practices are identified as a major threat to the Knuckles region. The excess use of biocides and chemical fertilizers, especially in the rice fields, carried the residue in run-off, polluting the streams and harming aquatic life. The topography of this region is highly vulnerable to soil erosion. Without adequate soil conservation techniques, the erosion rates can escalate, resulting in soil and nutrient loss in agricultural lands. Farmers often lack awareness or incentives to adopt soil conservation which further perpetuates the cycle of soil degradation. In addition, several export-oriented crops such as cardamom and tea have been largely grown in the area (Wickramasingha *et al*., 2008). This resulted in significant deforestation and it can adversely affect the region's carbon balance. Due to the enforcement of conservation legislation, unsustainable practices such as slash-and-burn cultivation were prohibited in various parts of the Knuckles region. It also reduced illegal activities in this area (Weerawardhena and Russell, 2012). Therefore, sustainable agricultural land use practices play a crucial role in safeguarding and preserving agricultural productivity, which needs concerted efforts from various stakeholders, including government agencies and local communities for long-term prosperity and environmental stewardship.

Considering the growing need for a comprehensive study, this research aimed to investigate the complex interplay between human activities, ecosystem stability and the potential need for further conservation efforts in the Knuckles region. Also, this study aimed to assess the extent to which farmers in this region engage in sustainable land use practices and to elicit the value that the farmers place on the application of these practices with a special focus on soil conservation. It will contribute to a comprehensive understanding of sustainable agriculture in the Knuckles region.

Payment for Ecosystem Services (PES) is an innovative mechanism utilized to motivate the communities for better management of ecosystem services, where it is classified as a voluntary transaction of a well-defined ecosystem service being bought by an ecosystem service provider (Wunder, 2005). PES is a relatively new strategy for environmental conservation in Sri Lanka, but if designed properly it can be a holistic approach to the management of natural resources for achieving conservation (Kallesoe and De Alwis, 2005). While there are no currently and fully established PES schemes in Sri Lanka, there is a growing trend and interest in its potential for environmental conservation.

METHODOLOGY

Theoretical Framework

The stated preference method which includes the choice experiment is based on the Random Utility Theory and Lancaster's model of consumer demand and it is used for non-market valuation.

Lancaster's model suggests that individuals derive utility from the characteristics of goods and services they choose and not from the goods themselves (Lancaster, 1966). According to the Random Utility Theory, it is assumed that individuals make rational choices, which maximize satisfaction/utility, therefore the respondents are assumed to choose the alternatives that yield the highest utility which reflects their preference and perception on different attribute levels (McFadden, 1974). Accordingly, the utility of a choice consists of two main components: the systematic/observable component derived from the characteristics of the alternatives and the error/unobservable component which captures the random and unobserved influences in decision-making. Therefore, the utility U for the i^{th} alternative can be denoted as follows:

$$U_i = V_i + \varepsilon_i \quad \text{.....(1)}$$

U_i = Utility of the i^{th} alternative
V_i = Observable component of the i^{th} alternative
$\mathcal{E}_i$ = Error component

Choice Sets

By incorporating the insights from focus group discussions, literature reviews and expert consultations the necessary attributes and their specific levels were chosen. Initially, a full factorial design was generated using SPSS version 27, considering all the possible combinations of attribute levels. Subsequently, the fractional factorial design was derived to reduce the possible combinations. Three choice cards were created, which presented a set of three alternatives with varying attribute levels. Each card's final option was allocated as the opt-out option if none of the presented alternatives were preferred. The selected attributes and their levels are given in Table 1.

Table 1. Attributes and their levels

Attribute	Levels
Water quality improvement	30% reduction in the use of chemical fertilizer 10% reduction in the use of chemical fertilizer Status quo
Soil erosion reduction activities	50% land area Total land area Status quo
Carbon balance	25% increase 50% increase Status quo
Willingness to Pay (Monthly)	Rs. 50 Rs.100 Status quo

Data Collection

The study was conducted in the Matale district focusing on farmers in three different *Grama Niladhari* Divisions known for their exemplary agricultural practices. Using the cluster sampling method, a sample of 301 farmers was surveyed using a structured questionnaire with a set of choice cards. The questionnaire also included sections to gather information about the socioeconomic characteristics of the respondents, soil conservation practices, ecosystem services, the threats faced by the Knuckles region and their perception of practicing sustainable farming practices using a 1–5 point Likert scale. A pilot study was conducted before the main survey to refine the questionnaire.

The socio-demographic characteristics of the farmers in the area were examined through descriptive statistics. The reliability of the data

collected was measured using Cronbach's alpha value and a Confirmatory Factor Analysis (CFA) was conducted using SPSS software for each section to ensure the consistency of the data collected. From that, a Relative Importance Index (RII) was developed to identify the importance and perception of each indicator by farmers in this region. The equation for RII can be written as,

$$RII = \frac{AGS}{MPS} \quad \text{.....(2)}$$

AGS – Aggregated score
MPS – Maximum potential score

Statistical Analysis

The Conditional Logit Model (CLM) was used to estimate the equation. The data were analyzed through STATA 15 software. The model includes attributes in general linear form as given in equation 3, along with the Alternative Specific Constant (ASC) for each alternative. The parameters obtained from it can be used to obtain Marginal Willingness to Pay (MWTP) for each attribute proposed.

$$U_i = ASC_i + \beta_1(X_1) + \beta_2(X_2) + \beta_3(X_3) + \beta_4(X_4) + \varepsilon_i \quad \text{.....(3)}$$

U_i - Utility of the i^{th} alternative
ASC_i - Alternative Specific Constant for the i^{th} alternative
β_1 to β_4 - coefficients of the attributes 1- 4
X_1 to X_4 - component attributes of the i^{th} alternative
ε_i - Error component

Marginal Willingness to Pay (MWTP)

It represents the additional amount an individual is willing to pay for a marginal increase in a particular environment attribute or service. It is derived from the utility function, where it gives the preferences and trade-offs between the attributes. The MWTP was calculated for each attribute using the following formula.

$$MWTP_i = -\frac{\beta_i}{\beta_p} \quad \text{.....(4)}$$

β_i – Coefficient of the i^{th} attribute from CLM
β_p – Coefficient of the price attribute from the CLM

RESULTS AND DISCUSSION

Descriptive Statistics of the Sample

Of the 301 respondents, the majority of them in terms of gender were male, which comprised 63% of the sample, while females accounted for only 37%. The majority were married individuals accounting for 88.3% of the respondents, which suggests a predominantly married population in the study. The respondents were fairly and evenly distributed across different age groups, with the highest proportion falling within the age category of 46-55(24.2%) and most participants had completed secondary school (57.4%). Occupationally, within the farming cohort, the majority are full-time farmers representing 25.9%, though some engage in other occupations alongside their farming activities. When considering the monthly gross income of the respondents, the majority has an income of less than Rs.20,000 representing 30.2% of the sample.

Results of the Relative Importance Index

The radar chart (Figure 1) interprets the Likert scale survey results regarding the awareness and attitudes towards environmental practices and the challenges in the Knuckles region.

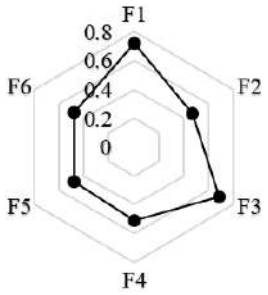

Figure 1. RII values of awareness among farmers

F1: Awareness of the watershed management practices, F2: Ecosystem services, F3: Climate change, F4: Soil conservation practices, F5: Ecosystem services and threats faced by the Knuckles region, F6: Sustainable farming practices

The scores on each axis were calculated using the RII and it reflects the mean level of agreement/awareness with the statements related to the corresponding indicator. The farmers are most aware of the practices impacting their daily activities, such as watershed management and climate change. This indicates that the farmers understand the importance of maintaining these practices to ensure that their productivity is maintained at balanced levels. The awareness of soil conservation and sustainable farming is moderate. It is important to enhance the understanding in these areas as it is crucial for the long-term implications such as achieving resilience and sustainability. However, the knowledge about ecosystem services and the threats seems to be quite low. This gap suggests that the farmers have already recognized the immediate benefits of certain practices and they

are less informed on the broader ecological benefits and risks, which can limit their ability to understand the connection between ecosystem health and agriculture productivity.

Awareness of Soil Conservation Practices

From the 19 different soil conservation practices presented to the farmers, RII values calculated indicate that the most important soil conservation practices among farmers are biological hedges, crop diversification and organic fertilizer applications. These high RII values imply that these soil conservation practices are familiar to farmers. Other significant practices include the use of grass hedges, stone bunds, and the use of recommended varieties. Conversely, practices such as mulching, the use of the SALT technique, and the fallowing period have the lowest RII values, reflecting that these practices are less prioritized and less familiar to the farmers. It may be due to the limited awareness of the perceived benefits or the challenges in implementing these practices, which results in less frequent use of these strategies. Therefore, it is essential to increase awareness about the potential benefits of these less prioritized practices and encourage the farmers to integrate a broader range of soil conservation practices.

Outcomes from the Choice Model

Table 2 includes the summarized outcomes of the choice model. The positive coefficients for water quality improvement, soil erosion reduction and carbon balance indicate that improvement in these attributes increases the utility of the alternatives. The negative coefficient of the price attribute (WTP) indicates that as the cost increases, the utility decreases and it lessens the preference for the alternative. Since the coefficient of the 30% reduction in chemical fertilizer is higher than the 10% reduction, it indicates that there is a strong preference for a greater reduction in chemical fertilizer use, which makes the respondents prioritize significant improvements in water quality. The higher coefficient for the total land area indicates that they prefer more comprehensive solutions for soil erosion reduction. The higher coefficient of the 50% increase in carbon balance, compared to the 25% increase, reflects the preference for greater improvements in carbon balance.

Attribute levels with high standard errors signify that there is more variability and less precision. Hence, it suggests that there is possible heterogeneity in the sample. It can be due to the differences in the preferences among the respondents based on varying socio-economic backgrounds, their farming practices or their perceptions regarding the environmental benefits.

The MWTP designate the monetary value the respondents place on each attribute. The highest MWTP is for a 30% reduction in chemical fertilizer use, indicating that respondents place a higher value on significant water quality improvements. The lowest MWTP value is with a 25% increase in carbon balance and is considered a less perceived benefit than others. The farmers are willing to pay more than four times more for a 50% increase in carbon balance compared to taking no action (status quo). And higher MWTP for total land area in soil erosion reduction suggests the respondents desire a more comprehensive solution for soil erosion reduction. It also suggests that the farmers are willing to pay four times more for a total land area soil erosion reduction strategy than taking no action (status quo). The Total Willingness to Pay (TWTP) by the farmers is Rs.270.56.

Table 2. Parameter estimates

Attribute	Level	Coefficient	SE	P value	MWTP (Rs)
ASC		-0.284	0.228	0.213	
Water quality improvement	30% reduction of chemical fertilizer	0.700	0.394	0.076	77.78
	10% reduction of chemical fertilizer	0.374	0.381	0.326	41.56
Soil erosion reduction activities	50% land area	0.268	0.176	0.129	29.78
	Total land area	0.413	0.122	0.001	45.89
Carbon balance	25% increase	0.211	0.156	0.177	23.44
	50% increase	0.469	0.162	0.004	52.11
WTP(Monthly)		-0.009	0.003	0.004	

SE- Standard Error, P<0.05, Pseudo R^2 = 0.046

CONCLUSIONS

The outcomes of the choice experiment reveal key insights into farmer's preferences and their willingness to pay for environmental improvement. The results indicate that clear preference for substantial reductions in chemical fertilizer use, for a comprehensive soil erosion reduction activity and their preference for a significant increase in carbon balance. The study provides a foundation for policymakers to design a targeted conservation strategy for proper land use adhering to the preferences and economic capabilities of the farmers. These findings can be used for implementing a nature-based solution such as a PES scheme, which can motivate farmers to adopt sustainable land use practices while enhancing the ecological health of the Knuckles Conservation Forest and supporting the livelihood of the local communities. If implemented successfully, this strategy may result in long-term sustainable agricultural productivity in this area, while addressing the needs of the local communities.

