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President's Message

As the Organisation of Professional Associations of Sri Lanka (OPA) embarks on its 51st year of dedicated service to the nation, I am honoured to share this message in the 2026 edition of the OPA Journal. Having celebrated our Golden Jubilee in 2025, we now move forward with renewed purpose, inspired by a proud legacy of professional excellence, integrity, and national contribution.

For over five decades, OPA has served as the apex body representing Sri Lanka's professional community, bringing together a diverse spectrum of disciplines under one platform. Through the collective expertise of our member associations, we have consistently promoted professional standards, encouraged knowledge sharing, and contributed to the social and economic advancement of our nation.

In an increasingly complex and rapidly evolving world, the role of professionals extends beyond their respective fields of practice. Today, there is a greater responsibility to contribute to public discourse, policy development, innovation, and sustainable national progress. OPA remains committed to fulfilling this responsibility by serving as an independent and respected voice on matters of national importance.

Over the years, OPA has actively engaged with successive governments and key stakeholders by presenting policy recommendations and professional perspectives on critical economic, social, and governance issues. These contributions reflect our steadfast belief that informed professional input is essential for sound decision-making and long-term national development.

This journal stands as a testament to the intellectual strength and collective wisdom of our professional community. It provides a valuable platform for the exchange of ideas, research, experiences, and insights that enrich professional practice and inspire future generations. The archival initiative undertaken during the past year further strengthens this legacy by preserving decades of knowledge and thought leadership for wider accessibility and future reference.

I extend my sincere appreciation to the Editor, the Publication Committee, authors and contributors, sponsors, and all those who have worked tirelessly to make this publication possible. Their dedication and commitment have ensured the continued success of this important endeavour.

As we begin a new chapter in OPA's distinguished journey, let us continue to uphold the values of professionalism, ethical leadership, innovation, and service to society. Together, we can strengthen our professions, contribute meaningfully to national development, and help shape a prosperous future for Sri Lanka.

Jayantha Gallehewa

President

Organisation of Professional Associations of Sri Lanka (OPA)

Editor's Note

The Organisation of Professional Associations of Sri Lanka (OPA), having proudly celebrated its Golden Jubilee in 2025, now steps into its 51st year, heralding the dawn of a new chapter in its distinguished journey. This milestone signifies not only more than five decades of professional excellence, service, and national contribution, but also a renewed and steadfast commitment to advancing intellectual and professional leadership in Sri Lanka.

Building on the momentum of its Golden Jubilee, the OPA successfully undertook a landmark archival initiative to index its journal, made possible through the leadership of the President, Mr. Jayantha Gallehewa, and the dedicated efforts of the Publication Committee 2026. This important endeavor ensures that the rich repository of research, thought leadership, and professional insight remains preserved and accessible for the benefit of future generations.

Priyantha Wickramarathna

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FROM VOLUME TO VALUE: STRUCTURAL TRANSFORMATION OF SRI LANKA'S TEA EXPORT COMPETITIVENESS

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ABSTRACT

Sri Lanka's tea industry has historically been one of the country's most important export sectors, contributing significantly to foreign exchange earnings, employment generation, and rural livelihoods. However, despite maintaining a strong global reputation for quality and achieving some of the highest tea auction prices in the world, Sri Lanka's share of global tea exports has declined considerably over recent decades. This apparent paradox raises important questions regarding the changing nature of the industry's competitiveness. Accordingly, this study examines whether Sri Lanka's tea industry has undergone a structural transformation in the basis of its export competitiveness. The study adopts a quantitative research design and utilizes secondary data obtained from the Sri Lanka Tea Board, Central Bank of Sri Lanka, International Tea Committee, and other official sources. Descriptive analysis, correlation analysis, regression analysis, and analysis of variance (ANOVA) were employed to examine the relationships among export quantity, export value, export unit value, cost of production, and auction prices. The findings reveal that export earnings are increasingly associated with growth in export unit values rather than growth in export quantities. Rising production costs were found to have a statistically significant negative effect on export quantities while exhibiting a strong positive relationship with export unit values and Colombo auction prices. The results indicate that Sri Lanka's ability to compete through volume expansion has weakened due to increasing production costs and declining relative productivity. Nevertheless, the industry has maintained export earnings through premium pricing, quality differentiation, and value-based market positioning. The study concludes that Sri Lanka's tea industry has transitioned from a broad cost-based comparative advantage towards a narrower but higher-value form of competitiveness. The findings highlight the importance of productivity enhancement, value addition, branding, and premium market development in sustaining the long-term competitiveness of Ceylon Tea.

Keywords: Tea export competitiveness, comparative advantage, value-based competitiveness, cost of production, export performance, Sri Lanka.

INTRODUCTION

Tea has played a central role in Sri Lanka's economy for more than a century, contributing significantly to export earnings, employment generation, and rural livelihoods. The industry supports approximately one million people directly and indirectly and remains one of the country's most important agricultural export sectors (Sri Lanka Tea Board [SLTB], various years; Central Bank of Sri Lanka [CBSL],

various years). Historically, Sri Lanka possessed a strong comparative advantage

in global tea markets. During much of the twentieth century, the country was among the world's leading tea exporters and maintained a substantial share of international tea trade. However, the competitive landscape of the global tea industry has changed considerably. Major producers such as Kenya, China, India, and Vietnam have expanded production,

improved productivity, and strengthened their positions within international markets (Food and Agriculture Organization [FAO], 2021; International Tea Committee [ITC], various years).

The traditional indicators of competitiveness suggest that Sri Lanka's relative position has weakened over time. Global export shares have declined, production growth has stagnated, yields have remained below those of several competing origins, and production costs have increased substantially. At the same time, the industry continues to command some of the highest auction prices globally and remains recognised internationally for quality, authenticity, and premium orthodox teas (Kithsiri et al., 2020; SLTB, various years). These developments raise an important question. Has Sri Lanka simply become less competitive, or has the nature of its competitiveness fundamentally changed?

Existing studies have largely examined individual constraints affecting the tea industry, including productivity challenges, labour shortages, ageing plantations, market access issues, and policy constraints (Athukorala, 2021; FAO, 2021). While these studies provide valuable insights, relatively little attention has been given to understanding how the basis of Sri Lanka's competitiveness may have evolved over time. The concept of competitiveness has also evolved within international trade literature. Classical theories emphasised comparative advantage arising from factor endowments and production efficiency (Ricardo, 1817; Balassa, 1965). More recent perspectives highlight the importance of productivity, innovation, branding, quality differentiation, and value-chain positioning in sustaining competitive advantage (Porter, 1990; Kaplinsky, 2000; Ponte, 2019). Under these conditions, countries may lose cost-based advantages while maintaining competitiveness through quality-based and value-added market strategies.

This study argues that such a transformation may be occurring within Sri Lanka's tea industry. Rather than viewing declining export volumes and market shares as evidence of competitiveness failure alone, the study examines whether the industry has shifted from a volume-driven export model toward a value-driven export model characterised by premium pricing and quality differentiation.

RESEARCH OBJECTIVES

The study seeks to:

- 1) Examine long-term trends in Sri Lanka's tea export competitiveness.
- 2) Analyse the relationships among export quantity, export value, export unit value, exchange rates, inflation, and cost of production.
- 3) Evaluate whether Sri Lanka's tea industry has experienced a structural transition from volume-based competitiveness to value-based competitiveness.
- 4) Identify the implications of this transformation for future export strategy and policy.

Research Propositions

P1: Export earnings have become increasingly dependent on growth in export unit values rather than growth in export quantities.

P2: Rising production costs have contributed to the erosion of volume-based competitiveness.

P3: Sri Lanka's tea industry increasingly relies on quality differentiation and premium pricing to sustain export performance.

P4: The basis of Sri Lanka's comparative advantage has shifted from cost competitiveness toward value-based competitiveness.

Contribution of the Study

The study contributes to the literature by introducing a structural transformation perspective to the analysis of tea export competitiveness. Rather than examining isolated determinants of export performance, the paper focuses on how the basis of competitiveness has evolved over time. The study further contributes by integrating export quantity, export value, export unit value, and production-cost dynamics into a single analytical framework. The findings

provide evidence that Sri Lanka's tea industry may be transitioning from broad comparative advantage toward a narrower, premium-oriented competitive position within global tea markets.

LITERATURE REVIEW AND DEVELOPMENT OF RESEARCH PROPOSITIONS

Export Competitiveness and Comparative Advantage

Competitiveness is a multidimensional concept that reflects a country's ability to produce and market goods successfully in international markets while maintaining or improving the living standards of its population (Porter, 1990). In agricultural export industries, competitiveness is often associated with productivity, production costs, quality, market access, innovation, and value addition (FAO, 2021).

The traditional explanation for international trade originates from Ricardo's (1817) theory of comparative advantage, which argues that countries benefit from specialising in products that they can produce relatively more efficiently than others. Balassa (1965) extended this concept through the Revealed Comparative Advantage (RCA) framework, proposing that trade patterns can be used to assess a country's competitive position in international markets.

While comparative advantage remains important, modern trade literature increasingly recognises that competitiveness is dynamic rather than static. Competitive positions evolve due to technological change, productivity improvements, institutional quality, market developments, and changing consumer preferences (Porter, 1990; Athukorala, 2021). Consequently, industries may lose traditional cost-based advantages while developing new forms of competitiveness based on quality, branding, innovation, and value addition.

From Cost-Based Competitiveness to Value-Based Competitiveness

Historically, agricultural export competitiveness has been strongly linked to production efficiency and cost advantages. Countries capable of producing at lower costs have generally been able to expand market share and compete successfully in international markets (Kinnucan & Zhang, 2018). However, increasing global competition and changing consumer preferences have altered the determinants of competitiveness. Porter (1990) argues that sustainable competitive advantage increasingly depends on differentiation strategies rather than cost leadership alone. Similarly, Kaplinsky (2000) and Ponte (2019) highlight the growing importance of value-chain positioning, branding, product differentiation, and quality upgrading in determining export success.

Under such circumstances, industries facing rising production costs may remain competitive if they successfully differentiate their products and capture higher value segments of international markets. This transition represents a movement from volume-based competitiveness towards value-based competitiveness, where export earnings depend less on production expansion and more on premium pricing, quality enhancement, and market positioning.

Competitiveness in the Global Tea Industry

The global tea industry has undergone significant structural changes during recent decades. The emergence of low-cost producers such as Kenya, Vietnam, and parts of East Africa has intensified competition in international tea markets. These producers have benefited from higher yields, lower labour costs, and more extensive mechanisation, enabling them to compete effectively in price-sensitive market segments (FAO, 2021; ITC, various years). At the same time, consumer preferences have become increasingly diversified. Demand for specialty teas, premium products, origin-certified products, ethical sourcing, wellness beverages, and value-added tea products has expanded significantly (Ponte, 2019). These developments have created opportunities for producing countries to compete through differentiation rather than volume alone. Within this evolving environment, the ability to sustain competitiveness depends increasingly on quality assurance, branding, innovation, market diversification, and value addition rather than solely on production costs.