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The Expected Role and Current Status of Use of Key Performance Indicators (KPIs) to Drive the Performance of Export Oriented Firms in the Plantation Sector of Sri Lanka

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ABSTRACT

Key Performance Indicators (KPIs) are vital in driving performance toward achieving the organizational vision by focusing on the targets set through SMART objectives. This study explores the desired role of KPI with reference to its current status in evaluating the performance of export-oriented firms. A series of Semi-Structured Interviews (n=10) were carried out with the managers attached to those firms via an Online Video Conferencing Facility, where the key focus is on the issues of formulation, implementation, and measurement of KPIs. Their expressions taken in the form of attitudinal statements were transcribed into text files. These were then fed into the MAXQDA 2024 software by following the Thematic Analysis qualitative methods to retrieve five key themes, including (1) Barriers to KPI implementation; (2) Performance challenges; (3) Strategic synergy; (4) Value addition to market, and (5) Tech innovations for optimization. The findings, overall, revealed that, while the KPIs were vital for aligning with strategic goals, there exist significant challenges to overcome, i.e. rapid KPI changes, technical and psychological barriers, and gaps in stakeholder understanding of SMART KPIs. Under these circumstances, a critical need of adapting KPIs to keep objectives and strategies intact with the organization's vision is warranted. Further, it suggests that moving with digital technologies; the KPIs must closely be monitored to enhance effective performance management practices in order to craft the aspects of profitability and competitiveness of those export-oriented firms in the plantation sector.

KEYWORDS: Export-oriented firms**,** Key performance indicators (KPIs), Performance evaluation, Plantation sector, Sustainable industries

INTRODUCTION

As the plantation sector is a major source of foreign exchange, approximately 800,000 hectares of land in Sri Lanka are dedicated to cultivating plantation crops such as tea, rubber, coconut, etc. (Weerarathna, 2023). Sri Lanka's global presence is significantly shown through the export of high-quality tea and rubber products, appealing to a worldwide market that values excellence in agricultural products.

The goal of the Sri Lanka Export Development Board (SLEDB) is to provide assistance and create opportunities for Sri Lankan exporters to expand their business internationally, thereby increasing export sales and employment prospects in the region (SLEDB, 2023). However, they are void of tools to make data-driven decision-making in manipulating the sector performance drivers. In the context of export-oriented firms in the plantation sector in Sri Lanka, Key Performance Indicators (KPIs) become crucial metrics for assessing not only the economic viability of export outputs but also their sustainability and contribution to the country's socio-economy.

KPIs play an important role in evaluating the key performance of the organization to achieve the vision and mission aligned with the SMART objectives (Abeysiriwardana and Jayasinghe-Mudalige, 2021a). By getting insights from industry experts, this study seeks to evaluate the KPIs that are most relevant in driving performance and competitiveness within the plantation sector. By understanding and leveraging the most relevant KPIs that act on critical success factors, export-oriented organizations in the plantation sector can optimize their operations and capitalize on opportunities for growth and sustainability in Sri Lanka and the global marketplace.

The plantation sector performance in Sri Lanka has been the subject of various studies, but comprehensive scholarly literature on the use of KPIs in managing the performance of the sector is lacking. Previous research has explored performance aspects such as yield per hectare, labour productivity, and financial metrics, yet a synthesis of these findings with the most wanted non-financial performance drivers is needed to identify patterns, gaps, and inconsistencies in the literature to support decision-making in the sector and policy decisions to be aimed at establishing the development of the industry (Ministry of Plantation, 2021).

METHODOLOGY

Conceptual and Theoretical Framework

It is expected to provide a comprehensive understanding of the present performance management in the plantation sector by conducting a qualitative analysis focusing on managers' perspectives on KPIs through semi-structured interviews. Qualitative analysis generates deep, rich, and networked knowledge about the current status of KPIs in the plantation sector (Abeysiriwardana *et al*., 2023).

In this qualitative approach, the attitudinal statements of the exports regarding the utilization of KPIs in the performance of export-oriented firms in the plantation sector in Sri Lanka were extracted and grouped into codes, categories, sub-themes, and themes in a hierarchical order to find answers for the following six major research questions that are formulated based on previous studies (Abeysiriwardana and Jayasinghe-Mudalige, 2021a, 2021b): (1) Does practicing KPIs in the company suffer from technical or psychological barriers?, (2) How many KPIs are used in the organization? Have the company set sector-specific KPIs for the plantation sector?, (3) Does the company formulate KPIs based on key performance drivers towards the vision and mission of the company?, (4) Is KPI a difficult concept to grab by the non-managerial staff of the organization?, (5) Is decision-making towards the sustainability of the organization properly facilitated by KPIs?, and (6) Does the company use any digital method to track KPIs within the organization and what are those?.

The purpose of this particular analysis is to evaluate the KPIs of export-oriented firms in the plantation sector. Therefore, the collected data obtained through semi-structured interviews has been analyzed using Thematic Analysis methods (Naeem *et al*., 2023) which involves the identification and reporting of patterns in a data set and then interpreted for their inherent meaning (Braun and Clarke, 2006; Leibenberg *et al.*, 2020; Xu and Zammit, 2020). Thematic Analysis carried out comprised of six phases as follows: (1) Familiarization with the data; (2) Selection of keywords; (3) Coding; (4) Theme development; (5) Identifying patterns (Themes, Sub-themes, Categories, and Codes), and (6) Searching reviewing and finalizing of themes (Braun and Clarke, 2006). Once this procedure is completed, the patterns and insights can be identified on the basis of understanding the common words used by the interviewees.

Data Collection and Analysis

The target population was the managers of export-oriented firms in the plantation sector in Sri Lanka. Through Purposeful Sampling, 10 firms were selected to ensure representation across the industry. Semi-structured interviews were conducted via an Online Video Conferencing facility. These facilitated an efficient data collection process by overcoming geographical barriers. During the interviews, managers were questioned about their perspectives on the expected role and current utilization of KPIs in evaluating firm performance within the plantation sector.

The semi-structured nature of interviews enabled a deep exploration of various aspects related to KPIs, including their relevance, effectiveness, challenges, and potential improvements. The interviews were conducted in an open-ended questions manner by ensuring comprehensive data capture. Following the process of data collection, the Thematic Analysis was used to identify the patterns, themes, and insights from the interview transcripts.

The audio-recorded interview data were manually transcribed into text files and fed into the computer-aided qualitative data analysis program called MAXQDA 2024. This software is equipped with tools to make detailed content analyses and derive comprehensive relationships between the concepts presented behind the codes systematically and easily.

The imported transcripts were organized into a hierarchical structure within MAXQDA, allowing for easy management of the data. Then, a coding framework was developed to generate themes and concepts related to KPIs. Five themes were identified for the purpose of addressing the above research questions (1) Barriers to KPI Implementation, (2) Performance Challenges, (3) Strategic Synergy, (4) Value Addition to Market, and (5) Tech Innovations for Optimization. To explore and understand the relationships emerging from the data, themes were finalized by narrowing down and refining the sub-themes, categories, and codes.

RESULTS AND DISCUSSION

Overall, the analysis of perspective data using MAXQDA revealed a prevailing trend among managers to utilize KPIs for managing the performance of export-oriented firms in the plantation sector. Furthermore, the graphical results provided insights into answering the research questions appropriately.

Throughout the 10 interviews analyzed, certain words were highlighted prominently in the Word Cloud, as depicted in Figure 1.

These findings emphasized the interviewees' perspectives on KPIs when

evaluating the performance of export-oriented firms in the plantation sector.

Figure 1. Word Cloud: KPIs in the plantation sector

Notably, terms like “KPIs”, “Sustainability”, “Vision and mission”, and “Profitability” were more prominent, indicating their significance in addressing research questions 3 and 5. This explains the need for clear and effective KPI frameworks aligning with broader business goals. Terms associated with performance and measurement are also prevalent, highlighting the importance of assessing and monitoring performance.

The code relations browser (CRB) serves as an analytical tool designed to visually depict the network of relationships among various segments of code within a given document. It describes how often individual codes occur together, showing their interactions and emphasizing the strength of their relationships. By systematically assessing these co-occurrences, the CRB facilitates the evaluation of the intensity and nature of relationships.

Figure 2 illustrates a network of key relationships identified by managers of export-oriented firms, emphasizing the importance of various attributes central to KPI tracking within these organizations. Several significant relationships can frequently be observed: “Value addition” and “Adherence to certification standards”, “Enhancing market competitiveness” and “Importance sustainability”, “Optimization of resource use” and “Necessity of strategic alignment”, “Targets and profitability” and “Optimization of resource use”, and “Digitalization” and “Technology adoption”. These relationships depict the critical role of KPIs in guiding organizational strategy from the traditional marketplace to the modern one by following the most critical success factors of the industry through performance evaluation as highlighted by the managers of the export-oriented firms. This shows how important the attributes mentioned in research questions 4 and 6.

Furthermore, the analysis reveals certain codes with weak interactions, indicating one-time relationships within the dataset. Notable examples include the connection between “Mitigation of risks” and “Importance of sustainability”, “Performance metrics” and “Understanding of KPIs”, “ERP system” and “Digitalization”, and the association of “Non-managerial perception” and “Lack of knowledge of KPIs” among others. These findings directly address research questions 1 and 2, highlighting that research undertaken by export-oriented firms has not significantly addressed these specific points although they want to change the status quo of the present sector performance directions.

The third output of the analysis, depicted in Figure 3, presents a comprehensive visualization of all relevant data, including memos, codes, and coded segments within the documents. This graphical representation offers insights into the significance of the relationship between expert views and the associated entities related to KPIs in organizational performance. Notably entities such as “Importance of sustainability”, “Effect of rapid change of KPIs”, “Strategic synergy”, and “Performance challenges” emerge as dominant factors influencing the performance evaluation in export-oriented firms in Sri Lanka.

These entities are depicted by thicker lines, indicating their main role in enhancing organizational performance. Conversely, entities represented by low-thickness lines, such as “Having specific KPIs”, “Digitalization”,

Figure 2. Part of code relations browser for KPIs in export-oriented firms

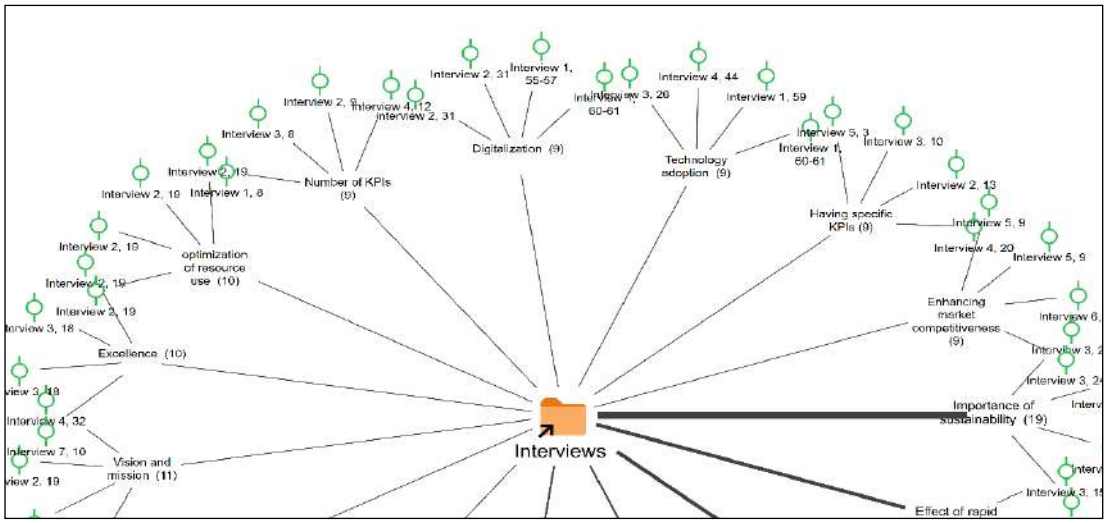

Figure 3. Part of single case model (coded segments) for interviews

"Understanding of KPIs", and "Barriers to KPI implementation" suggest areas where further attention and development may be needed to establish good performance culture in the organization. To address this, organizations could focus on enhancing understanding and satisfaction with KPIs among stakeholders, improving digitalization for KPI tracking and analysis, and aligning KPIs more closely with profitability goals. By addressing these areas, organizations can achieve effective performance.

The code map, as illustrated in Figure 4, provides a visual representation of selected codes arranged in a map-like structure.

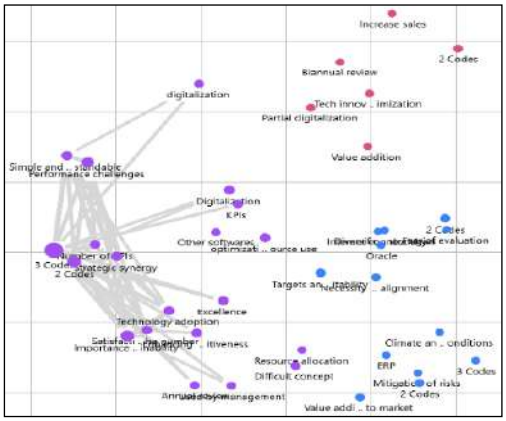

Figure 4. Code Map: relationship between "Strategic decision making and sustainable practices" and "Quantitative dynamic"

In this visualization, the distance between codes signifies the degree of co-occurrence observed within the codes, while the thickness of the connection lines indicates the strength of the relationships between them. Each circle on the map represents a specific code, with the size of the symbol and the font size reflecting the frequency occurrence of each code. Through the analysis of the code map, significant relationships between "Strategic decision-making and sustainable practices" and "Quantitative dynamics" become dominant. This displays how these two elements interact within the organization context and how to impact on overall performance management of the organization. As shown in Figure 4, certain codes within the themes of "Digitalization" and "Technology adoption" exhibit co-occurrence within their themes. This observation depicts the significance of identifying and understanding the connections within the themes. Moreover, the relationships between the themes show that digitalization is closely linked with optimizing KPI implementation and improving resource use. "Strategic synergy" and "Performance challenges" are closely linked, showing that working together effectively is key to overcoming performance-related problems. However, it's noteworthy that only a limited number of inter-relationships were identified between themes, such as "Barriers to KPI implementation" and "Tech innovations for optimization" where further analysis of the subject may reveal the cause for certain issues.

Figures 2, 3, and 4 collectively illustrate the significance of decision-making processes, the specificity of KPIs, the challenges that emerged from rapid changes, and technical barriers. Additionally, Figure 3 presents the dominant influence of certain factors on organizational performance, while the code map in Figure 4 highlights the co-occurrence of codes within thematic areas. Overall, these findings depict the importance of strategic alignment and adaptability.

CONCLUSIONS

In conclusion, this research provides a comprehensive understanding of the expected

role and current status of Key Performance Indicators (KPIs) in evaluating the performance of export-oriented firms in the plantation sector in Sri Lanka. The findings represent the various issues and challenges of implementing effective performance management systems through KPIs as addressed by managers of these firms. Enhancing product quality, market competitiveness, and profitability can be achieved through resource optimization. Firms are prioritizing eco-friendly strategies to ensure environmental compliance and long-term sustainability. The pursuit of excellence in the plantation sector involves overcoming various performance challenges. Firms are dedicated to continuous improvement to maintain high standards. And less co-occurrence between strategic alignment and risk mitigation suggests that firms are aware of the need to align their strategies with risk management practices. At last, digitalization and the adoption of new technologies are recommended for enhancing the efficiency and effectiveness of plantation management. Firms are ready to utilize digital tools in KPI manipulations to enhance operations, optimize resource use, and improve overall performance. All of these insights provide a comprehensive understanding of the strategic and operational dynamics of the performance management through KPIs in the plantation sector.

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Determinants of Entrepreneurial Intention of University Undergraduates in Sri Lanka

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ABSTRACT

This study investigates the determinants of university students' decision to become an entrepreneur. As a strategic measure for unemployment, entrepreneurship plays a vital role in enhancing the financial situation of people and in turn the country. The sample (n=484) was selected using the multistage sampling technique. Data were collected via an online survey using a structured questionnaire developed based on the literature to explore the factors that affect entrepreneurial intentions. Confirmatory Factor Analysis and Multiple Regression were employed to analyze the data. Five factors namely; Attitude (AT), Subjective Norm (SN), Perceived Behavioral Control (PB), Entrepreneurial Curriculum and Content (EC), and Entrepreneurship Education (EE) were explored in the literature. Based on that, a conceptual framework was developed with five hypotheses. The estimated model revealed that potential factors including Attitude, Subjective Norms, and Perceived Behavioral Control have a significant positive impact on entrepreneurial intentions among Sri Lankan university students. Hence, the results of this research depict vital information for entrepreneurs to execute their own businesses as well as to develop themselves as successful entrepreneurs. Furthermore, this study provides essential insights for policymakers regarding the construction of proper policies to enhance the entrepreneurial intention among university students.

KEYWORDS: Attitudes, Entrepreneurial Intention, Perceived behavioral control, Subjective norms, University undergraduates

INTRODUCTION

Entrepreneurship is an attitude of mind that can take risks but calculated ones, where a true entrepreneur is one who can see possibilities in a given situation where others see none and has the patience to work out the idea into a scheme to which financial support can be provided (Palanivelu and Manikandan, 2015). In today's era, entrepreneurship is a more popular and profitable occupation among many people.

Sri Lankan startup founders can be considered young as 33% of founders who responded to a study conducted by the Sri Lanka Association for Software Services Companies (SLASSCOM) are between the ages of 25 – 29, while only 2% were between the ages 20 – 24. Moreover, founders are considered educated, with 73% of respondents having a bachelor's degree or above. It was also noted that while 40% of founders come from a computer science background, 31% identified their area of expertise as business management. Furthermore, 30.32% of start-up founders were graduates (SLASSCOM, 2019). This study provides a strong background to form a notion regarding the positive entrepreneurial behavior of Sri Lankan graduates. Hence, in higher education, undergraduate students play a crucial role in shaping the future of entrepreneurship. It's important to grasp their attitudes towards starting businesses to encourage innovation and entrepreneurship.

The promotion of entrepreneurship policy shouldn't just target those who are already convinced to start businesses. It should also aim to increase the number of people considering entrepreneurship. This requires ambitious educational initiatives (Liñán *et al.*, 2015). Dissanayake (2014) explores that it is a generally accepted fact that, "if you want to be an entrepreneur, you want to study how first". Therefore, entrepreneurial education plays a pivotal role in shaping entrepreneurial intentions. Entrepreneurship education programs, both formal and informal, provide students with the necessary knowledge, skills, and mindset to embark on entrepreneurial ventures. According to Liñán *et al.* (2015), a significant discovery was that individuals who participated in entrepreneurship courses or training demonstrated notably higher levels of both attitude and social skills.

Furthermore, the findings of Amanamha *et al.* (2018) validate those of earlier research, highlighting the notable correlation between entrepreneurial intention and entrepreneurship education, as well as attitude towards engaging in entrepreneurial behavior, subjective norms, and perceived behavioral control. Moreover, attitudes toward risk-taking, failure, and success may shape individuals' perceptions of entrepreneurial intentions.

In numerous countries, entrepreneurship is regarded as a means of generating wealth and is considered the most effective solution to

address unemployment issues in developing nations (Thrikawala, 2011). Consequently, investigating the entrepreneurial intentions of university students is essential for developing countries such as Sri Lanka to overcome unemployment issues, particularly in the economic crisis around the world. Hence, this study aimed to find different levels of entrepreneurial intention among university undergraduates in Sri Lanka and understand the attitudes undergraduates hold toward starting their own businesses upon graduation. Moreover, the most vital objective was exploring the factors that determine the propensity to start their own business and in turn to be an entrepreneur.

METHODOLOGY

Conceptual Framework

Based on the literature, factors such as Attitude (AT), Subjective Norms (SN), Perceived Behavioral Control (PB), Entrepreneurial Curriculum and Content (EC), and Entrepreneurship Education (EE) are identified as the most influential factors that affect the entrepreneurial intention of undergraduates. In light of this, the following research model was proposed to identify the determinants of the entrepreneurial intention of undergraduates in Sri Lanka (Figure 1).

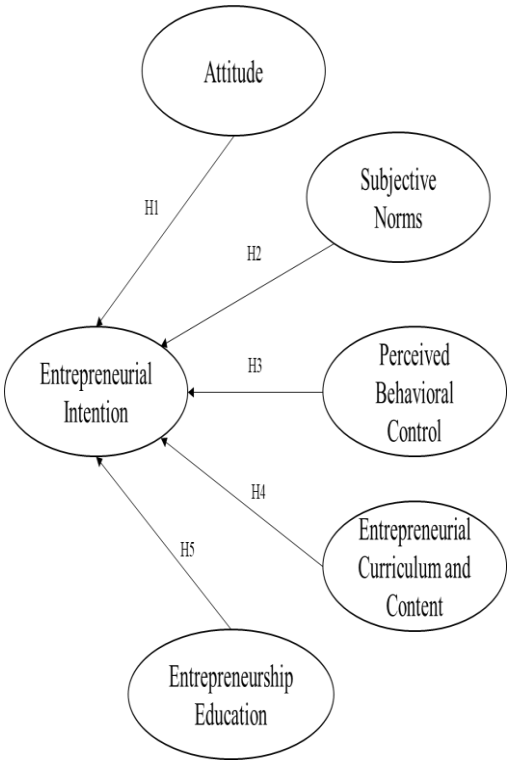

Figure 1. Conceptual framework

Based on the conceptual framework five hypotheses were developed to represent the relationship between independent and dependent variables.

H_1: Attitude has a significant and positive impact on Entrepreneurial Intention

H_2: Subjective Nor has a significant and positive impact on Enrepreneurial Intention

H_3: Perceived Behavioral Control has a significant and positive impact on Entrepreneurial Intention

H_4: Entrepreneurial Curriculum and Content has a significant and positive impact on Entrepreneurial Intention

H_5: Entrepreneurship Education has a significant and positive impact on Entrepreneurial Intention

Survey Instrument Development

A structured questionnaire consisting of two parts; (a) demographic information of respondents and (b) statements used to evaluate their level of agreement or disagreement on independent and dependent variables chosen for the study using a five-point Likert scale ranging from; strongly agree (5), agree (4), neutral (3), disagree (2) and strongly disagree (1) was developed. Whereby, 36 questionnaire items were built to gather data on independent and dependent variables. The questionnaire was pre-tested with 15 respondents to ensure the validity of the questionnaire before conducting the survey.

Data Collection

Undergraduate students in Sri Lanka were selected as the population for the study where a multiple-stage sampling technique was employed to select the sample. Five universities were randomly selected out of the 13 state universities and two degree programs that offer entrepreneurship-related subjects were chosen from each of the selected universities (Table 1). Degree programs such as medicine, engineering, and nursing were excluded from the sample as they are mainly directed toward a specific occupation. According to the data received from the Assistant Registrars of the faculties, the total population of undergraduates was estimated to be 710 where 484 were selected as the sample. The questionnaire survey was conducted online from March to April in 2024.