Sri Lanka's Tea Industry and Emerging Structural Challenges

Sri Lanka's tea industry faces several well-documented structural challenges. These include ageing tea bushes, low replanting rates, labour shortages, declining productivity, increasing energy costs, rising wages, and growing compliance requirements in international markets (Athukorala, 2021; FAO, 2021; SLTB, various years). Evidence suggests that the industry's cost structure has deteriorated considerably over time, reducing its ability to compete directly with lower-cost producers. Rising production costs have increasingly constrained export volumes and weakened Sri Lanka's position within highly price-sensitive markets. However, despite these challenges, Sri Lanka continues to

command premium prices in many export destinations and

maintains a strong international reputation for quality. These contrasting developments suggest that the industry may be undergoing a structural adjustment in the basis of its competitiveness. Rather than competing primarily through production scale and cost efficiency, Sri Lanka appears to be relying increasingly on premium pricing, quality differentiation, and value-based market positioning.

Research Propositions

Drawing upon the theoretical and empirical literature, the study advances the following propositions:

P1: Export earnings have become increasingly dependent on growth in export unit values rather than growth in export quantities.

P2: Rising production costs have contributed to the erosion of volume-based competitiveness within Sri Lanka's tea industry.

P3: Sri Lanka's tea industry increasingly relies on quality differentiation and premium pricing to sustain export performance.

P4: The basis of Sri Lanka's comparative advantage has shifted from cost competitiveness toward value-based competitiveness.

These propositions form the analytical framework of the study and guide the interpretation of the empirical findings presented in the subsequent sections.

METHODOLOGY

Research Philosophy

This study adopts a positivist research philosophy, which assumes that relationships between economic variables can be objectively observed, measured, and analysed using statistical techniques (Saunders et al., 2019). Positivism is appropriate because the study seeks to

examine observable relationships among export performance indicators and selected macroeconomic variables using historical quantitative data.

Research Design

The study employs a quantitative explanatory research design. The objective is not merely to describe trends in Sri Lanka's tea export sector but to explain the relationships between export performance and selected economic variables. The study combines trend analysis with inferential statistical techniques to examine whether the observed changes in export

competitiveness are associated with changes in exchange rates, inflation, and production costs.

Data Sources

The analysis is based entirely on secondary data obtained from official and internationally recognised sources. The use of secondary data is appropriate because the study investigates long-term structural changes in export competitiveness spanning several decades.

The principal data sources include:

Table 1: Data Sources

Variable	Source
Tea export quantity	Sri Lanka Tea Board (SLTB)
Tea export value	Sri Lanka Tea Board (SLTB)
Export unit value	Computed from export value and quantity
Exchange rate	Central Bank of Sri Lanka (CBSL)
Inflation rate	Central Bank of Sri Lanka (CBSL)
Cost of production (COP)	Sri Lanka Tea Board (SLTB)
World tea statistics	International Tea Committee (ITC)
Global tea production data	FAOSTAT

Annual data covering the period 1962-2024 were utilised where available. Cost of production data were analysed for the period for which consistent records were available.

Variables and Measurement

The study evaluates export competitiveness using three indicators:

1. Export Quantity (MT)
2. Export Value (US\$)
3. Export Unit Value (US\$/kg)

Export quantity represents the volume dimension of competitiveness, while export value reflects the industry's overall export

earnings. Export unit value serves as an indicator of value-based competitiveness and reflects the industry's ability to command premium prices in international markets.

The explanatory variables include:

- ✓ Exchange Rate (LKR/US\$)
- ✓ Inflation Rate (%)
- ✓ Cost of Production (LKR/kg)

These variables were selected based on international trade literature and previous studies examining export competitiveness and agricultural export performance (Balassa, 1965; Porter, 1990; Rodrik, 2008; Kinnucan & Zhang, 2018).

Analytical Framework

The study adopts a multi-stage analytical approach. First, descriptive and trend analyses are used to examine long-term changes in export quantity, export value, export unit value, production costs, and market shares. Second, correlation analysis is used to assess the strength and direction of relationships among the variables. Third, regression analysis is employed to evaluate the effects of exchange rate movements, inflation, and cost of production on export performance indicators. The general regression model is specified as:

$$Y_t = \beta_0 + \beta_1 EXR_t + \beta_2 INF_t + \beta_3 COPt + \varepsilon_t$$

where:

Y_t = Tea export performance indicator

EXR_t = Exchange rate

INF_t = Inflation rate

$COPt$ = Cost of production

β_0 = Intercept

$\beta_1, \beta_2, \beta_3$ = Regression coefficients

ε_t = Error term

Separate models are estimated using export quantity, export value, and export unit value as dependent variables. Analysis of Variance (ANOVA) is used to evaluate the overall significance of the regression models.

Reliability

Reliability refers to the consistency and stability of measurement (Bryman, 2016). Reliability was enhanced through the use of official secondary data obtained from institutions that employ established statistical procedures and reporting standards. The Sri Lanka Tea Board, Central Bank of Sri Lanka, International Tea Committee, and FAOSTAT maintain systematic data collection mechanisms and provide consistent definitions across reporting periods. To further enhance reliability, data were cross-checked across multiple sources wherever possible, and trends were compared for consistency.

Validity

Construct validity was ensured by adopting variables that are widely recognised in the literature as indicators of export competitiveness and macroeconomic performance. Export quantity, export value, and export unit value have been extensively used in studies examining agricultural export performance and international competitiveness (Balassa, 1965; Porter, 1990; Athukorala, 2021). Content validity was strengthened by incorporating variables representing both production-related factors and macroeconomic influences. Together, these variables capture key dimensions of export competitiveness. Statistical conclusion validity was enhanced through the application of multiple analytical techniques, including trend analysis, correlation analysis, regression analysis, ANOVA, and diagnostic testing.

Diagnostic and Robustness Tests

Several diagnostic procedures were employed to assess the adequacy of the statistical models. Multicollinearity among independent variables was evaluated using Variance Inflation Factors (VIF). VIF values below accepted thresholds indicate the absence of serious multicollinearity. Autocorrelation was assessed using the Durbin-Watson statistic. Values close to two indicate that residuals are independent. Heteroscedasticity was examined using the Breusch-Pagan test to verify the assumption of constant error variance. Normality of residuals was assessed through normal probability plots and normality tests. Where necessary, transformations and robustness checks were undertaken to improve model validity.

Ethical Considerations

The study relied exclusively on secondary data obtained from publicly available and officially published sources. No human participants were involved, and no personal, confidential, or sensitive information was

collected. The research adhered to accepted principles of academic integrity by ensuring accurate reporting, transparent presentation of findings, proper acknowledgement of data sources, and objective interpretation of results. All statistical analyses were conducted without manipulation or selective reporting of findings.

Limitations of the Study

The study relies on aggregated industry-level data and therefore cannot capture firm-level variations in competitiveness, marketing strategies, or operational performance. Furthermore, factors such as geopolitical developments, consumer preferences, international sanctions, and firm-specific innovations could not be directly incorporated into the statistical models despite their potential influence on export performance. Nevertheless, the long-term nature of the dataset provides a valuable

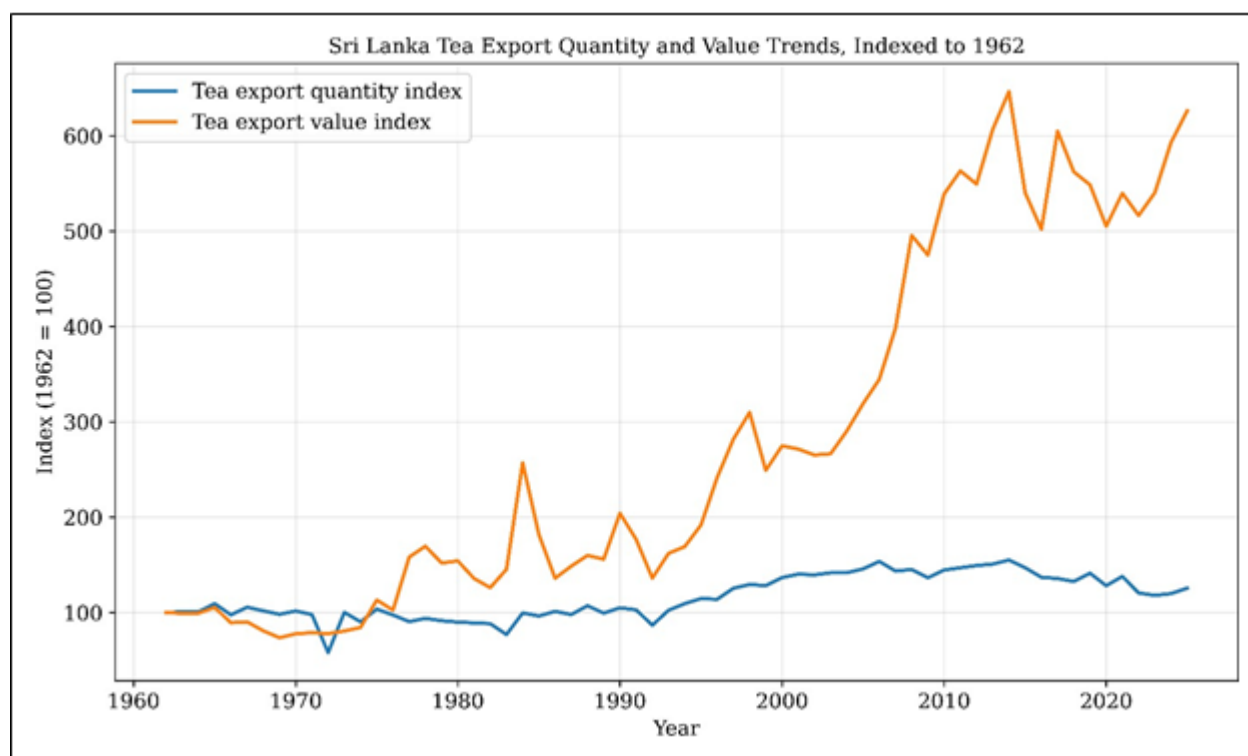
basis for examining structural changes in Sri Lanka's tea export competitiveness over time.

RESULTS AND DISCUSSION

Evidence of Declining Volume Competitiveness

Historically, Sri Lanka maintained a strong position in global tea markets through export volume growth and a substantial share of international tea trade. However, the long-term evidence suggests that this form of competitiveness has weakened considerably. Export quantities remained relatively stagnant during the study period despite fluctuations in international demand and prices. At the same time, Sri Lanka's share of world tea exports declined as competing producers such as Kenya, China, India, and Vietnam expanded production capacity and strengthened their positions in international markets.