Table 1. The universities and degree programs selected in the study

University	Degree Program
Eastern University, Sri Lanka	Bachelor of Science Honours in Agriculture Bachelor of Biosystems Technology in Agriculture Technology and Entrepreneurship
Sabaragamuwa University of Sri Lanka	Bachelor of Biosystems Technology Honours Bachelor of Arts Honors in Sociology
South Eastern University of Sri Lanka	Bachelor of Biosystems Technology Honours Bachelor of Commerce Honours
Wayamba University of Sri Lanka	Bachelor of Science Honours in Banking & Finance Bachelor of Science Honours in Agriculture
University of Sri Jayewardenepura, Sri Lanka	Bachelor of Arts Honours in Dancing and Cultural Studies Bachelor of Commerce Honours

Data Analysis

The data were analyzed using both descriptive and inferential statistical approaches with the use of Statistical Package for the Social Science (SPSS). The demographic factors were mainly summarized using descriptive measures while Reliability analysis, Confirmatory Factor Analysis (CFA), and Regression analysis were employed as statistical measures.

RESULTS AND DISCUSSION

Sample Summary

The summary of the socio-demographic information of the respondents indicates that the majority of respondents were female (78.3%) and the percentage of males was 21.7% (Table 2). Nearly a third of the sample were pursuing B. Com, B.Tech. and BSc. degrees while a small proportion (4.3%) represented the B.A. student category. Concerning family income, the majority of students came from the Rs.50,000-100,000 category representing 34.5% which is followed by Rs.25,000-50,000, above Rs.100,000, and below 25,000 categories accounting for 33.9%, 18.2%, and 13.4% respectively.

Additionally, it reveals that a notable percentage of respondents (43.8%) have self-employed parents, while a slightly higher proportion (56.8%) lack prior self-employment experience themselves (Table 2). These findings illuminate the influence of familial backgrounds and personal exposure on entrepreneurial inclinations and preparedness among the surveyed individuals.

Table 2 explores respondents' openness to pursuing other professions alongside entrepreneurship and their preferences regarding the location of entrepreneurial endeavors. It indicates that a substantial majority (75.8%) are receptive to engaging in additional professions alongside entrepreneurship. This reflects that people need more income sources and they do not need to depend on one occupation or income source in today's world.

Table 2. Respondent profile

Parameter	Category	Percentage (%)
Gender	Female	78.3
	Male	21.7
Degree program	B.A.	4.3
	B.Com.	27.3
	B.Tech.	33.7
	BSc.	34.7
Average monthly family income (Rs.)	>100,000	18.2
	50,000-100,000	34.5
	25,000–50,000	33.9
	< 25,000	13.4
Self-employed parents	No	56.2
	Yes	43.8
Self-employment experience	No	56.8
	Yes	43.2
Willing to do another profession while being an entrepreneur	No	24.2
	Yes	75.8
Most preferred location	In foreign country	22.9
	In Sri Lanka	77.1

Furthermore, it reveals a strong preference among respondents (77.1%) for establishing entrepreneurial ventures within Sri Lanka, as opposed to foreign countries (22.9%) (Table 2). Therefore, it is obvious that undergraduates prefer to start their own business in Sri Lanka despite the current economic situation of the country. These findings offer valuable perspectives on the multifaceted nature of entrepreneurial pursuits and the significance of geographical considerations in entrepreneurial decision-making processes.

Moreover, Figure 2 probes into respondents' intentions and preferences

concerning entrepreneurship. It highlights that a significant majority (56.0%) aspire to become entrepreneurs after gaining experience in a company, while a considerable portion (40.3%) express a desire to embark on entrepreneurial ventures immediately upon graduation. Additionally, a small minority (3.7%) indicate no inclination towards entrepreneurship. These insights provide a valuable understanding of the timing and motivations driving entrepreneurial aspirations among the respondents.

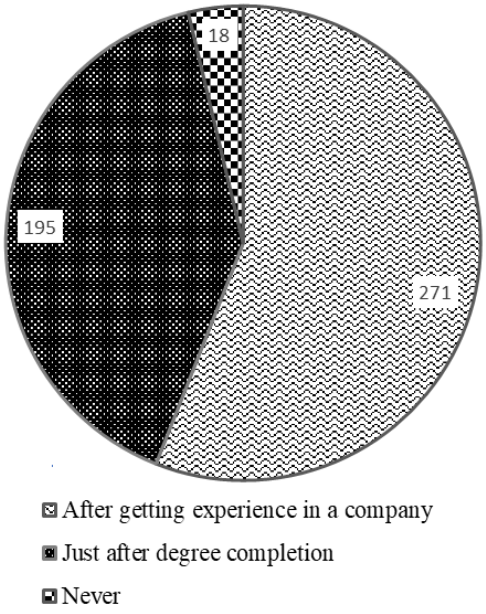

Figure 2. Respondents' entrepreneurial intentions

Reliability Analysis

The reliability of the survey instrument was tested using Cronbach's alpha and ensured internal consistency of variables that were higher than the threshold of 0.7 by proceeding with 36 indicators. The alpha values for each variable were AT=0.908, SN=0.904, PB=0.839, EC=0.884, and EE=0.909. These values confirmed that the internal consistency is sufficient enough to proceed with further statistical analysis. Sample adequacy and correlation adequacy of data were confirmed by the 0.953 of Kaiser–Meyer–Olkin (KMO) test and significant probability (0.000) of Bartlett's test. Hence the data was deemed appropriate to perform the Confirmatory Factor Analysis.

Confirmatory Factor Analysis (CFA)

The CFA was performed by using Principal Components as the extraction method and Varimax as the rotation technique. According to (Hair *et al*., 2017) factor loadings above 0.5 were considered suitable for a sample of 484 respondents. The results indicated that all the indicators have adequate extraction value to perform the CFA without dropping items. Consequently, five factors were confirmed based on the Eigenvalue greater than one to consider a significant factor as mentioned in the Scree Plot (Figure 3). The CFA confirmed the independent variables identified from the literature. The questionnaire items that were loaded under the five factors ideally represented the five independent variables; AT, SN, PB, EC, and EE.

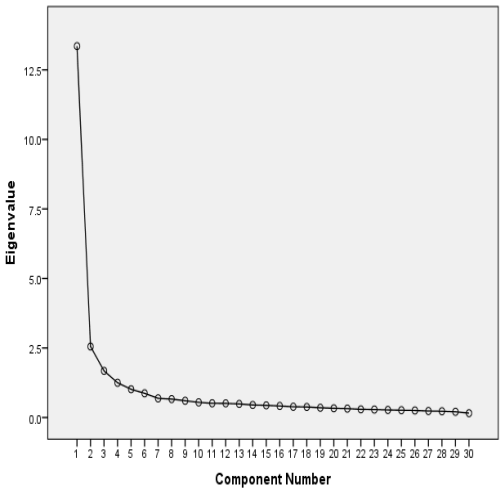

Figure 3. Scree plot of Confirmatory Factor Analysis

Thereby, the respondent scores provided for each variable were then averaged to form five simple indices to represent each independent variable. These indices were then subjected to a Regression Analysis to determine their impact on entrepreneurial intentions.

Regression Analysis

The entrepreneurial intention was used as the dependent variable while the independent variables were the indices developed for Attitudes (AT), Subjective norms (SN), Perceived behavioral control (PB), Entrepreneurial curriculum (EC), and Entrepreneurship Education (EE).

At 95% confidence interval level, a regression model was fitted. The model resulted in a multiple correlation of 0.824 and the adjusted R square is 0.675 which proves that nearly 68% of the variation of entrepreneurial intention can be explained by the model. ANOVA provides information on the significance of the regression model. The significance value linked with the F-Test is 0.000, indicating high significance and affirming that the model effectively explains a substantial portion of the variability in entrepreneurial intention. Additionally, the Mean Square values further support that the

regression line accounts for much more variance (37.794) than the residual (0.187).

As per the results (Table 3) of the regression analysis, three factors can be identified as significant factors including Attitudes, Subjective Norms, and Perceived Behavioral Control representing coefficient values (Beta) 0.651, 0.139, and 0.149 respectively with a significant probability of below 0.05. Thus, the Attitudes of undergraduate students, Subjective Norms, and Perceived Behavioral Control have a significant positive impact on Entrepreneurial Intention. Consequently, H1, H2, and H3 are accepted by the model. It confirms that altogether, these elements do encourage students to pursue their entrepreneurial dreams. Hence, it is recommended to implement effective strategies such as providing funding for initiating business and facilitating encouragement and awareness programs to enhance the intention of being an entrepreneur in the foreseeable future.

Furthermore, the Variance Inflation Factor (VIF) provides evidence for multicollinearity which proves that there is no multicollinearity in regression analysis as the VIF value is below three (Table 3).

Table 3. Regression coefficients

Factor	Coefficient	Probability	VIF
Constant		0.088	
AT	0.651	0.000*	2.293
SN	0.139	0.000*	1.655
PB	0.149	0.000*	2.220
EC	-0.046	0.275	2.632
EE	0.004	0.935	2.851

*Note: *Significant at; probability< 0.05*
Attitudes (AT), Subjective norms (SN), Perceived behavioral control (PB), Entrepreneurial curriculum (EC), and Entrepreneurship Education (EE)

CONCLUSIONS

The empirical results elicit that five factors are explored which affect the entrepreneurial intention of undergraduate students in Sri Lanka. The regression analysis reveals three pivotal factors that significantly contribute to students' entrepreneurial intentions: Attitude, Subjective Norms, and Perceived Behavioral Control. These factors emerge as influential drivers, fostering a positive inclination towards entrepreneurship among students. Attitude reflects their overall perception and evaluation of entrepreneurship, while Subjective Norms denote the social pressures or influences from significant others. Perceived Behavioral Control encapsulates their belief in their ability to engage in entrepreneurial activities effectively. Recognizing the significance of these factors offers valuable insights for educators and policymakers seeking to cultivate a conducive environment for entrepreneurial development among students.

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Agro-ecotourism Prospects in the Village Tank Cascade Systems (VTCs) in Sri Lanka: Structure-Conduct-Performance Approach

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ABSTRACT

In developing countries, one of the alternations of tourism, "agro-ecotourism" is becoming popular with the concern for sustainability and natural resources conservation. Sri Lanka is an Asian country with a great agricultural history and has ancient human-made tank systems called village tank cascade systems (VTCs) in the dry zone for farming purposes. Agro-ecotourism has an emerging potential in Sri Lanka with its agricultural background. In Anuradhapura district, Hiriwadunna village, a popular agro-ecotourism destination within the Bellankadawala cascade system was selected for the study. The study was designed to examine the Structure-Conduct-Performance of agro-ecotourism in the VTCs. The study also aims to explore the opportunities and challenges in the sector. A semi-structured questionnaire was used for the primary data collection with face-to-face interviews selecting 36 stakeholders engaged in agro-ecotourism in the Anuradhapura district. The study revealed that the agro-ecotourism market performance has not been maximized. High competition of stakeholders due to few service differentiation and entry barriers impact the market structure in this sector. This is a type of oligopoly market. The lack of pricing mechanisms for services and marketing strategies also hinders the profitability of the agro-ecotourism sector. It is concluded that government intervention is needed to introduce a firm regulatory framework ensuring a sustainable market by protecting the environment, standardizing food quality, enhancing safety, implementing vocational training programs that improve language skills, and crafting skills of community for fostering community participation in agro-ecotourism.

KEYWORDS: Agro-ecotourism, Livelihood dynamics, Structure-Conduct-Performance, Village tank cascades

INTRODUCTION

The world tourism industry is expanding continuously by providing financial benefits to developing countries. One of the alternations of tourism, "agro-ecotourism" has been an emerging trend in the tourism industry, and has great potential in developing countries like Sri Lanka, with its agricultural background. Agriculture and Sri Lanka have a non-separable history although GDP contribution from agriculture is becoming low by 2024. The majority of Sri Lankan people live in rural areas and engage in agriculture-based livelihoods. Therefore, connecting agriculture with the tourism sector helps them to upgrade the present living conditions and reduce poverty because Sri Lanka is one of the best tourist attractions due to its natural beauty.

Agro-ecotourism is a niche tourist activity that combines agro-tourism and ecotourism. The activities related to agriculture such as cultivating the land, raising livestock, and catching fish provide interesting knowledge and experiences for tourists who live outside the countryside (Djuwendah *et al*., 2023). Sri Lankan unique traditional activities and the famous cuisine and culinary activities, local handicrafts, rural-based accommodation facilities, cultural events as well as specific traditions can generate livelihood opportunities when linked with agriculture for improving agro-ecotourism that benefit the rural community (Rambodagedara *et al*., 2015).

Hussain (2022) defined ecotourism, one part of agro-ecotourism in his study as an activity consecrated for preserving and sustaining the diversity of the world's natural and cultural environments and it accommodates and entertains visitors in a way that is minimally intrusive or destructive to the environment and sustains and supports the native cultures in the locations it is operating in. On the other hand, agro-tourism, the other part of agro-ecotourism, is more modern and developed in the latter part of the twentieth century. The farmers provide facilities for tourists to engage in daily agricultural activities on the farmlands, giving them knowledge of agricultural activities. Agro-tourism is frequently regarded as a subset of ecotourism because "both are related and subject to natural attractions" (Zoto *et al*., 2013).

Anuradhapura is an agricultural district in the North Central province of Sri Lanka. Since this is in the Dry zone, ancient kings built elaborate village tank cascade systems (VTCs) called *"Ellanga system"* to provide water management techniques to support agriculture. In this area, many people own agricultural lands, which open up chances for agro-ecotourism as a source of income. Nowadays, different countries engage in agro-ecotourism

since it is a good livelihood opportunity for their rural communities to uplift the standard of living (Ogutu, 2002; Djuwendah *et al*., 2023).

In Sri Lanka, several previous studies have been conducted in VTCs focusing on different areas of sustainable rural livelihoods, farming systems, climate change, and so on (Dharmasena, 2004; Melles and Perera, 2020; Perera *et al*., 2021). However, the studies related to agro-ecotourism in VTCs are limited. Therefore, this study focused on examining the Structure-Conduct-Performance of agro-ecotourism in the VTCs. The study also aims to explore the opportunities and challenges in the sector.

METHODOLOGY

A qualitative approach was used for the study. The steps followed in the study include: (1) Preliminary assessment and identification of key entry points (2) Data collection from selected stakeholders (3) Data analysis and exploration of opportunities and barriers in the sector.

Study Area Selection

Anuradhapura district which is located in the dry zone was selected for this study. Among three cascades of Bellankadawala, Horiwila, and Mahakanamulla which are in the Divisional secretariat divisions of Palugaswewa and Thirappane, Bellankadawala VTCs was selected. In Bellankadawala VTCs, Hiriwadunna, a rural village with a tank, was selected. Hiriwadunna is a famous tourist site for agro-ecotourism which gives countryside experience to tourists in between Habarana and Dambulla.

Sample Selection

Two-stage sampling was used in this step to select participants in data collection. In sampling stage one, sampling was done at the VTCs level where the primary sampling unit as the Grama Niladhari Division. In sampling stage two, purposive sampling was employed to select the stakeholders prioritizing the information richness. In the sample, there were 36 stakeholders; Village house owners (n=07), Boat riders (n=08), Cart riders (n=06), Safari jeep riders (n=04), Tuk-tuk riders (n=03), Tour counters (n=02), Village house helpers (n=03), Craft items producers (n=03).

Data Collection

Primary data were collected for the study. A survey including a semi-structured questionnaire with face-to-face interviews for selected stakeholders was carried out along with focus group discussions for in-depth data collection. The questionnaire was subjected to a pilot test to identify the feasibility of the study by omitting errors. The questions in the questionnaire were organized to collect the primary data on the details of the market, products or services provided, and challenges, opportunities, threats, and strengths faced by stakeholders. Data collection was done from February to April 2024. In addition, village-level public and private societies and committees were consulted to derive preliminary insights on the area, sample, and initiatives related to agro-ecotourism.

Structure-Conduct-Performance Approach

The structure-conduct-performance (S-C-P) is a tool to analyze how the market structure impacts on behavior and performance of the industry. Bain (1956) assumed that market structure determines the industry conduct and the industry conduct determines the overall performance. According to Wijesooriya and Priyadarshana (2013), the structure consists of relatively stable facts that impact the behavior and competition of buyers and sellers, and the conduct refers to the behavior that stakeholders practice to adjust in the market alternations whereas the performance determines the outcomes and the profitability of the sector. Hence, the S-C-P approach was used to explore the overall performance of the agro-ecotourism sector. Furthermore, a SWOT analysis was carried out to identify the sector's strengths, weaknesses, opportunities, and threats.

RESULTS AND DISCUSSION

Agro-ecotourism Operations in Hiriwadunna

Figure 1 illustrates the overall products and service provisions in the Hiriwadunna village tour. Local or foreign tourists get an opportunity to choose village tour packages and spend about three to four hours in the village. The village tour includes a combination of cultural, traditional, and natural community-based experiences, giving them knowledge of the local traditional way of living (Weerasingha, 2018).

Village tour package selection occurs in four distinct ways. The standard process involves visiting tour counters, receiving recommendations from tour guides, and selecting packages. Additionally, some tourists, primarily locals, directly engage with stakeholders to receive services. Another method is through hotel chains, where hotels coordinate with selected stakeholders to provide services. Finally, online booking is also available.

When focusing on the inbound operations provided by the rural community, as depicted in

Figure 1, the tour packages primarily include food and beverage provision, transport services, and excursion services. Village houses, traditional Sri Lankan homes, have been constructed to offer food and beverages along with traditional household activities. Traditional cuisine featuring six to ten curries (such as brinjal, cooking melon, leafy vegetables, cucumber, mung bean, lady fingers, dhal, and fried tank fish - *Theppili*) is offered at prices ranging from Rs. 600 to Rs. 1000. Additionally, beverages served with *pol roti*, *halapa*, or other sweet items are priced at Rs. 150. This service allows tourists to experience traditional cooking methods and the use of traditional kitchen utensils.

Transport services are provided based on tourist preferences. A bullock cart ride costs Rs. 800 per ride, a boat ride is Rs. 600, and a tractor ride is Rs. 1000. The number of tourists per ride varies. Safari jeeps and tuk-tuks have different charges depending on tourist requirements. Excursions are offered free of charge to enhance tourist satisfaction. Activities include flora and fauna watching, visits to chena cultivations, climbing to tree huts or *pelas*, and viewing the tank. Some village houses maintain home gardens or tree huts, where tourists can pick vegetables for cooking activities or enjoy the view by climbing the tree hut.

Structure of the Agro-ecotourism Sector

Market structure includes participants and characteristics of a market. Figure 2 indicates the elements of the S-C-P approach for the agro-ecotourism sector. The study identified seven key stakeholders in the study area. They are village house owners, bullock cart riders, boat riders, village counter owners, tractor riders, tuk-tuk riders and safari jeep riders. Moreover, supportive stakeholders are village house helping ladies, tour guides, input providers (food and beverages), craft item suppliers and

financial supporters. The study revealed that there are barriers to entry. Despite lower running costs, new participants need large initial investments and independent participation in tourism services is complicated by the influence of counter members who lead the agro-ecotourism operations with an extensive connection with tour companies, agencies, and hotels. Moreover, less differentiation of services offered resulted in high rivalry, which lowers profit margins by splitting up travelers among more service providers.

Conduct of the Agro-ecotourism Sector

Market conduct refers to how the market acts or behaves in the market alternations. According to the study, tour counters provided four main service channels. Channel 01: Tour counter – Tuk-tuk ride – Cart ride – Boat ride – Village house – Tuk-tuk ride. Channel 02: Tour counter – Tuk-tuk ride – Boat ride – Village house – Tuk-tuk ride. Channel 03: Tour counter – Safari jeep ride – Cart ride – Boat ride – Village house – Safari jeep ride. Channel 04: Tour counter – Tractor ride – Boat ride – Village house – Tuk-tuk ride.

Further, the study identified four extra service channels. Channel 05: Hotel chain – Cart ride – Boat ride – Village house. Channel 06: Hotel chain – Village house. Channel 07: Direct arrival – Cart ride – Boat ride – Village house. Channel 08: Online booking – Cart ride – Boat ride – Village house. According to the study, it is clear that the industry is dominated by hotel chains and tour counters, which leads to oligopolistic conduct in the marketplace.

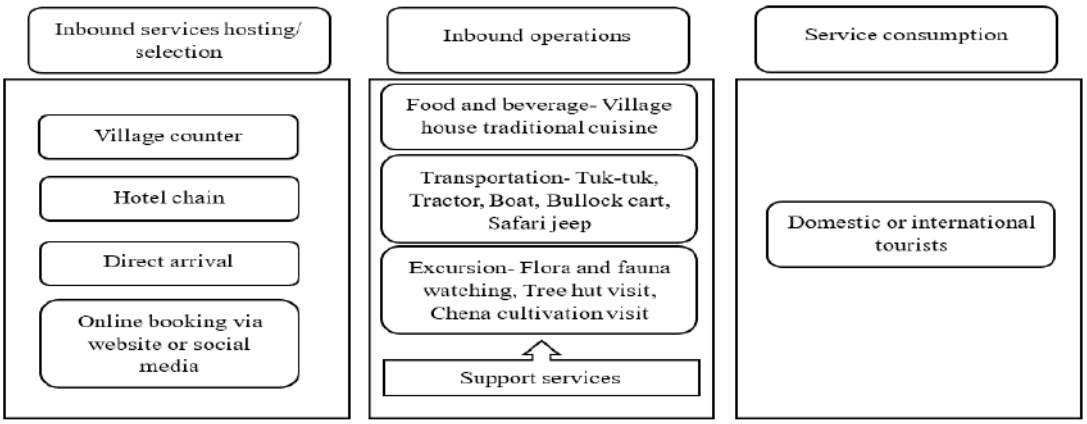

Figure 1. Agro-ecotourism service procedure in Hiriwadunna village tour

Tour counters or hotels determine the prices for providing services and there is little space for negotiation, as stakeholders provide services at the command of registered tour operators or hotels. Stakeholders stated that the prices are not sufficient for the services with the inflation of the country. The village tour is promoted through marketing using social media, websites, and partnerships with travel agencies, tour guides, and hotels. The main constraints that stakeholders had to cope with were those related to the lack of reasonable loan facilities, seasonality, wild animal attacks, and the absence of on-site sanitary facilities.

Performance of the Agro-ecotourism Sector

Market performance explains outcomes and the success of the market. When demand changes due to seasonality in the tourism sector, the stakeholders are ready to supply services as orders placed by the tour counters or hotels they have registered. The community has implemented eco-friendly practices by reducing polythene, and using recycled materials like lotus leaves for handwoven plates, and coconut shell cups for beverage serving. Transport providers also keep a plastic-free environment in their yards. In particular, village houses certify food quality when preparing meals. Additionally, social welfare improvement was identified within the sector, by providing tourism-related livelihood opportunities as an extra source of income. Customer satisfaction was another component that influenced performance in the sector. Travelers who are pleased with their experience give tips or incentives to service providers, which encourage repeat business, helpful word-of-mouth, and favorable online reviews.

The transport providers have implemented safety precautions for the tourists. Boat riders have placed safety jackets in boats while cart riders have added safety cushion seats. However, based on tour counter information, the most common complaints from customers were regarding inadequate security for the transportation system, unhygienic food preparation, and low meal quality. This attests to the fact that the industry is not performing to its full potential.