Figure 1: Export Quantity and Export Value Trends, 1962-2025



Source: Author's illustration using data from ICT Bulletin (various editions)

The divergence between export quantity and export value trends is particularly noteworthy. While export quantities remained relatively stable, export values increased substantially over time. This suggests that export earnings were increasingly sustained through factors other than volume expansion. The findings indicate that Sri Lanka's traditional volume-based competitiveness has weakened, providing initial support for the proposition

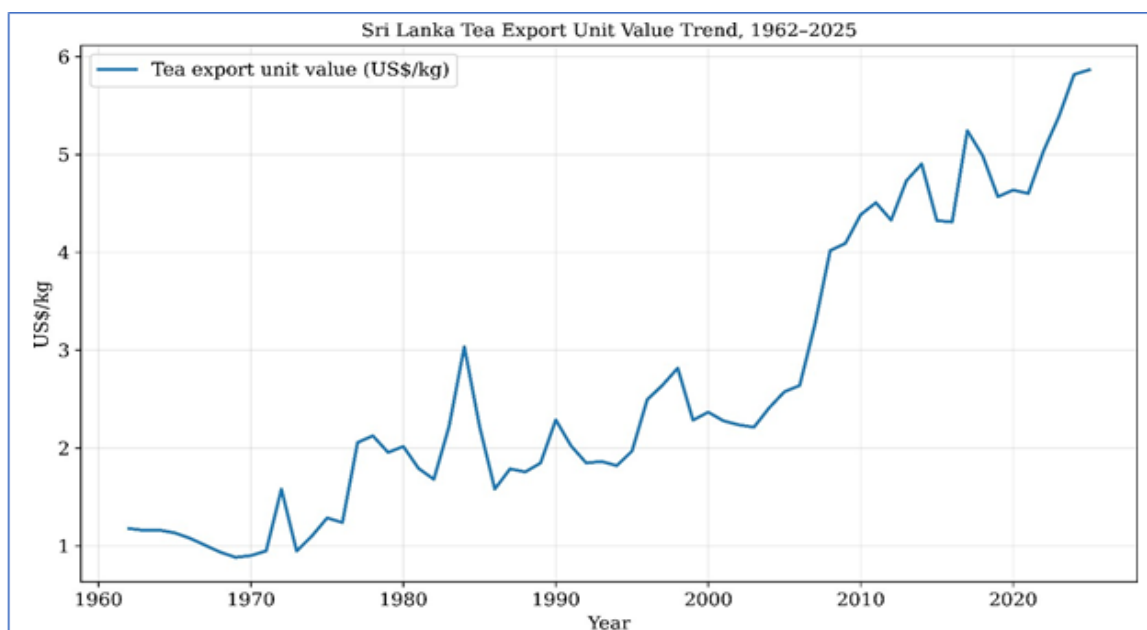
that the basis of competitiveness may be changing.

Evidence of Rising Value Competitiveness

Although volume competitiveness appears to have weakened, the evidence simultaneously suggests a strengthening of value-based competitiveness.

Export earnings continued to increase despite stagnating export volumes. Furthermore, export unit values increased substantially during the study period.

Figure 2: Export Unit Value Trend, 1962-2025



The continuous upward movement in export unit values provides preliminary evidence that competitiveness is becoming increasingly value-oriented. The increase in unit export values indicates that Sri Lanka increasingly relied on premium pricing rather than export volume growth. This finding is consistent with the continued global reputation of Ceylon Tea as a premium-quality product.

Correlation Analysis

To examine the relationships among the variables, Pearson correlation analysis was conducted.

Table 2: Correlation Matrix

Variables	Export Quantity	Export Value	Unit Value	COP	Auction Price
Export Quantity	1.000	-0.132	-0.436	-0.708	-0.852
Export Value	-0.132	1.000	0.948***	0.688***	0.471*
Unit Value	-0.436	0.948***	1.000	0.858***	0.766***

COP	-0.708***	0.688***	0.858***	1.000	0.970***
Auction Price	-0.852***	0.471*	0.766***	0.970***	1.000

***p < 0.001

The results reveal several important patterns. First, export value demonstrates an extremely strong positive correlation with unit export value ($r = 0.948$, $p < 0.001$). In contrast, export value exhibits only a weak relationship with export quantity. Second, cost of production demonstrates a strong negative relationship with export quantity ($r = -0.708$, $p < 0.001$), suggesting that increasing production costs undermine volume competitiveness. Third, cost of production demonstrates a strong positive relationship with export unit value ($r = 0.858$, $p < 0.001$), indicating that rising costs are increasingly reflected in higher export prices. These findings provide preliminary support for Propositions 1, 2, and 3.

Regression Model 1: Determinants of Export Earnings

To evaluate whether export earnings depend more strongly on volume growth or value growth, the following model was estimated:

$$EXPVt = \beta_0 + \beta_1 EXPQt + \beta_2 UVt + \varepsilon t$$

Table 3: Regression Results

Variable	B	Std. Error	t	p-value
Constant	-1,425,941.00	58,969.91	-24.181	<0.001
Export Quantity	4.907	0.180	27.209	<0.001
Unit Export Value	289,129.60	3,355.26	86.172	<0.001

Model Summary

R ²	Adjusted R ²	F	Sig.
0.917	0.917	3779.005	<0.001

ANOVA

Source	SS	df	MS	F	Sig.
Regression	1,938,106,560,201.23	2	969,053,280,100.62	3779.005	<0.001
Residual	5,385,046,820.63	21	256,430,800.98		
Total	1,943,491,607,021.83	23			

The model is statistically significant ($F = 3779.005$, $p < 0.001$), explaining 99.7% of the variation in export earnings.

Most importantly, export unit value exhibits a substantially stronger influence than export quantity. This provides strong support for Proposition 1 and suggests that export earnings increasingly depend on value creation rather than volume expansion.

Regression Model 2: Impact of Cost of Production on Export Quantity Model Specification

$$EXPQt = \beta_0 + \beta_1 COPt + \varepsilon_t$$

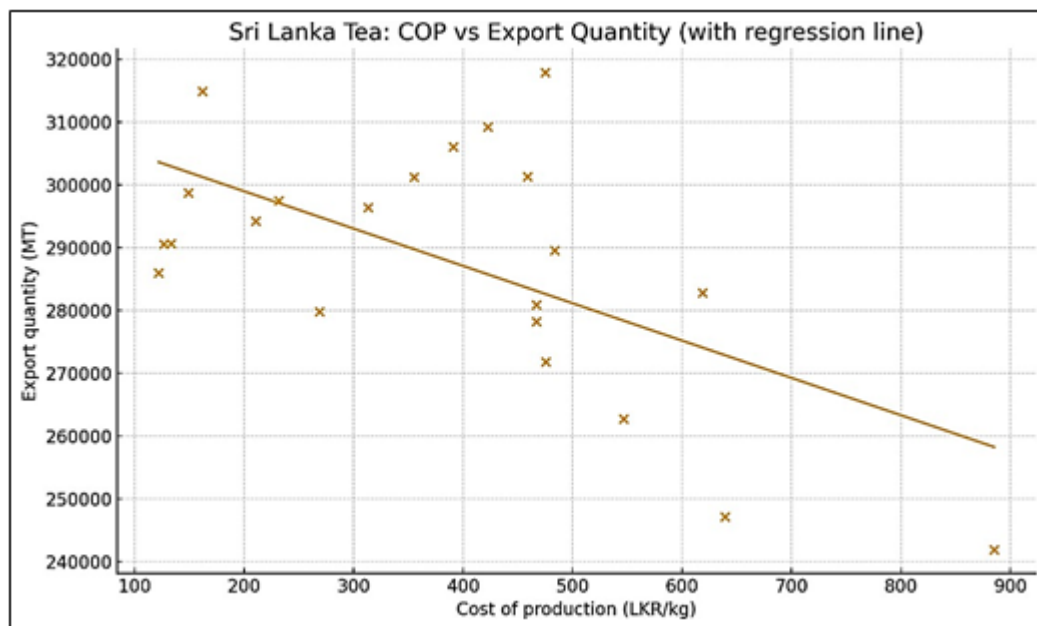
Table 4: Regression Results

Variable	B	Std. Error	t	p-value
Constant	310,861.58	6,022.66	51.615	<0.001
COP	-56.472	12.000	-4.706	<0.001

Model Summary

R ²	Adjusted R ²	F	Sig.
0.502	0.479	22.148	<0.001

The negative coefficient confirms that increasing production costs significantly reduce export quantities.

Figure 3: The relationship between the COP and Export Quantity

This result supports Proposition 2 and demonstrates that Sri Lanka's ability to compete on volume has been constrained by rising production costs.

Regression Model 3: Impact of Cost of Production on Unit Export Value Model Specification

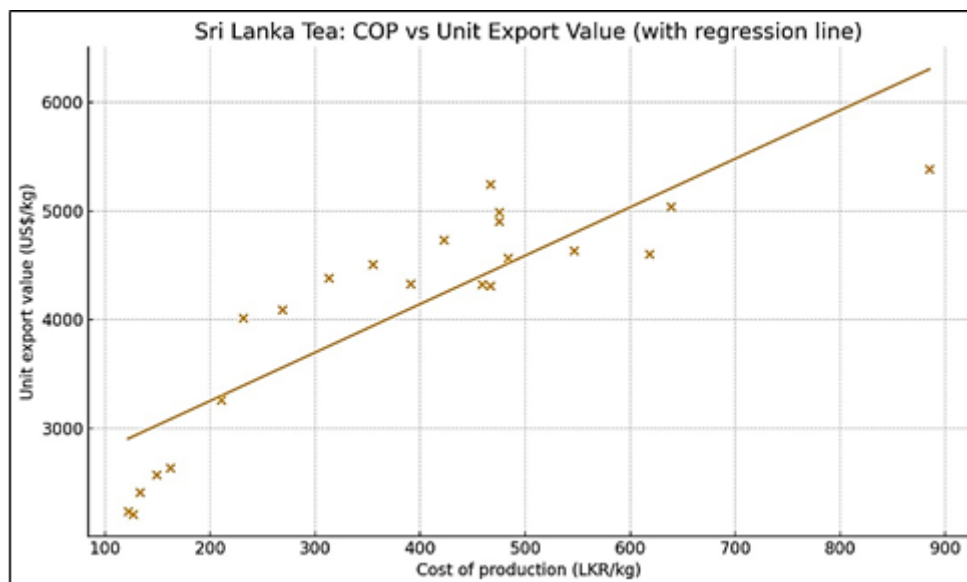
$$UVt = \beta_0 + \beta_1 COPt + \varepsilon_t$$

Table 5: Regression Results

Variable	B	Std. Error	t	p-value
Constant	2.467	0.236	10.474	<0.001
COP	0.00368	0.00047	7.833	<0.001

Model Summary

R ²	Adjusted R ²	F	Sig.
0.736	0.724	61.362	<0.001

Figure 4: The relationship between the COP and Unit Export Value US\$/kg

Source: Author's illustration using data from ICT Bulletin (various editions)

The positive and highly significant coefficient indicates that rising costs are increasingly compensated through higher export prices. This finding supports Proposition 3.

COP and Colombo Auction Prices**Table 6:** Regression Results

Variable	B	Std. Error	t	p-value
Constant	-99.473	40.687	-2.445	0.024
COP	1.324	0.076	17.389	<0.001

Model Summary

R ²	Adjusted R ²	F	Sig.
0.941	0.938	302.391	<0.001

The model indicates that approximately 94.1% of the variation in auction prices is explained by production costs. This demonstrates that rising costs are strongly transmitted into market prices.

Testing the Structural Transformation Proposition

Table 7: Evidence of Structural Transformation

Indicator	Evidence	Interpretation
Export Quantity	Stagnating	Weakening volume competitiveness
Export Value	Increasing	Sustained export earnings
Unit Export Value	Increasing	Growing value competitiveness
COP	Increasing	Erosion of cost advantage
Auction Price	Increasing	Premium pricing mechanism
Global Export Share	Declining	Reduced volume competitiveness

Collectively, the evidence supports all four propositions and demonstrates that Sri Lanka's tea industry has undergone a structural transformation. The industry increasingly depends on premium pricing, quality differentiation, and value creation rather than volume expansion. Consequently, Sri Lanka's competitive position has evolved from broad cost-based competitiveness towards a narrower but higher-value form of export competitiveness.

Implications and Recommendations

The findings of this study indicate that Sri Lanka's tea industry has undergone a significant structural transformation. Historically, competitiveness was largely supported by production volumes, favourable production economics, and strong comparative advantage in global tea markets. However, increasing production costs, declining relative productivity, labour shortages, and intensifying international competition have gradually weakened the foundations of volume-based competitiveness. At the same time, Sri Lanka has retained a strong reputation for quality, authenticity, and premium orthodox tea production. Consequently, export performance is increasingly sustained through higher export prices and value creation rather than through volume expansion. This transformation has

important implications for policymakers, industry stakeholders, exporters, and producers.

Policy Implications

The findings suggest that future policy interventions should focus on improving productivity rather than merely increasing production volumes. While production expansion remains desirable, long-term competitiveness will depend largely on reducing production costs and increasing productivity per hectare. One of the most critical challenges facing the industry is the ageing tea bush population. Replanting rates remain substantially below recommended levels, contributing to declining yields and reduced productivity. Therefore, greater emphasis should be placed on long-term replanting programmes supported through targeted financial incentives, concessional financing schemes, and technical assistance.

Labour shortages continue to constrain productivity across the plantation sector. Consequently, policymakers should accelerate initiatives supporting mechanisation, labour-saving technologies, and productivity-enhancing innovations. Such interventions may help reduce production costs while improving operational efficiency. The findings further suggest that exchange-rate adjustments

alone are unlikely to restore competitiveness. Although exchange-rate depreciation may improve export earnings in the short term, the analysis indicates that long-term competitiveness is fundamentally linked to productivity, cost efficiency, and value creation. Therefore, macroeconomic stability should be complemented by structural reforms aimed at strengthening industry fundamentals.

Industry Implications

The results demonstrate that competing directly with low-cost producers may become increasingly difficult for Sri Lanka. Countries such as Kenya, Vietnam, and parts of East Africa continue to enjoy significant cost advantages, enabling them to compete effectively within price-sensitive market segments. Consequently, Sri Lanka should strengthen its position within premium market segments where quality, authenticity, traceability, sustainability, and branding command higher prices.

Industry stakeholders should therefore focus on:

1. Expanding value-added tea exports.
2. Strengthening the global positioning of the Ceylon Tea brand
3. Developing specialty and premium tea segments.
4. Increasing investments in packaging, branding, and product innovation.
5. Expanding certified and sustainably produced tea products.

The findings suggest that value creation rather than volume expansion is likely to become the primary driver of future export growth.

Institutional Implications

The structural transformation identified in this study highlights the need for stronger institutional coordination among industry stakeholders. Several institutions influence

the competitiveness of Sri Lanka's tea industry, including the Sri Lanka Tea Board, Tea Research Institute, Export Development Board, Ministry of Plantation Industries, and various producer organisations. Greater coordination among these institutions could facilitate more coherent policy implementation, stronger innovation systems, improved market intelligence, and enhanced support for exporters. Particular attention should be given to improving research-commercialisation linkages, facilitating technology transfer, and promoting collaborative industry upgrading initiatives.

Strategic Implications

The findings suggest that Sri Lanka should increasingly position itself as a premium tea-producing nation rather than a high-volume tea exporter.

Future competitiveness may depend on developing a strategic model built upon:

1. Productivity improvement.
2. Quality leadership.
3. Sustainability certification.
4. Innovation and product diversification.
5. Value addition
6. Premium market positioning.

Rather than competing primarily on price, Sri Lanka should seek to compete through differentiation and value creation. The transition from volume-based competitiveness to value-based competitiveness should therefore be viewed not merely as a response to rising production costs but as a strategic opportunity to strengthen the long-term resilience and profitability of the tea industry.

CONCLUSION

This study examined the evolving nature of Sri Lanka's tea export competitiveness through an analysis of export quantities, export values, export unit values, production costs, and market dynamics. The findings reveal clear evidence of structural transformation within the industry. While traditional indicators point towards declining volume competitiveness, export earnings have remained relatively resilient due to increasing unit export values and premium pricing. Rising production costs have weakened Sri Lanka's ability to compete in price-sensitive market segments, while simultaneously encouraging greater reliance on quality differentiation and value-based competitiveness. The statistical analysis demonstrated that export earnings are increasingly associated with growth in export unit values rather than growth in export quantities. Furthermore, production costs were found to negatively influence export quantities while positively influencing export prices and auction values.

These findings suggest that Sri Lanka's tea industry has not simply lost competitiveness. Rather, the basis of competitiveness has changed. The industry appears to be transitioning from broad cost-based comparative advantage towards a narrower but potentially more sustainable form of value-based competitiveness centred on quality, reputation, and premium market positioning. Future success will depend not only on improving productivity and controlling costs but also on strengthening branding, innovation, value addition, and market differentiation strategies. The findings therefore provide important insights for policymakers and industry stakeholders seeking to ensure the long-term sustainability of one of Sri Lanka's most important export sectors.

The key findings reveal a fundamental shift in Sri Lanka's tea export performance, where earnings are now driven more by rising unit

values than by increases in export volume. This transition is largely attributed to escalating production costs, which have eroded the country's volume-based competitiveness while simultaneously pushing up export prices and Colombo auction prices. Consequently, Sri Lanka's tea industry has moved away from competing on low costs and now relies on value-based competitiveness. Looking ahead, further strengthening of this position will require strategic investments in productivity enhancements, greater value addition, robust branding, and a sustained focus on premium market positioning.

LIMITATIONS AND FUTURE RESEARCH

This study provides evidence of a structural transformation in Sri Lanka's tea export competitiveness using long-term secondary data and quantitative analysis. However, several limitations should be acknowledged. First, the study relies on aggregated industry-level data and therefore cannot capture firm-level variations in productivity, marketing strategies, innovation capabilities, or export performance. Individual exporters may adopt different competitive strategies that are not observable through industry-level statistics. Second, while the study incorporates key economic variables such as production costs, export quantities, export values, and export prices, other potentially important determinants of export competitiveness, including geopolitical developments, trade agreements, consumer preferences, sustainability requirements, and market-specific demand conditions, were not explicitly modelled. Third, the analysis focuses primarily on Sri Lanka and does not undertake a direct comparative evaluation with competing tea-exporting countries such as Kenya, India, China, or Vietnam. Such comparisons may provide further insights into the changing nature of international tea competitiveness.

Future research may therefore focus on firm-level competitiveness, comparative studies

among major tea-exporting nations, value-chain upgrading strategies, branding effectiveness, and the role of sustainability certification in shaping export performance. Further research may also investigate how digital marketing, specialty tea segments, and emerging consumer trends influence the future competitiveness of Sri Lanka's tea industry.

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ORGANIC FOOD PURCHASE INTENTION AMONG GENERATION Z CONSUMERS: AN EXTENDED THEORY OF PLANNED BEHAVIOR APPROACH

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ABSTRACT

Growing global concern over environmental sustainability and personal health has significantly influenced consumer purchasing behavior in recent years, leading to increased attention toward environmentally friendly products. In this context, the present study explores the factors influencing the intention of urban youth in Sri Lanka to purchase organic food products. The study employed a quantitative cross-sectional research design, and primary data were collected in 2024 from 300 Generation Z respondents residing in the Colombo District. The analysis examined the effects of attitudes, subjective norms, perceived behavioral control (PBC), awareness, trust in certification systems, digital influence, and affordability on young consumers' purchase intention toward organic food. Attitudes, subjective norms, and PBC were found to significantly influence young consumers' intention to purchase organic food products. Further, attitude ($r = 0.67$) and PBC ($r = 0.58$) had the strongest positive associations with purchase intention. Among these determinants, PBC exerted the greatest influence, underscoring the importance of factors such as convenience, accessibility, and affordability in encouraging sustainable consumption behavior. Further, awareness did not significantly influence consumer attitudes, indicating that possessing knowledge about organic food alone may not be sufficient to generate stronger purchase intentions. In addition, moderation analysis showed that trust in organic certification, social media influence, and affordability perceptions did not significantly affect the relationships between attitudes, subjective norms, PBC, and purchase intention. The findings suggest that policy interventions should prioritize improving market accessibility, increasing affordability, strengthening retail distribution, and fostering positive consumer perceptions toward organic food among young urban consumers.

Keywords: Purchase intention, Theory of Planned Behaviour, Generation Z, Colombo

INTRODUCTION

The increased awareness on health, food safety and sustainable consumption has had a significant impact on consumer behavior in the world over the last several decades. Specific attention has been paid to organic food consumption, as it has been viewed as a healthier food, with few chemical additives, and environmentally friendly production methods (Yadav and Pathak, 2016; Thoges, 2020). Although the

markets of organic foods expanded globally, there is a difference in the adoption patterns among regions, cultural backgrounds, and demographics. Understanding these determinants is essential to inform effective marketing strategies, policy interventions, and public health initiatives.

Organic food intake is mostly influenced by the broader trends in the society. Amongst, the younger generations are predominant. Many studies have identified that the Generation Z (Gen Z) who were born between 1997- 2012 is in the frontline in

redefining consumption norms all over the countries (Espejo et al., 2024; Kirubasri, 2024; Nuresa, 2023). Generation Z people are digital natives, so they are more in touch with the global information and cultural networks. They also tend to integrate sustainability, wellness, and ethical values when making their daily decisions more than their predecessors (Francis and Hoefel, 2018). Such orientations will be manifest in their food buying behavior which now forms a main area of interest by both marketers and policymakers in an effort to promote sustainable consumption.

In Sri Lanka, the importance of organic food has become particularly salient in recent years. Traditionally, Sri Lanka has reputation of exporting organic products including tea, spices, vegetables, fruits, coconut products, herbs, and essential oils that are in high demand in Europe, the United States, and Japan (Export Development Board, 2022). However, the domestic organic market is narrow, urbanized and underdeveloped. Consumer awareness on organic food has increased, but local consumption is limited due to affordability issues, low credibility of certification, and supplies (Narmilan and Amuthenie, 2015).

This situation highlights the need of consumer-side research. Organic production, certification and export have received policy and scholarly interest but little is known of the dynamics of demand among the younger consumer groups in Sri Lanka. In particular, generation Z is one of the major cohort whose values and behaviors should predetermine the direction of domestic organic food markets within the next decades. Majority of the available research consider consumers as a homogenous market, thus neglecting the unique attributes of younger, digitally native sub-groups (Wijesinghe and Attanayaka, 2021). This leaves a research gap on the manner in which this particular group of young consumers makes their organic food purchase decisions, as well as the impact of psychological and contextual constraints on

the intention to purchase organic foods in Sri Lanka by Generation Z. Knowledge of their purchase intentions is thus vital in closing the gap between what is desired in policy and what is possible in the market.