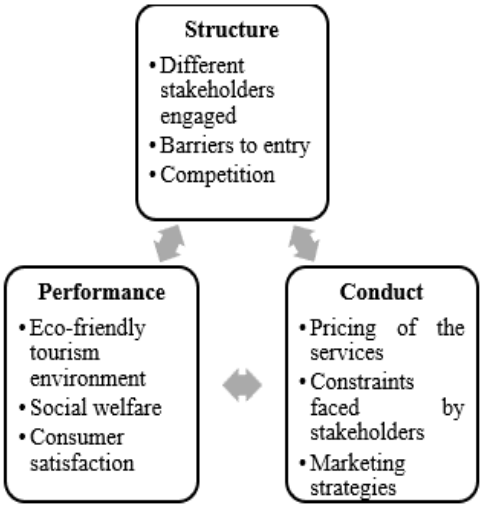

Figure 2. Elements of agro-ecotourism S-C-P approach

SWOT Analysis

Figure 3 indicates the strengths, weaknesses, opportunities and threats of agro-ecotourism in Hiriwadunna.

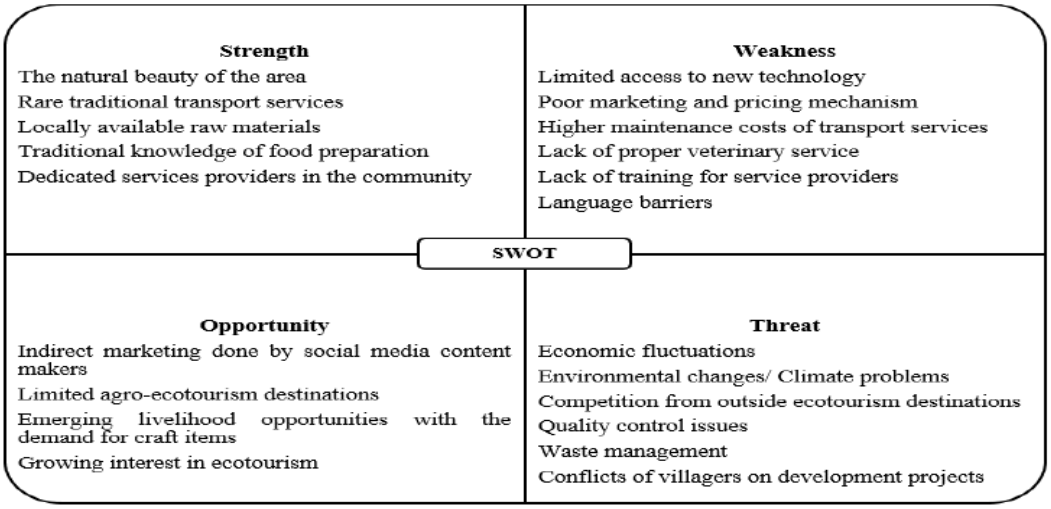

Figure 3. SWOT analysis of Hiriwadunna agro-ecotourism village

CONCLUSIONS

This study was conducted to examine the Structure-Conduct-Performance of agro-ecotourism in the VTCs. The structure of the Hiriwadunna agro-ecotourism sector includes major stakeholders of village house owners, bullock cart riders, boat riders, village counter owners, tuk-tuk riders, and safari jeep riders. Higher initial investments and aggressive leading parties were some entry barriers. The promotions were done through social media, websites or partnerships. Sanitation problems, financial problems, and seasonality were distinctive constraints faced by stakeholders. Further, stakeholders maintained an eco-friendly environment in the area. The negative feedbacks of dissatisfied visitors on food quality, hygiene and safety of transportation services affect the performance of the sector.

The agro-ecotourism sector in VTCs assists the community in reducing poverty with secondary occupation opportunities. To grow agro-ecotourism and achieve optimal market performance, it is necessary to tackle the problems of sanitation, marketing, and language skills of the community members. To improve community engagement, the government should introduce a firm regulatory framework to alleviate stakeholder constraints and barriers. In addition, individuals with innovative concepts for agro-ecotourism should be encouraged to expand both the market and the dynamics of livelihood. Further investigation into the agro-ecotourism market is also important. Research on market dynamics, tourist expectations, agro-ecotourism value chain analysis, and the effect of digital or online marketing is crucial for agro-ecotourism growth in VTCs.

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Assessing the Livelihood Opportunities Associated With the Development of Bee Honey Value Chains in a Village Tank Cascade System in Rural Sri Lanka

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ABSTRACT

The bee honey value chain within the Village Tank Cascade System (VTCs) in rural Sri Lanka holds significant economic, cultural, and environmental importance. However, there are a limited number of studies prevail in the context of Sri Lanka, and more specifically that addressing a bee honey value chain within VTCs. In the shed of this light, this study was aimed to identify the opportunities for livelihood improvement by developing a 'bee honey value chain' with an enhanced efficiency to which the Palugaswewa area in Sri Lanka, known for VCTs and bee- honey value chains, was selected by way of a two-stage sampling technique. Research tools such as Semi-Structured Questionnaires, Personal Interviews, and Focus Group Discussions were employed systematically to gather data, both qualitative and quantitative. The key stakeholders in the area including the producers, local collectors, wholesalers, and retailers etc. The sample also included these types of stakeholders (n=25). The Cost-Benefit analysis together with Value Chain Analysis and SWOT analyses were applied to analyze data. The outcomes of multiple analytical tools suggest that the "end producers" stand considerably in accruing the most profit generated, while the "wholesalers" and "retailers" outside the province often benefit from the economies of scale. For instance, producers and collectors demonstrated a VA of 657 Rs/kg, yielding a GPM of 53 percent. On the other end of the spectrum, end producers exhibited a VA of 8,727 Rs/kg, with a high GPM of 68.7 percent. These point out the need for key stakeholders with greater interest and impact to act on improving the beekeeping methods, organizing distribution channels better, and focusing on efficiency to increase profits, etc. The figures generated through study provide values information for policymakers and value-chain participants; yet, warranted an in-depth analysis into multiple aspects, including agronomics, socio-economics and politics.

KEYWORDS: Bee honey value chain mapping, Value addition, Village tank cascade system (VTCs)

INTRODUCTION

The bee honey value chain within the VTCs of rural Sri Lanka holds significant economic, cultural, and environmental relevance. These interconnected small tanks or reservoirs support agricultural activities and are essential for the sustainability of rural communities. Beekeeping, when integrated into these systems, offers a promising avenue for diversifying income sources, enhancing economic resilience, and promoting VTCs conservation (Madduma Bandara, 2009).

Beside the potential of the bee honey value chain within VTCs, comprehensive research on optimizing this value chain to boost economic sustainability and industry growth is limited. This gap in research presents challenges in developing effective strategies for VTCs communities, particularly in leveraging beekeeping as a tool for livelihood improvement and resilience against environmental changes.

The study aims to explore, analyze, and understand the complete bee honey value chain within the VTCs, focusing on enhancing sustainability and efficiency. By doing so, the study seeks to identify and implement opportunities for improving livelihoods within the VTCs, particularly in the Palugaswewa area.

The primary aim of the research is to identify and implement strategies for livelihood improvement in the Palugaswewa area's VTCs through the development of the bee honey value chain. This includes a thorough examination of all relevant actors and intermediaries involved in the value chain, from production to market.

This study evaluates the economic contributions of beekeeping to local communities, including income generation, employment opportunities, and the economic impact on household welfare. It will delve into the cultural practices and traditional knowledge associated with beekeeping in VTCs, exploring how these can be leveraged or preserved in modern practices. Additionally, the study will analyze the role of beekeeping in VTCs conservation, including its benefits for biodiversity, pollination of crops, and maintaining ecological balance within the VTCs.

The research involves mapping the entire bee honey value chain, identifying key players, processes, and linkages from production to consumption. This includes assessing the efficiency of each stage, from beekeepers to

processors, distributors, and retailers. The study will identify the main challenges faced by beekeepers and other stakeholders in the value chain, such as access to markets, financial constraints, and environmental threats, while exploring opportunities for enhancing productivity, market access, and value addition.

The study will recommend policies and development strategies that can support the sustainable growth of the bee honey value chain within VTCs. This might include capacity-building programs, financial support, market development initiatives, and infrastructure improvements. By focusing on these aspects, the study aims to provide a comprehensive understanding of the bee honey value chain within VTCs and offer actionable insights and strategies for enhancing the livelihoods of rural communities in the Palugaswewa area through sustainable and efficient beekeeping practices.

METHODOLOGY

The Study Area

The study area, Palugaswewa DS Division in the North Central Province, is chosen for its significant VTCs and the bee honey value chain.

Study Sample

A two-stage sampling technique was used. First, the Thumbikulama VTCs was selected, optimizing accessibility and honey production potential, while diverse perspectives and expertise specific to this system were captured through purposive sampling (Suri, 2011). Second, snowball sampling, facilitated by a value chain map, was used to select respondents from each actor category, ensuring diverse insights within the bee honey value chain were captured and key stakeholders crucial for comprehensive data collection and analysis were identified (Naderifar and Ghaljaie, 2017).

The total sample included 25 respondents, distributed as follows: Producer and collector (n=1), producer, collector, and retailer (n=1), producer (n=17), local collector, wholesaler, and retailer (n=2), wholesaler and retailer within the province (n=2), wholesaler within the province (n=1), and collector and retailer (n=1). These sampling methods ensured rich data collection while optimizing resources and enhancing the understanding of the differences within the bee honey value chain.

Research Tools and Procedure

Semi-Structured Questionnaires, Personal Interviews, and Focus Group Discussions were utilized as research tools.

One-to-one interviews enabled in-depth exploration of individual perspectives, essential for decision-making processes influenced by social pressures and beliefs. Focus group meetings facilitated the exchange of diverse viewpoints, covering a broader range of insights and recognizing the interconnectedness of all actors in the value chain dynamics. By combining both quantitative and qualitative approaches, researchers could develop a comprehensive understanding of the dynamics within the bee honey value chain (Hellin and Meijer, 2006).

Both qualitative and quantitative data were gathered simultaneously through Semi-Structured Questionnaires, Personal Interviews, and Focus Group Discussions covering a range of qualitative factors including customer perceptions, demographics, product destinations, potential demand, value chain activities, industry development opportunities, stakeholder obstacles, and underlying causes, while quantitative measures such as production costs, selling prices, unit costs, fixed costs, variable costs, revenue generation, and production quantities were also collected.

Data Analysis

The value addition (VA) is determined using equation 1,

$$VA\left(\frac{Rs}{kg}\right) = Selling\ Price - Unit\ Cost \ldots\ldots (1)$$

Additionally, the percentage of gross profit margin (GPM) was calculated using equation 2,

$$GPM\% = \frac{(TRi - TVCi)}{TRi} \times 100 \ldots\ldots (2)$$

Here, GPM represented the gross profit margin percentage of actors, TRi represented the total revenue of actors (Rs/kg), TVCi represented the total variable cost of actors (Rs/kg), and i represented the number of actors in the value chain.

In addition, a SWOT analysis, was employed to explore the strengths, weaknesses, opportunities and threats pertaining to the sector. The study was initiated with the development of the flow chart illustrating the processes and actors involved in the bee honey value chain.