In this regard, the current research attempted to investigate the purchase intentions of the Generation Z consumers in the Colombo district on organic food and to determine the major psychological and contextual determinants that affect consumer purchasing behavior using the extended Theory of Planned Behavior.

THEORICAL BACKGROUND

Theories on consumer behavior support the systematic approach to the study and prediction of purchase intentions. Several theoretical frameworks have been established over the years to explain decision-making processes. Among them, the Theory of Reasoned Action (TRA), the Health Belief Model (HBM), Value-Belief-Norm (VBN) theory, and the Theory of Planned Behavior (TPB) are widely used in the research related to sustainable consumption and health-related consumption. All these paradigms help in explaining why consumers choose to adopt certain behavior such as buying organic food yet they are not equally applicable in various research settings.

The TRA predicts attitude and subjective norms and assumes total behavioral control, an assumption that is not always true in certain situations like in the case of organic food acquisition, where consumers are faced with limits of price, availability, or accessibility (Fishbein and Ajzen, 1975). HBM focuses on health-related reasons but fails to explain the impact of social influence and perceived control, which restricts its applicability to socially networked groups like Generation Z (Rosenstock, 1974). VBN explains pro-environmental behavior by values and moral imperative, but does not consider practical obstacles such as affordability and accessibility that are

especially relevant in new economies such as Sri Lanka (Stern et al., 1999).

The Theory of Planned Behavior (Ajzen, 1991) is more comprehensive in evaluating organic food purchase intention by comparison. TPB adds to TRA the element of perceived behavioral control (PBC), which is the ease or difficulty with which an individual believes he or she can do a behavior. The importance of including PBC in the research on organic foods cannot be overstated since it includes the variables like affordability, availability, accessibility and the ability of a consumer to make a choice between organic and non-organic products. Al-Swidi et al. (2014), confirmed the significant effect of PBC on purchase intention toward organic food. Empirical studies that have utilized TPB in the field of organic and sustainable food consumption have revealed a significant explanatory power to associate the psychology of consumers with the consumption behavior (Asif et al., 2023; Vermeir and Verbeke, 2008). In general, consumers with positive attitudes towards organic food are more inclined to buy organic food (Clark et al., 2019; Trivedi et al., 2018). Research studies in India and among working adults indicate that positive attitudes, which are motivated by opinions of health benefits, environmental protection, and product safety, are the most powerful predictors of intention (Selvaraj et al., 2024). Similarly, studies that examine consumer behavioral intention to sustainable organic food products also confirm that a positive assessment of organic food always results in an increased purchasing intention (Mrihahayu et al., 2022). Subjective norms play a vital role in the utilization and purchase intentions of young consumers for organic food (Akbari et al., 2019). Study conducted by Scalco et al. (2017) indicated that subjective norms have greater importance and positive effects on purchase intentions.

Despite the popularity of TPB as a tool to explain the intentions to purchase organic food, some researchers argue that its initial

formulation might not be able to capture the complexity of ethically and sustainably oriented consumption. Thus, an extended form of TPB has been adopted with increased adoption of other psychological and situational variables to maximize the explanatory capability. Some of these extensions include environmental concern, health consciousness, trust in certification, moral norms, awareness and perceived product attributes like quality and safety (Yadav and Pathak, 2016; Chen, 2007).

Awareness of organic food is initially integrated as a forerunner to attitudes. Awareness is measured as a cognitive construct reflecting respondents' knowledge and familiarity with organic food and its general attributes. Studies have shown that increased awareness reduces uncertainty, enhances perceived benefits, and positively shapes attitudes, which in turn influences intention to buy organic products (Kamboj et al., 2023). Trust, especially in certification and labeling systems, has demonstrated a significant role in strengthening the attitude intention relationship in research on organic food, especially in developing nations where doubt of organic assertions is strong (Rana and Paul, 2017; Teng and Wang, 2015). Social and digital media are known to drive change in a contextual manner. Digital and social media serve as the main sources of information, social norms and facilitate lifestyle to Generation Z. Based on that, the use of social media is likely to make the connection between subjective norms and purchase intention moderate and consequently increase the impact of peer and influencer endorsement on decision-making (Kaur et al., 2023). The aspect of affordability is operationalized as a separate factor to capture financial factors that drive the intention of Generation Z consumers to buy organic food. Perceived financial capacity (income) and price sensitivity (reverse-scored) and acceptance of price premiums are denoted as the construct. The extended Theory of Planned Behavior provides a more detailed approach to the

study of the intentions to buy organic food by taking into consideration both rational decision-making process and value motivated intentions.

Hypothesis derived from the theoretical background

H1: Higher levels of awareness (AW) positively influence attitudes toward organic food

H2: Positive attitudes (AT) toward organic food significantly predict purchase intention (PI)

H3: Subjective norms (SN) positively influence purchase intention

H4: Perceived behavioral control (PBC) positively influences purchase intentions

H5: Trust in certification (TC) strengthens the relationship between attitudes and purchase intention.

H6: Digital media influence (DI) strengthen the relationship between subjective norms and purchase intention.

H7: Affordability (AF) constraints weaken the relationship between perceived behavioral control and purchase intention.

METHODOLOGY

This study adopted a quantitative research approach within the theoretical framework of the TPB. A quantitative design is appropriate given the objective of empirically examining the relationships among multiple latent constructs namely attitudes, subjective norms, perceived behavioral control, awareness, trust in certification, digital influence, and perceived affordability and their influence on purchase intention. By employing structured measurement scales, the study enables statistical assessment of the strength and direction of these associations. A cross-sectional survey design was utilized to

collect data from Generation Z respondents at a single point in time. This design facilitates the analysis of behavioral intentions across a relatively large sample, allowing for broader inferences regarding consumer behavior patterns (Creswell & Creswell, 2018). The Colombo District was purposively selected as the study location due to its distinct socio-economic and market characteristics (Figure 1). As the most urbanized and economically active region in Sri Lanka, Colombo provides a comparatively developed retail environment where organic food products are more accessible through supermarkets, specialized outlets, and digital retail platforms.



Figure 1: Map of the Study Area -Colombo district

The sampling frame for this study comprised individuals aged between 18 and 27 years residing in the Colombo District. This age range represents the adult segment of Generation Z, who are assumed to possess independent purchasing power and the independence to make personal consumption decisions. According to the Census of Population and Housing conducted in 2012, individuals within this age cohort account for approximately 24

percent of the total population of the Colombo District (Department of Census and Statistics, 2012), thereby constituting a substantial and economically relevant consumer group. A non-probability snowball sampling technique was employed to select the respondents. Under this approach, initial participants were identified and subsequently requested to refer other eligible individuals within their social networks. This method is particularly useful when targeting specific demographic groups and facilitates access to interconnected respondent networks that may be difficult to reach through conventional random sampling techniques (Etikan et al., 2016).

The determination of sample size was guided by established methodological recommendations for Structural Equation Modeling (SEM). According to Hair et al. (2019), a minimum of 10 to 15 observations per estimated parameter or measurement item is required to ensure adequate statistical power and stable model estimation. Given that the proposed model comprised 25 measurement items, a minimum sample size is 250 respondents. However, to mitigate potential clustering effects associated with snowball sampling

and to enhance the diversity of the sample across gender, income, and educational categories, the final sample size was increased to 300 respondents. This adjustment ensured sufficient representativeness and compliance with SEM adequacy standards. Both primary and secondary data sources were utilized. Primary data were collected during 2024 through a pre-tested, semi-structured questionnaire administered to Generation Z consumers residing in Colombo District. All components in the theoretical model were operationalized using validated scales derived from prior research studies. Table 1 presents the constructions, their measurement dimensions, and the selected sources. Considering the digitally oriented nature of this cohort and the urban characteristics of the study area, data collection was primarily conducted using an online survey platform (Google Forms), distributed through academic, professional, and social networks. To broaden coverage, initial respondents from diverse socio-economic backgrounds were encouraged to circulate the survey link among peers within the specified age range.

Table 1: Measurement of constructs

Construct	Dimensions/Indicators	Sources
Awareness	Knowledge of organic food Health benefits Environmental benefits Labelling	Karalliyadda & Kazunari (2018)
Attitudes	Health beliefs Environmental concerns Lifestyle values Quality & taste preference	Bazhan (2024); Asif et al. (2023); Vermeir & Verbeke (2008)
Subjective Norms	Peer influence Family influence	Ham et al. (2015); Al-Swidi et al. (2014); Ajzen (1991)
Perceived Behavioural Control	Ease of access Availability Ability to choose organic food	Pang, (2021); Weerasiri & Cooray, (2016); Ajzen (1991)
Trust in Certification	Trust in local labels Credibility of standards Confidence in enforcement and verification	Priyanath & Dangalla (2022); Murphy (2022); Wu (2021).

Digital Media Influence	Influence of influencers Online reviews Digital communities	Samaniego-Arias, (2025); Nataraj & Shivanna (2024); Regina (2024)
Affordability	Income Price Premium	Hughner et al. (2007)
Purchase Intention	Likelihood of future purchase Willingness to pay Consistency	Asif et al. (2023); Vermeir & Verbeke (2008)

Source: Author's depiction based on literature review

The characteristics of the respondents and the distribution of the constructs were assessed using descriptive statistics. Cronbach's Alpha, Composite Reliability (CR) and Confirmatory Factor Analysis (CFA) were used to test the reliability and validity of the collected data set. The hypothesis testing was done to find the relationships of constructs through SEM using AMOS software. Model fit indices including χ^2/df , Comparative Fit Index (CFI), Tucker–Lewis Index (TLI), Root Mean Square Error of Approximation (RMSEA) and Standardized Root Mean Square Residual (SRMR) indicated satisfactory model adequacy. Microsoft excel and SPSS AMOS software was used to analyze the data.

RESULTS

Demographic information of the sample

The demographic profile of the sample indicates that there is a balance in terms of gender with 51% of the respondents being females and 49% males. The age group was concentrated between 21–23 years. The educational attainment was high, with 53% undergraduates and 20% graduates, reflecting the cognitively aware, digitally connected youth segment. The distribution of income (the average amount of money respondents receives or have available to spend each month, regardless of the source) reflected that 64% of the respondents less earn LKR 100,000, while only 12% earn more than LKR 150,000, signifying affordability sensitivity. Spatially, the sample contained residents in both metropolitan and

suburban Colombo, providing a comparative basis for analyzing access-driven behavioral differences.

Reliability and Validity Testing

According to Table 2, all constructs exceed the minimum acceptable threshold of 0.70 of Cronbach's Alpha (α), confirming adequate internal consistency across the measurement model. The reliability results confirm that the measurement scales used in this study are internally consistent and statistically reliable. Further, all constructs exceed the recommended CR value of 0.70 and Average Variance Extracted (AVE) value of 0.50, confirming high internal consistency and convergent validity. Notably, purchase intention (CR = 0.90; AVE = 0.68) and attitude (CR = 0.89; AVE = 0.67) show the strongest indicator reliability.

Table 2: Reliability, Composite Reliability (CR) and Convergent Validity Testing Results

CONSTRUCT	CRONBACH'S ALPHA (A)	CR	AVE	RELIABILITY STATUS
Awareness	0.782	0.84	0.58	Acceptable
Attitude	0.862	0.89	0.67	Good
Subjective Norms	0.808	0.85	0.60	Good
Perceived Behavioural Control	0.826	0.86	0.63	Good
Trust in Certification	0.849	0.88	0.66	Good
Digital Influence	0.834	0.87	0.64	Good
Affordability	0.795	0.83	0.55	Acceptable
Purchase Intention	0.874	0.90	0.68	Excellent

Source: Sample Survey Data, 2024

According to the Table 3, the diagonal values (AW = 0.76, AT = 0.82, SN = 0.77, PBC = 0.79, TC = 0.81, DI = 0.80, AF = 0.74, PI = 0.82) represent the square roots of the AVEs, while the off-diagonal values represent the correlations between constructs. The diagonal values for all constructs are higher than any of the corresponding inter-construct correlations. Therefore, the constructs have discriminant validity.

Table 3: Discriminant Validity: Fornell–Larcker Criterion

Construct	AW	AT	SN	PBC	TC	DI	AF	PI
Awareness	0.76							
Attitude	0.39	0.82						
Subjective Norm	0.28	0.49	0.77					
Perceived Behavioural Control	0.35	0.55	0.37	0.79				
Trust in Certification	0.32	0.47	0.33	0.36	0.81			
Digital Influence	0.30	0.46	0.42	0.33	0.41	0.80		
Affordability	0.27	0.37	0.29	0.45	0.32	0.31	0.74	
Purchase Intention	0.36	0.67	0.48	0.58	0.43	0.49	0.42	0.82

Source: Sample Survey Data, 2024

Structural Equation Modelling (SEM) and Hypothesis Testing

After establishing measurement reliability and validity, the next analytical phase assessed the causal relationships among constructs through SEM. Model fit indices were examined to confirm that the hypothesized structure adequately represents the data. A combination of absolute, incremental, and parsimony indices were used following Hair et al. (2019). Table 4 presents the recommended thresholds, obtained results and interpretation detail of model fit indices. According to the results all indices meet recommended thresholds, confirming a statistically acceptable model fit.

Table 4: Model Fit Indices for Structural Model

Fit Index	Recommended Threshold	Obtained Value	Interpretation
χ^2 / df	< 3.00	2.41	Acceptable fit
GFI (Goodness-of-Fit Index)	≥ 0.90	0.925	Good fit
AGFI (Adjusted GFI)	≥ 0.85	0.889	Marginal fit
CFI (Comparative Fit Index)	≥ 0.90	0.946	Excellent fit
TLI (Tucker–Lewis Index)	≥ 0.90	0.939	Excellent fit
RMSEA (Root Mean Square Error of Approximation)	≤ 0.08	0.062	Good fit
SRMR (Standardized Root Mean Square Residual)	≤ 0.08	0.056	Good fit

Source: Sample Survey Data, 2024

Structural path coefficients and hypothesis testing

The standardized path coefficients (β), t-values, and significance levels ($p < 0.05$) were obtained to test each hypothesis (H_1 – H_7) formulated in the theoretical framework. The coefficients obtained are summarized in Table 5. Accordingly, attitude ($\beta = 0.44$, $p = 0.001$) and PBC ($\beta = 0.47$, $p = 0.001$) have the strongest, statistically significant impacts on purchase intention and both contribute to about half of the variance ($R^2 = 0.47$). These results support the strength of the TPB within the context of the Sri Lankan Generation Z and indicate that the positive assessment and the perceived control are two key motivators of behavioral intention. Moreover, the significant

contribution of subjective norms ($\beta = 0.25$, $p=0.001$) emphasizes the continuing role of social influence particularly peers and family in shaping organic food choices (Ajzen, 2002). The hypothesis, Awareness $\rightarrow$ Attitude (H_1) was non-significant. This suggests that mere factual knowledge or formal education level does not necessarily translate into favorable attitudes or intentions; experiential learning and value alignment appear more influential. The R^2 value of 0.47 indicates that nearly half of Generation Z's organic purchase intention is explainable by attitudinal, normative, and control factors.

Table 5: Results of Hypothesis Testing

Hypothesis	Path	Standardized β	t-value	p-value	Result
H_1	Awareness $\rightarrow$ Attitude	0.07	0.57	0.569	Not Supported
H_2	Attitude $\rightarrow$ Purchase Intention	0.44	6.82	< 0.001	Supported
H_3	Subjective Norms $\rightarrow$ Purchase Intention	0.25	4.01	< 0.001	Supported
H_4	PBC $\rightarrow$ Purchase Intention	0.47	7.12	< 0.001	Supported

Model R^2 (Purchase Intention) = 0.47 | **Source:** Sample survey data, 2024

Moderation analysis

The main TPB constructs attitude, subjective norms, and PBC significantly explain purchase intention, the explanatory ability of the model may vary depending on contextual factors. Therefore, study investigated three theoretically related moderators incorporated into the extended TPB model. Each moderation was tested using a product-indicator approach (interaction term analysis) within the SEM framework. Interaction terms were mean-centered to minimize multicollinearity and significance was evaluated through bootstrapped standard errors (5,000 samples). Each moderating model maintained an acceptable fit level (Table 6), indicating that the inclusion of interaction terms did not degrade model performance and suggesting robustness of the extended structure.

Table 6: Model Fit Indices for Moderation Model

MODEL	χ^2/DF	CFI	TLI	RMSEA	SRMR	INTERPRETATION
MODEL 1: TC $\times$ ATTITUDE $\rightarrow$ INTENTION	2.53	0.942	0.931	0.064	0.058	Acceptable fit
MODEL 2: DI $\times$ SN $\rightarrow$ INTENTION	2.47	0.946	0.935	0.061	0.055	Acceptable fit
MODEL 3: AF $\times$ PBC $\rightarrow$ INTENTION	2.45	0.949	0.938	0.060	0.054	Acceptable fit

Source: Sample survey data, 2024

However, the results of the moderation analysis revealed that none of the proposed moderating variables exerted a statistically significant effect on the respective relationships with purchase intention. Specifically, trust in certification did not significantly moderate the relationship between attitude and purchase intention ($\beta = 0.05$, $p = 0.418$). Similarly, digital influence showed no significant moderating effect ($\beta = 0.07$, $p = 0.278$), and affordability also failed

to demonstrate a significant moderating impact ($\beta = 0.06$, $p = 0.334$).

The moderation results collectively demonstrate that none of the three contextual moderators (TC, DI, AF) significantly alter the main structural relationships. This implies that the core TPB relationships are robust and stable across varying contextual conditions. Therefore, the core TPB components (Attitude, Subjective Norms, PBC) consistently predict

purchase intention across consumer subgroups. Contextual factors such as certification trust and digital exposure act more as universal reinforcers rather than conditional determinants of organic purchasing intention. This outcome suggests that strategic efforts to promote organic food consumption among Generation Z should primarily focus on attitudinal reinforcement, perceived control enhancement, and behavioral convenience, rather than over-segmenting markets by digital engagement or income levels.

DISCUSSION

This study was designed to explore Generation Z consumers' purchase intention towards organic food using extended TPB model. Accordingly, PBC emerged as the strongest determinant of organic food purchase intention with ($\beta = 0.47, p < 0.001$). This points to perceived ease, availability and accessibility as the most facilitative elements of behavioral readiness. This is supported by Woo and Kim (2019). Respondents believed that they could easily locate and afford organic products easily had considerably higher intentions to purchase organic food. This finding is in line with the findings from various cross-national TPB applications, which report that PBC becomes salient in contexts were characterized by price sensitivity and lack of market access are high (Kaur et al., 2022). It underscores that, in developing countries, control over resources and situational access exerts a stronger behavioral influence than attitudinal favorability alone.

The attitude has a strong and significant effect on purchase intention ($\beta = 0.44, p < 0.001$), highlighting the fact that those positive appraisal of organic food attributes of health benefits, safety, and environmental value significantly drive purchasing intention. This result is consistent with the basic assumption of the

TPB that a behavioral intention is a direct consequence of the evaluative beliefs about the behavior (Ajzen, 2020). The central role of attitude in this present study is in concert with several recent studies that have identified health consciousness, environmental concern, and ethical orientation as the attitudinal antecedents that drive intention among young consumers (Kaur et al., 2022; Li et al., 2023). Within the Sri Lankan context, this finding reflects the growing alignment between consumer values and sustainability principles, particularly among educated urban youth.

Subjective norms had a significant, positive effect on purchase intention ($\beta = 0.25, p < 0.001$), indicating that in Colombo's generation Z population, social and peer influences are very important role in shaping behavioral motivation among them. This confirms that, according to TPB, social expectations shape personal intentions through normative beliefs about what others think one should do. The study finding is supported by Chi et al. (2019). This influence can also be elaborated in the Sri Lankan cultural context, where social interactions are strongly collectivist in orientation, and consumer choices are influenced by peer approval and family endorsement.

The R^2 value of 0.47 reveals that these three constructs together explain nearly half of the variance in purchase intention, which is comparable to or higher than what has been reported in similar TPB-based consumer studies in emerging markets (Li et al., 2023; Kaur et al., 2022). The model's robustness is further supported by the stability of these relationships across demographic subgroups and contextual moderators, with implications for the TPB's predictive integrity remains consistent despite digital, economic, or trust variations.

The path from awareness to attitude was not statistically significant ($\beta = 0.07, p = 0.569$),

indicating that basically knowing about a product does not lead to positive evaluations or intentions. This finding challenges the common assumption that increasing awareness alone will directly change behavior. In fact, this finding agrees with recent literature where, for digitally literate and socially active youth, knowledge saturation has lowered marginal utility (Ali & Bhasin, 2024). The lack of moderation from trust in certification suggests that the transformation of attitude into intention is uniform across levels of trust. This could reflect a relatively high baseline level of trust that educated youth in Sri Lanka have in the local organic labels represented by SLS 1324:2018. This pattern aligns with research indicating that certification trust operates as a foundational confidence factor rather than a behavioral amplifier in saturated digital markets (Chen & Lin, 2023).

The non-significant moderating effect of digital influence on the relationship between subjective norms and purchase intention is similarly explained by the high level of digital normalization among Generation Z in Colombo. This generation continuously experiences social media content, influencer recommendations, and algorithm-driven information; hence, digital experiences are almost general. Because most respondents generally share generally similar levels of digital engagement, the variation required to detect a moderation effect is limited.

The hypothesized moderation of the relationship between perceived behavioral control (PBC) and purchase intention by affordability was not significant ($\beta = 0.06$, $p = 0.334$). This result reflects that affordability operates as a direct financial constraint rather than influencing the effect of PBC on intention. The finding is in line with the research finding of Castillo-Plaza et al. (2025) that suggests that price and affordability function as direct constraints

rather than moderating factors in consumer behavior. In this study, PBC captured non-monetary aspects such as accessibility, availability, and the ability to choose organic products, while affordability was measured separately as a monetary consideration. As such, affordability affects behavior directly, for example by limiting or enabling purchases based on income, rather than acting as an interactive moderator.