RESULTS AND DISCUSSION

Value Chain Map (VCM)

Figure 1 illustrates the value chain map of the bee honey in Thumbikulama, Palugaswewa, Sri Lanka. In this value chain, “producers”, “producer, collector and retailer”, “producer and collector” were included. “Producers” were represented at 90%, while the other two

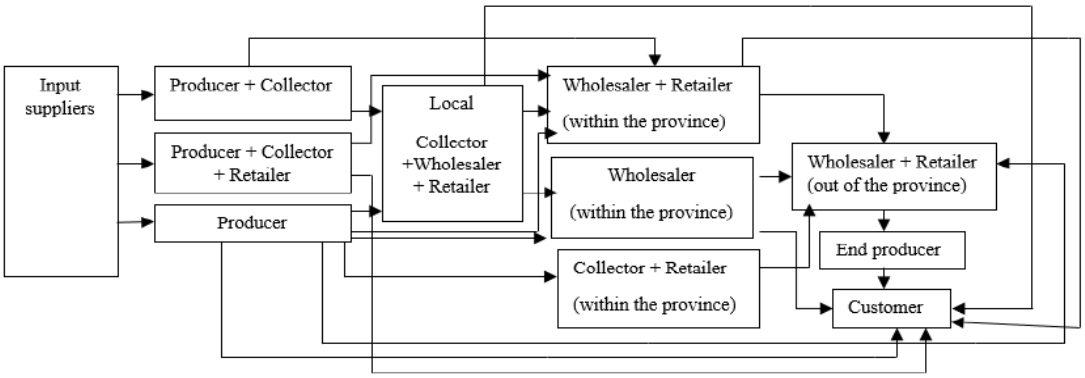

Figure 1. Value chain map for Bee honey

categories were represented at five percent each.

98% of bee honey is delivered by "producers". 0.3% of bee honey is delivered by "producer, collector and retailer". 1.8% of bee honey is delivered by "producer and collector". From "producers", 0.6% of bee honey was moved to "collector and retailer" (within the province), 1.5% to "wholesaler" (within the province), and 91.3% to "local collector, wholesaler and retailer".

Additionally, 5.95% was moved through "wholesaler and retailer" (out of the province), 0.6% through "wholesaler and retailer" (within the province), and 0.03% directly to local customers. From "producer, collector and retailer", 80% of bee honey was moved to "wholesaler and Retailer" (within the province), while 20% was directly sent to local customers.

From "producer and collector", 70% of bee honey was moved to "wholesaler and retailer" (within the province), and 30% to "local Collector, wholesaler and retailer". "Local collector, wholesaler and retailer", acting as both wholesaler and collector, accounted for 40%.

They represented around 33.3% of all retailers in the province, with 89.7% of their bee honey being moved through "wholesaler and retailer" (within the province), 6.8% through "wholesaler" (within the province), and 3.5% directly to local customers.

"Wholesaler and retailer" (within the province) served as a wholesaler for 40% and represented 33.3% of all retailers. Among them, 42.6% of their bee honey was moved through "wholesaler and retailer" (out of the province), and 57.4% went directly to customers.

"Wholesaler" (within the province) accounted for 20% of all "wholesalers", with 81.5% of their bee honey being moved through "wholesaler and retailer" (out of the province) and 18.6% going directly to customers. "Collector and retailer" (within the province) represented 20% of collectors and 16.66% of retailers, with all their bee honey being moved through "wholesaler and retailer" (out of the province).

"Wholesaler and retailer" (out of the province), end producers, and customers were at the end of the value chain. Processing occurred minimally before "wholesaler and retailer" (out of the province), with most value additions and product differentiation happening at the end producer level.

Actors of the Value Chain

Input suppliers provide containers and equipment, while producers specialize in forest bee honey collection and crop cultivation, with local collectors, wholesalers, and retailers serving as intermediaries, distributing honey within and outside the province. Forest bee honey is offered in various sizes within the province by wholesalers, who also implement product differentiation, while local collectors and retailers operate within the province, connecting producers with local customers.

Outside the province, forest bee honey and value-added products are distributed by wholesalers and retailers, ensuring strict hygiene practices and obtaining certifications. Such as GMP, HACCP, ISO 22000, ISO 14001, Halal, and Fair Trade for product safety and quality.

According to the studies carried throughout the provinces, 10 marketing channels were identified related to bee honey products in VTCS.

Channel 01: Producer → Wholesaler (within the province) → Customer

Channel 02: Producer → Local Collector, wholesaler and retailer → Customer

Channel 03: Producer → Wholesaler and retailer (out of the province) → End producer → Customer

Channel 04: Producer → Wholesaler and retailer (within the province) → Customer

Channel 05: Producer → Customer

Channel 06: Producer → Wholesaler and retailer (within the province) → Wholesaler and retailer (out of the province) → End producer → Customer

Channel 07: Producer → Local Collector, wholesaler and retailer → Wholesaler and retailer (within the province) → Customer

Channel 08: Producer → Local Collector, wholesaler and retailer → Wholesaler and retailer (within the province) → Wholesaler and retailer (out of the province) → End producer → Customer

Channel 09: Producer → Local Collector, wholesaler and retailer → Wholesaler (within the province) → Wholesaler and retailer (out of the province) → End producer → Customer

Channel 10: Producer → Collector and retailer (within the province) → Wholesaler and retailer (out of the province) → End producer →Customer

Developments of Bee Honey Value Chain

This value chain map needs several improvements. Vertical integrations are currently low, with many producers operating solely. There is a need to reduce the high number of sole producers and increase the amount of bee honey going directly to customers from various stages of the chain.

At the producer level, most producers supply bee honey to local collectors, wholesalers, and retailers, with minimal amounts passing through other combinations. Enhancing these vertical integrations and improving direct sales to customers from both local and provincial wholesalers will significantly improve the value chain

End Producers

It is observed that the highest value addition (VA) of 8727 Rs/kg and gross profit margin (GPM) of 68.6% among all actors in the bee honey value chain is showed by end producers. Their important role in adding significant value to the product and generating higher profits compared to other actors is emphasized.

Producers

The majority of producers are sole producers. These producers have a value addition of 486.1 Rs/kg and a gross profit margin (GPM) of 24.31%, reflecting moderate profitability and highlighting their key role in the initial stages of the value chain.

Wholesaler (Within the Province)

It is reported that while maintaining a positive gross profit margin, this actor demonstrates a lower value addition and gross profit margin compared to end producers. With VA of 197.7 Rs/kg and GPM of 12.6%, it's noted that profitability remains lower than that of end producers.

Local Collector, Wholesaler and Retailer

Observations indicate that operating solely as a wholesaler within the province yields the lowest value addition and gross profit margin compared to the wholesaler and retailer within the province. With VA of 121.6 Rs/kg and GPM of 9.01%, this actor indicates the lowest profits.

Wholesaler and Retailer (Within the Province)

The analysis reveals that this actor demonstrates a moderate value addition and gross profit margin, higher than that of wholesalers but lower than end producers and wholesalers and retailers within the province. With VA of 225 Rs/kg and GPM of 14.3%, moderately profitable.

Collector and Retailer (Within the Province)

Compared to local collectors, wholesalers, and end producers, it's important that this segment shows moderate value addition and gross profit margin. With VA of 976.1 Rs/kg and GPM of 42.4%, it suggests that profits might be lower for collectors and retailers within the province.

Wholesaler and Retailer (Out of the Province)

As observed, this actor exhibits moderate value addition and gross profit margin in the bee honey value chain with VA 1500 Rs/kg and GPM of 50%.

Local collectors, wholesalers, and retailers within the province demonstrate moderate profitability, whereas their counterparts outside the province exhibit lower profitability. Stakeholders should prioritize high-value, high-profit activities, particularly end production, and optimize operations within the province.

Strategies should focus on enhancing efficiency and reducing costs for less profitable actors to improve overall value chain performance. These producers and results are presented in accordance with Table 01.

Table 01: Calculations of value additions and gross profit margin percentages

Actor	VA	GPM%
P+C	657.6	52.6
P+C+R	177.6	10.5
P	486.1	24.31
W/R(In)	225.0	14.29
W(In)	197.7	12.6
Local W+R+C	121.6	9
C/R(In)	976.1	42.4
W/R(Out)	1500	50
End producers	8727	68.6

VA-Value added (Rs/Kg), GPM- Gross profit Margin (%), P+C- Producer and collector, P+C+R- Producer, collector and retailer, P- Producer, W/R(In)- Wholesaler and retailer (within the province), W(In)- Wholesaler (within the province), Local W+R+C– Local Collector, wholesaler and retailer, C/R (In)- Collector and retailer (within the province), W/R (Out)- Wholesaler and retailer (out of the province)

SWOT Analysis

Low time consumption, low risk, an easy harvesting process, a high amount of harvesting, low energy consumption, and lenient rules and regulations are strengths at the producer level. High demand for Ayurvedic, food, and cosmetic industries, and a naturally available environment for bee honey production are strengths at the collector level.

High levels of foreign demand and a naturally available environment for bee honey production are strengths at the retailer and wholesaler levels. A suitable environment, high ayurvedic value, and high demand are opportunities at the producer level.

High demand for value-added products of honey is an opportunity at the collector, retailer, and wholesaler levels. High time consumption, low availability of resources, knowledge, standards, and seasonality of honey production are weaknesses at the producer level. Insufficient supply for demand and low quality in bulks are some weaknesses at the collector, retailer, and wholesaler levels. Wild animals, lizard, ants, giant honeybee, wax moths, and other pest attacks, and threats from wildlife conservation officers are threats at the producer level. Price conflicts of bee products are a threat at the collector, retailer, and wholesaler levels.

CONCLUSIONS

The strategic findings obtained from the analysis informed the development of an action plan aimed at integrating sustainable practices into the bee honey value chain. Stakeholders should prioritize beekeeping practice improvement and intermediary reduction, encourage forest honey processing, and optimize bee box utilization. Product differentiation, pest control, and adherence to quality standards are essential. Exploring product and price differentiation is advised. Retailers should support beekeeping, maintain quality, and diversify offerings. Wholesalers should enhance production quality, support beekeeping, and implement market expansion strategies. Overall, focus on high-value activities, optimize operations, and improve efficiency to maximize performance in the bee honey value chain.

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Unlocking the Economic Value of Gregory Lake: A Travel Cost Approach

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ABSTRACT

Recreational areas offer significant benefits to society that encompass both direct uses and indirect uses. However, because these benefits are not sold in markets, their value is often overlooked or underestimated. This study aims to comprehensively analyze the economic value of Gregory Lake in Nuwara Eliya, Sri Lanka, using the Travel Cost Method (TCM) to highlight its significance and potential for boosting local and regional economies through sustainable tourism and conservation practices. Data were collected through face-to-face interviews with 300 respondents during off season using a detailed questionnaire and estimated monthly local visitor population in approximately 2,100. The analysis identified several critical factors influencing visitation rates: travel cost, distance, income, education, and age. Higher travel costs and longer distances were found to deter visits, while higher income levels, greater educational attainment, and older age were associated with increased visitation frequency. These findings emphasize the importance of demographic and economic variables in assessing the recreational value of natural sites. The study's primary outcome was the calculation of the consumer surplus for Gregory Lake, determined to be LKR 83,333 per visitor, represents the difference between visitors' willingness to pay for access to the lake and their actual expenditure. The substantial consumer surplus underscores the significant recreational value that visitors place on Gregory Lake, beyond the tangible costs incurred. Study provides valuable insights for policymakers and stakeholders for promoting sustainable tourism and conservation practices that enhance recreational experiences while preserving the natural environment. This research highlights the need to recognize and value the non-market benefits of recreational areas to inform better management and conservation strategies.

KEYWORDS: Consumer surplus, Non-market valuation, Recreational benefits, Travel cost method

INTRODUCTION

Non-market valuation plays a crucial role in understanding and appreciating the full value of goods and services that are not traded in conventional markets. These include environmental assets, public goods, and recreational areas whose benefits are enjoyed freely or at a nominal fee, making their economic value less obvious. (Emerton and Bos, 2004; Pearce, 2006) By quantifying these values, non-market valuation provides essential data that can inform public policy, resource management, and investment decisions (Johnston *et al.,* 2015).

Recreational areas like parks, lakes, and natural reserves offer significant benefits to society. These benefits encompass both direct uses, such as outdoor activities and leisure, and indirect uses, such as ecosystem services and aesthetic enjoyment. (Willis and Garrod, 1993) However, because these benefits are not sold in markets, their value is often overlooked or underestimated. (Freeman, 2003) non-market valuation techniques, such as the travel cost method, contingent valuation method, and hedonic pricing, help in estimating the economic value of these recreational areas, thereby highlighting their importance in economic terms. This valuation is critical for making informed decisions about conservation, maintenance, and development of these spaces, ensuring that they continue to provide social, environmental, and economic benefits (Carson and Hanemann, 2005).