CONCLUSIONS AND POLICY IMPLICATIONS

This study investigated the determinants of organic food purchase intention among Generation Z consumers in the Colombo District using an extended Theory of Planned Behavior framework. The findings suggest that structural and market-related conditions play a central role in enabling organic consumption among young consumers. Even when favorable attitudes are present, limitations in product availability, convenience, and purchasing possibility may constrain actual intention formation. This finding implies that demand expansion in the domestic organic market requires improvements in retail accessibility and distribution networks. Retailers could strengthen organic product visibility by expanding dedicated organic sections within conventional supermarkets and integrating certified organic products into mainstream retail channels. Furthermore, partnerships with e-commerce platforms offering rapid delivery services may be particularly effective in reaching digitally engaged youth populations, especially in university environments and workplace clusters.

From a policy perspective, strengthening the domestic organic market requires coordinated efforts to address structural supply-side constraints. Public authorities can facilitate private investment in organic retail infrastructure to improve market penetration. Financial incentives, such as

tax concessions or targeted subsidies for certified organic producers, may help reduce retail price premiums and enhance affordability. In addition, promoting public-private partnerships (PPPs) to expand certified organic production and streamline supply chains could contribute to price stabilization and improved distribution efficiency. Such interventions would not only enhance consumer access but also support the broader development of a sustainable domestic organic sector. The overall implication of these findings is that successful promotion of organic food among Generation Z in Sri Lanka requires a dual focus on motivation and capability.

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ISO 27001 COMPLIANCE VS. TRUE SECURITY: A STUDY OF GAPS, CHALLENGES, AND OPERATIONAL IMPACTS

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ABSTRACT

The effectiveness of ISO 27001 as an information security management system is determined by the extent to which post-certification outcomes align with pre-implementation expectations. Rather than mere procedural compliance, true effectiveness is measured by the framework's capacity to prevent or mitigate real-world security incidents. Given the substantial investment required for ISO 27001 adoption and the high level of stakeholder assurance it provides, it is critical to identify not only where the framework succeeds, but also where residual gaps remain. Notably, security risks can still materialize even when the standard is fully implemented and certified. Certified organizations benefit from a risk-based approach reinforced by regular audits, enabling them to prioritize countermeasures and stress-test their security posture. Furthermore, they can integrate information security and financial controls under a unified system, complementing the Plan-Do-Check-Act (PDCA) cycle for continual improvement. This study analyzes these dynamics to help organizations and security managers identify systemic gaps and optimize their frameworks for greater efficiency in information security management.

Keywords: Information Security, Information Security Management, Information Security Management System (ISMS), ISO 27001 Standards.

INTRODUCTION

Information Security

In today's digital world, the primary concern is the protection of information and critical data. The need for information security varies according to the different levels of impact that information may have. Given the immense value of information to organizations, securing information assets through a robust information security system is of paramount importance. However, the very nature of information assets, which contributes to their strengths, also gives rise to certain weaknesses.

The necessity for information security can be examined across three categories of impact levels resulting from an information security incident: individual, organizational, and national.

At the individual level, the most common

incident is identity theft, where an attacker gains access to a person's unique identity characteristics to assume that identity. Once this occurs, the victim remains primarily liable for all activities carried out by the perpetrator under the assumed identity until the true facts of the case are uncovered. Another type of incident at the individual level involves the disclosure of confidential personal data to interested parties, who may then use the data for illegal or unethical purposes.

At the organizational level, the consequences of information security incidents fall into three categories: operational, legal, and reputational.

Operational consequences have an immediate impact. They may involve the loss of critical information assets, affecting business performance through reduced

profitability and/or revenue. For example, the loss of a design document for a new product can set an organization back considerably. If sensitive information such as industrial secrets, trade secrets, intellectual property, or research findings reaches a competitor, the organization's competitive position may be compromised, requiring substantial resources to recover.

Legal consequences unfold over a longer period. They may arise from violations of regulatory and statutory requirements or from breaches of contractual agreements. In the case of a breach of contract, the impact includes loss of business, reduced revenue, and threats to future opportunities. An example would be subcontracting part of a contracted work, which involves sharing information, without obtaining proper clearance from all relevant stakeholders. The impact becomes far more serious if statutory and regulatory requirements are violated. For instance, in most developed countries, disclosing sensitive personal information about an individual without their prior consent can attract severe penalties, potentially threatening the very existence of the organization responsible for safeguarding that information.

Reputational consequences can persist throughout an organization's lifetime and hinder its future growth. This category of consequences also has a highly negative effect on employee morale, motivation, and, consequently, productivity.

ISO 27001

ISO/IEC 27001, titled "Information technology, Security techniques, Information security management systems, Requirements," was first issued in November 2005 as ISO/IEC 27001:2005. This standard was preceded by the British standard BS 7799, which was published in 1995 by the British Standards Institute (BSI) and authored by the UK's Department of Trade and Industry (DTI).

BS 7799 was originally written as a document focused on the development and implementation of an information security management system (ISMS). It served as a "Code of Practice" intended to provide guidance to organizations; however, it did not include a scheme that would enable third-party certification.

In 1999, a second part of BS 7799 emerged, BS 7799 Part 2, which took the form of a specification and was titled "Specification of Information Security Management Systems." Consequently, the original standard became a single-part document, BS 7799 Part 1, retitled as "Information Technology, Code of Practice for Information Security Management."

Following the adoption of BS 7799 as an international standard, ISO/IEC 27001:2005 was released, followed by ISO/IEC 27001:2013. The most current version, ISO/IEC 27001:2022, was published in October 2022 to address the evolving cybersecurity landscape, including cloud computing, remote work, and supply chain vulnerabilities. The 2022 version of the standard includes four thematic control categories comprising a total of 93 controls (reorganized from the previous 114 controls found in ISO/IEC 27001:2013). In practice, ISO 27001 is intended to be used alongside ISO 27002, which provides implementation guidance for each control.

A key point to understanding is that ISO 27001 remains a management standard, not a security standard per se. It provides a framework for managing security within an organization but does not offer a "gold standard" for security that, if implemented, would guarantee an organization's security. Instead, ISO 27001 adopts a risk assessment-based approach. An information security risk assessment is conducted to identify the organization's security requirements and then determine the security controls needed to reduce risk to an acceptable level. Once the necessary controls are identified, ISO 27001 defines

processes to ensure they are implemented effectively and continue to meet the organization's evolving security needs.

The 2022 revision places stronger emphasis on ongoing risk monitoring and requires organizations to document their risk treatment plans more rigorously. It also introduces the concept of "information security objectives" that must be measurable, monitored, and communicated throughout the organization.

ISO 27001 offers a best-practice management framework for implementing and maintaining security. It also provides a baseline for compliance, either for internal demonstration of conformity or for external certification against the standard. Organizations must decide on a risk assessment method, carry out the risk assessment, select appropriate security controls, and ensure these controls adequately address their security needs. This requires both information risk management and security expertise to implement effectively. ISO 27001 does not prescribe exactly how to perform these activities; rather, it provides a framework within which to carry them out.

When used in conjunction with ISO 27002:2022 (which was also revised alongside ISO 27001:2022), the standard offers detailed guidance on the controls organizations should consider. However, it does not provide organization-specific guidance tailored to the unique information an organization handles or the systems it operates. Once again, security expertise is essential, both to conduct an information security risk assessment and to define the required security controls.

Purpose of the ISO 27001 Standard

The ISO 27001 standard aims to provide a comprehensive approach for establishing, implementing, operating, monitoring, reviewing, maintaining, and improving an Information Security Management System

(ISMS). Earlier versions of the standard focused primarily on protecting confidentiality, integrity, and availability of information. However, newer versions, including the current standard, also address information from a business perspective. As defined in the standard: "Information security is the protection of information from a wide range of threats in order to ensure business continuity, minimize risk, and maximize return on investments and business opportunities." Information itself may exist in various forms, including written, spoken, electronic, or visual.

Content of the ISO 27001 Standard

The standard includes 11 control objectives and a total of 39 controls. In practice, ISO 27001 is intended to be used alongside ISO 27002.

A key point to understanding is that ISO 27001 is a management standard, not a security standard per se. It provides a framework for managing security within an organization but does not offer a "gold standard" for security that, if implemented, would guarantee an organization's security. Instead, ISO 27001 adopts a risk assessment-based approach. An information security risk assessment is conducted to identify the organization's security requirements and then determine the security controls needed to reduce risk to an acceptable level. Once the necessary controls are identified, ISO 27001 defines processes to ensure they are implemented effectively and continue to meet the organization's evolving security needs.

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adequately address their security needs. This requires both information risk management and security expertise to implement effectively. ISO 27001 does not prescribe exactly how to perform these activities; rather, it provides a framework within which to carry them out.

When used in conjunction with ISO 27002 (formerly ISO 17799), ISO 27001 offers guidance on the controls organizations should consider. However, it does not provide detailed, organization-specific guidance tailored to the unique information an organization handles or the systems it operates. Once again, security expertise is essential, both to conduct an information security risk assessment and to define the required security controls.

OBJECTIVES OF THE RESEARCH

1. To identify the challenges encountered during and after the implementation of the ISO 27001 standard.
2. To study the financial and material impacts on organizations before and after the implementation of the ISO 27001 standard.
3. To identify the threats associated with certifying against the ISO 27001 standard, specifically in relation to preventing information security incidents that have a material and financial impact on organizational operations.

Hypothesis

H1: ISO 27001 functions as an effective protective system against information security incidents that carry critical consequences for the organization.

H2: The implementation of ISO 27001 within an organization yields significant financial growth and operational benefits to business functions..

RESEARCH METHODOLOGY

Research methodology is the process through which knowledge is produced. It seeks to validate the reasoning behind the chosen research design and justify why that design is appropriate for addressing the selected research problem. A well-defined methodology provides essential information regarding method critique, sampling strategy, topic selection, research process, data collection, data sources, sampling strategy, data analysis, and the overarching methodological framework.

Population and Sampling

The target population for this study consists of all ISO 27001 certified organizations worldwide. Currently, there are 7,840 ISO 27001 certified organizations globally, of which 545 are based in India. The sampling frame is defined as the number of ISO 27001 certified organizations located in the National Capital Region (NCR) of India. From these 545 organizations, 38 were selected for quantitative data collection. From these 38, the top 15 organizations were chosen based on their responses to the initial questionnaire.

Sampling Unit and Elements

The sampling unit and element consist of three key roles within each ISO 27001 certified organization in the NCR: the head of the security function, the head of IT, and the head of finance.

Sample Size Determination and Sampling Technique

A confidence interval approach was used to determine the sample size. A probability sampling technique, specifically, simple random sampling, was employed to identify the elements to whom the survey questionnaire would be administered.

Pilot Study

A pilot study of the questionnaire was conducted to adapt the instrument to the local context.