The travel cost method (TCM) is a widely used non-market valuation technique, particularly suitable for evaluating recreational sites. It estimates the value of a site by examining how much visitors are willing to pay to travel to the site (Smith, 1993). This includes direct costs such as transportation, accommodation, and entry fees, as well as indirect costs like the value of time spent traveling. By analyzing the relationship between the number of visits to a site and the travel costs incurred by visitors, TCM can estimate the site's recreational value in monetary terms (Parsons, 2003).

Gregory Lake in Nuwara Eliya, Sri Lanka, serves as an ideal case study for applying the TCM. The lake is a key tourist destination (for both domestic and foreign), attracting numerous visitors with its scenic beauty and recreational offerings such as boating, fishing, and picnicking (Gunawardena and Mahanama, 2012). To unlock the economic value of Gregory Lake, it is essential to understand how much visitors are willing to spend to access and enjoy its amenities. This study aims to provide a comprehensive economic analysis of Gregory Lake, employing TCM to highlight its value and potential for enhancing local and regional economies through sustainable tourism and conservation practices (Gunawardena and Mahanama, 2012).

METHODOLOGY

Theoretical Framework

Travel cost method (TCM) is a revealed preference method based on observed behavior reflecting utility maximization subject to a constraint, developed by Hotelling, one of the oldest methods in environmental valuation (Freeman, 2003). TCM measures Marshallian consumer surplus that approximates and is bounded by the compensating variation (CV) and equivalent variation (EV) welfare measures This method uses the travel cost as a proxy for the price of recreation assuming rational behavior on the part of the consumer while the sole decision variable is the number of visits paid by the consumer to a certain recreation site within a period. The travel cost varies with distance from the recreational site, a surrogate demand curve can be derived based on the varying cost information that can be used to estimate the consumer surplus as a measure of welfare. individual travel cost method (ITCM) which is appropriate for sites with high individual visitation rates. Recreational demand was derived through ITCM and the number of visits the user made to the site during the last month was taken as the dependent variable. The explanatory variables include the travel cost, age, income, gender, distance to the site, and time spent. As with any demand function, a negative relationship is established between demand quantity and price, so when travel costs are higher, the demand is lower. For a given visitor, the demand for visits to a site follows the expression:

$$V_{i=} f\left(TC_i, I_i, D_i, A_i, T_i, G_i, ED_i, EM_i, M_i\right) + \in_i \ldots\ldots\ldots (1)$$

V_i =Number of visits by individual i
TC_i =Travel cost to the site
I_i = Income level of the visitor
D_i = Distance to the site from visitor's home
A_i = Age of the visitor
$T_{i,}$ = Time spent in site (hours)
G_i = Gender of the visitor
ED_i= Education
EM_i= Employment status
M_i = Marital status
$\in_i$ = Error term

Estimation of Consumer Surplus

Consumer surplus measures the economic benefit visitors derive from accessing Gregory Lake. It represents the difference between what visitors are willing to pay and what they actually pay. The consumer surplus (CS) per visit is calculated using the estimated demand function. It is the area under the demand curve above the actual travel cost, up to the maximum willingness to pay (choke price). The choke price is the travel cost at which the number of visits drops to zero. It is calculated by setting the expected number of visits to zero in the demand function and solving for the travel cost. This price represents the maximum amount visitors are willing to pay before they cease visiting the site.

$$0 = \beta_0 + \beta_1 CP + \beta_2 Y_i + \beta_3 Z_i \ldots\ldots\ldots (2)$$

CP = Choke price
Y_i = income level of the Visitor
Z_i = other variables affect to visitation rate
$\beta_0, \beta_1, \beta_2, \beta_3$ = Coefficients to be estimated

The consumer surplus (CS) per visit is calculated using the following estimated demand function.

$$CS_i = \int_{TC}^{P_{max}} f\,(TC_i, Y_i, Z_i) dTC \ldots\ldots\ldots (3)$$

CS_i= Consumer surplus per individual
P_{max}= Choke price
TC_i = Travel cost to the site
Y_i = Income level of the visitor
Z_i = Other variables affect to visitation rate

The total economic value (TEV) of Gregory Lake is then obtained by multiplying the individual consumer surplus by the total number of visits (Marawila and Thibbotuwawa, 2010).

$$TEV = CS\ per\ visit \times Size\ of\ annual\ population \times Average\ no\ per\ visit\ per\ individual \ldots\ldots\ldots (4)$$

This estimation provides a monetary measure of the recreational benefits enjoyed by visitors, aiding policy decisions and resource allocation for the site.

Study Area and Data Collection

Gregory Lake, nestled in the picturesque town of Nuwara Eliya, Sri Lanka, is not only a natural gem but also a pivotal economic asset. Established during the British colonial era, this man-made lake has evolved into a major tourist attraction, drawing both local and international visitors. The serene environment, coupled with various recreational activities such as boating, site seeing, and picnicking, makes Gregory Lake a focal point for tourism and local commerce. Data were collected through detailed questionnaires administered to visitors. Additionally, the on-site data collection involved counting the number of tickets issued from 9 am to 5 pm over three consecutive weekdays and two weekend days during the off-season. Recorded figures were 35, 48, and 50 for weekdays and weekend visitor number was 150. This resulted in estimated monthly visitor population in off-season approximately 2100. (Jala and Nandagiri, 2015). However, it is important to note that these figures can change during the on-season days when visitor numbers are typically higher. To ensure representative sampling, the survey was conducted at different times and days to capture variations in visitation patterns. The questionnaire included sections on general information, recreational behavior, travel costs, and willingness to pay for improved services.

Data Analysis

When estimating the TC function, the number of visits (*Vi*) cannot take continuous values (only integer values), so the use of regression with ordinary least squares (OLS) can lead to errors irreconcilable and unreliable. The simplest solution is to use a regression model based on a Poisson distribution. The Poisson distribution meets the assumption that the average number of visits is the same as the variance. When this condition is not met, and the data show a greater dispersion (common in practice), and the use of negative binomial distributions can be an alternative. NB models introduce an error term into the hypothesis above mentioned of equality of mean and variance, allowing the deliberation of unobserved systematic differences.

Negative binomial regression model, suitable for modeling count data, which provides robust estimates of the relationship between travel cost and visitation rates. The model is specified as:

$$ln(E[Vi]) = \beta_0 + \beta_1 TC_i + \beta_2 Y_i + \beta_3 Z_i + \epsilon_i \dots\dots\dots (5)$$

Where;

$ln(E[V_i])$ = Expected number of visits by individual i

$\beta_0, \beta_1, \beta_2, \beta_3$ = Coefficients to be estimated

ϵ_i = Error term

Regression analysis helps identify key factors influencing the number of visits and estimate the coefficients quantifying the impact of travel cost and other variables on visitation rates.

RESULTS AND DISCUSSION

Descriptive Statistics

The sample was composed of 300 respondents with a mean age of 38 years, ranging from 25 to 76 years. The standard deviation of ±13 years was observed, indicating moderate age variation among visitors. Approximately 69.41% of respondents were female, and 30.9% were male, indicating a higher participation rate among females in recreational activities at Gregory Lake. Among the respondents, 61.9% were married, 38.1% were unmarried, highlighting that a significant portion of visitors are married individuals. A high education level was noted, with 58.4% holding a degree or higher and 34.7% having completed GCE A/L. Only 0.7% had secondary education, indicating a well-educated visitor group. Gregory Lake has visited an average of 2.6 times per year, with a maximum of 20 visits per year. The median number of visits was 2, indicating relatively infrequent visits for most visitors. The average time spent per visit was 3.45 hours, with a maximum of 6 hours. The average travel cost per visit to Gregory Lake was 45978.69 LKR. The income level of the Most visitors (55%) is between 50,000LKR – 100,000LKR. While 17.5% of the visitors belongs to >100,000LKR income level and 15.5% of them were 30,000 - 50,000LKR income level. an average distance of 114.9 km was traveled, with distances ranging from 0.5 to 393 km, highlighting that many visitors came from considerable distances. Occupations were diverse, including regular employees (36.4%), general employees (22.3%), students (17.5%), and various other professions, reflecting a wide range of professional backgrounds among visitors. The estimated off-peak season monthly local visitor population approximately 2,100 provides a baseline for understanding visitation patterns. This figure highlights the significance

of Gregory Lake as a recreational site even during less busy periods.

Regression Analysis

The economic analysis employed a negative binomial regression model to accommodate the overdispersion typical in count data, such as the number of visits. This model highlighted several critical factors influencing visitation rates. Table 1 shows travel cost has a significant negative impact, indicating that higher costs are likely to reduce the number of visits ($p = 0.003$). The reason for this is straightforward: as the cost of travel increases, it becomes less affordable for people to visit, leading to a decrease in the number of trips. This effect is consistent with economic theory, which suggests that higher costs deter consumption, in this case, visits to Gregory Lake. Similarly, the distance variable also showed a strong negative correlation with visitation rates ($p < 0.01$); indicating that the farther away visitors live, the less likely they are to visit Gregory Lake. The rationale behind this result is that longer distances involve not only higher travel costs but also greater time and effort, which can discourage frequent visits.

Table 1. Tests of model effect

Source	Wald Chi-Square	df	Sig.
(Intercept)	23.692	1	.000
Income	15.799	4	.003*
Employment	3.216	7	.864
Education	38.646	3	.000*
Marital_Statues	.503	1	.478
Gender	1.547	1	.214
TC	6.181	1	.003*
Distance	24.170	1	.000*
Age	5.866	1	.005*
Time	3.019	1	.082

*Significant at: * $p < 0.01$*

According to the Table 1, Income and education levels were found to have a positive impact on visitation rates. Higher income levels allow individuals to afford more discretionary activities, such as visiting Gregory Lake, without financial strain. Additionally, people with higher educational attainment might value recreational and cultural activities more, leading to more frequent visits. These factors suggest that Gregory Lake attracts visitors from higher socioeconomic groups who have the means and perhaps the inclination to engage in such leisure activities. The positive correlation between the age of visitors and the frequency of visits ($p = 0.005$) suggests that older individuals tend to visit Gregory Lake more frequently. This trend could be attributed to several factors. Firstly, older individuals often have more free time, particularly if they are retired, allowing them to engage in leisure activities more regularly. Secondly, they might have greater disposable income, which enables them to afford travel and recreational activities without financial strain. Additionally, the recreational offerings at Gregory Lake might cater more to the interests and preferences of older visitors, making it a more appealing destination for this demographic.

Annual Recreational Value of Gregory Lake

The estimation of the annual recreational value of Gregory Lake involves calculating the consumer surplus and aggregating it over the total number of visits. Consumer surplus presents the difference between the individual willingness to pay and the actual expenditure, which was derived as LKR 83,333/visitor ($-1/\beta TC$). Social welfare value or the aggregate consumer surplus can be derived using the total monthly visits by the visitors to the site.

CONCLUSIONS

Preserving Gregory Lake is vital for sustaining the considerable non-market benefits it provides to the community, as this study highlights the importance of natural recreational areas in enhancing social welfare and supporting local economies. The TCM effectively evaluated these benefits, revealing the lake's significant value beyond traditional market measures. Critical factors such as travel cost, distance, income, education, and age influence visitation rates, with higher travel costs and distances deterring visits, while higher income, education levels, and older age encourage more frequent visits. Effective management and conservation strategies are essential to maintain the lake's recreational and environmental benefits, and policymakers must consider the economic implications of development projects that could reduce natural spaces. By prioritizing preservation efforts, the community's social and economic well-being can be safeguarded, ensuring that future generations continue to enjoy the lake's amenities and natural beauty.

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