Data Sources

The sources of information used in this study comprise both primary and secondary data. Research Nature

It is not solely the research strategy that determines the quantitative or qualitative nature of the research; rather, it is the combination of the research strategy, research objectives, and data collection techniques that collectively shape the research approach.

Primary Data

Primary data refers to data that is "originated by the researcher for the specific purpose of addressing the problem at hand." To obtain primary data, interviews were conducted. These interviews were not highly structured, as the main goal was to engage interviewees in detailed discussions around the subject matter. Accordingly, semi-structured interviews were employed. The aim of the interviews was to gather valuable information relevant to the research questions and the overall topic of the thesis.

Secondary Data

Secondary data served as the second source of information. Secondary data is defined as the "collection of data that already exists." To develop the conceptual framework and methodology, various sources of information were utilized, including articles, books, journals, online databases, and other relevant materials.

DATA ANALYSIS

Data analysis was conducted using the ANOVA technique, with calculations performed using SPSS software. Analysis of Variance (ANOVA) is a flexible statistical procedure used when a researcher wishes

to compare differences between more than two means. Two ANOVA models are described in this study: the simple one-way ANOVA and the two-way factorial ANOVA. The one-way ANOVA is analogous to the t-test, except that it can test for differences among more than two means simultaneously.

In addition, the chi-square goodness-of-fit test and the test for independence were also performed using SPSS. The chi-square test is useful for analyzing whether a frequency distribution for a categorical or nominal variable is consistent with expected values (a goodness-of-fit test), or whether two categorical or nominal variables are related or associated with each other (a test for independence). In chi-square analysis, the primary interest lies in the frequency with which individuals fall into a specific category or combination of categories.

Contextual Discussion (Separate from Data Analysis)

An Information Security Management System (ISMS) is necessary because the threats to the availability, integrity, and confidentiality of an organization's information are significant and continuously increasing. Consider a prudent householder whose house was built on the shores of a tidal river. Facing the risk of floods, the householder would take urgent steps to improve the house's defenses against the water. Blocking only the front gate would be insufficient, as water would enter through any available channel. The only prudent action would be to block every possible entry point for floodwaters and then build walls even higher in case the floods are worse than anticipated.

The same principle applies to threats against organizational information. All organizations possess information or data that is either critical or sensitive. Information is widely regarded as the lifeblood of modern business.

ISO 27001 is a non-prescriptive framework, as it is a technology-neutral and vendor-neutral standard. It provides the organization and all its stakeholders with a level of confidence regarding its information security measures. The fact that ISO 27001 offers the option of certification through an independent audit has the advantage of providing assurance regarding an organization's information security posture. For these reasons, as well as those stated

earlier, ISO 27001 has become the de facto global standard for information security management. According to recent data, 7,940 organizations worldwide are ISO 27001 certified.

The diagram in Figure 1 below illustrates the most effective outcomes observed by organizations after implementing the ISO 27001 standard.

Figure 1. Perceived organizational outcomes of ISO 27001 IMPLEMENTATION



Figure 1 presents the perceived outcomes of ISO 27001 implementation using three response categories: primary, secondary and not applicable (N/A). The results show that process formalization and organizational confidence in information security are the strongest perceived outcomes, followed by risk management effectiveness. Information management practices and other service improvements are also evident, but they are more commonly viewed as secondary benefits. Customer confidence appears to vary across organizations, indicating that the market-facing impact of certification depends on organizational context and stakeholder expectations. Overall, the figure supports the argument that ISO 27001

contributes most directly to structured security governance, process visibility and risk-based management.

In addition to asking participants about the challenges and obstacles they faced during the implementation of ISO 27001, we also inquired about the success factors they experienced and the lessons they learned. According to the eight organizations surveyed, coherent planning from project inception to completion, a sufficient budget, and employees' positive attitudes toward the project were the most helpful factors in achieving their goals of implementing the standard.

Secondary success factors, identified in sequential order, included outstanding project management skills, top

management's involvement and contributions, compatibility with existing policies and procedures, employee awareness of the importance of security, regarding the success factors they observed.

and the contribution of existing auditing functions. Figure 2 below illustrates the participants' responses

Figure 2. Critical success factors for ISO 27001 implementation

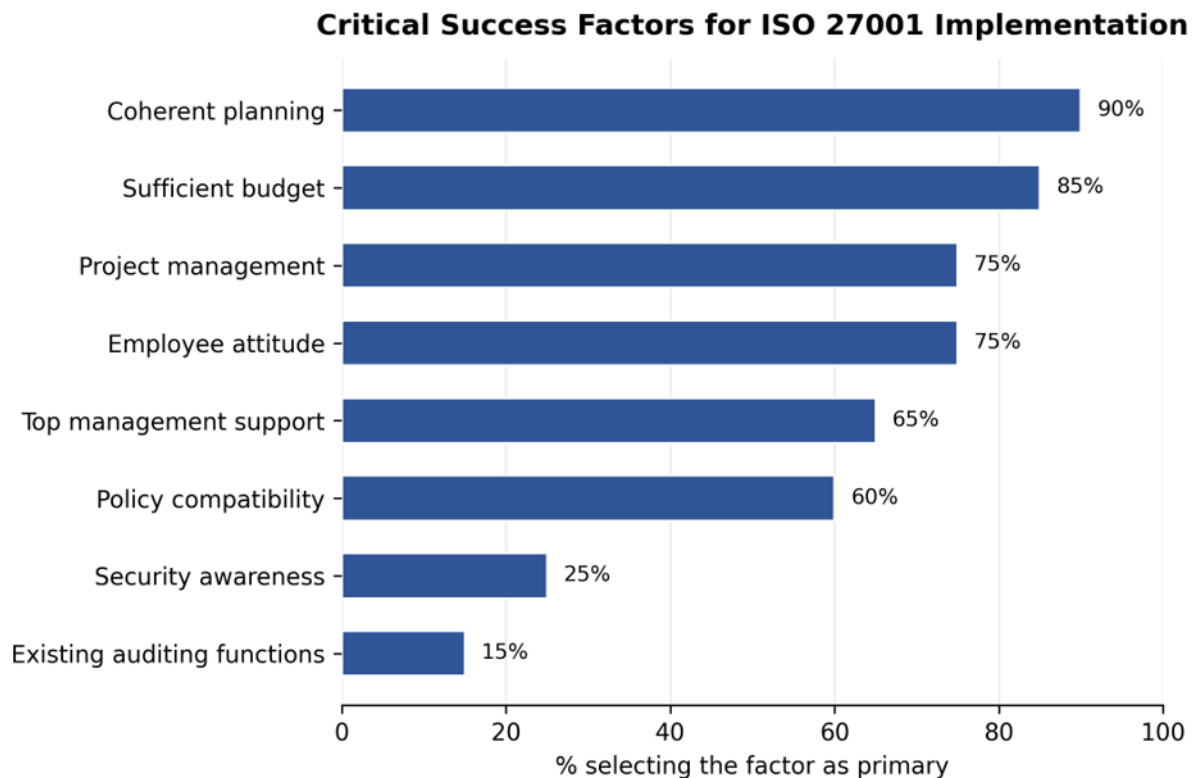


Figure 2 ranks the success factors according to the proportion of respondents identifying each factor as a primary contributor to implementation success. Coherent planning and sufficient budget emerge as the most influential factors, indicating that ISO 27001 implementation requires both strategic preparation and adequate resource allocation. Employee attitude, project management and top management support also appear important, while policy compatibility plays a supportive role. Security awareness and existing auditing functions are comparatively weaker as primary drivers, although they remain relevant as enabling conditions. The figure therefore reinforces the importance of planning, resources, leadership and organizational

readiness in successful ISO 27001 implementation.

Although all participants indicated satisfaction with the way they implemented the ISO 27001 standard, we asked them what they would do differently if they were to implement the standard again.

Nearly all participants agreed on four primary areas for improvement. These included, in order: increasing awareness of the benefits of an Information Security Management System (ISMS); ensuring staff involvement from project inception to completion; changing the risk assessment approach or method; and reducing reliance on external resources. Figure 3 presents all options and responses based on the reported votes.

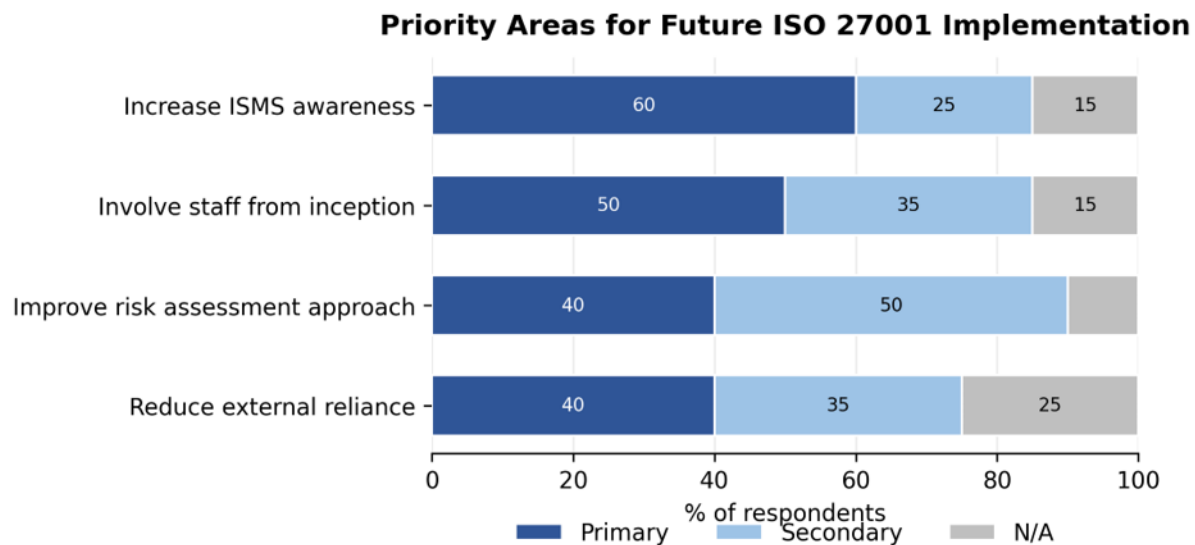
Figure 3. Priority areas for future ISO 27001 implementation

Figure 3 presents the areas that respondents would prioritize if they were to implement ISO 27001 again. Increasing awareness of ISMS benefits receives the highest primary emphasis, followed by early staff involvement. This suggests that implementation effectiveness depends not only on technical controls but also on employee understanding and participation from the beginning of the project. Improving the risk assessment approach is also important, particularly as a secondary priority, while reducing reliance on external resources shows mixed relevance across organizations. Overall, the figure indicates that future implementations should place greater emphasis on awareness, participation and context-specific risk assessment.

Participants in our survey recognize this trend: 73% of respondents perceive an increasing level of risk due to heightened external threats. At the same time, however, only about one-third of respondents have updated their information security strategy within the past 12 months to respond to these escalating threats. Additionally, 45%

of organizations have identified increased threats originating from within their own organizations.

It is entirely possible to implement an ISO 27001-compliant Information Security Management System (ISMS) without adequately addressing information security. This situation can arise in two ways: either it is deliberately "designed in" to the ISMS through management's acceptance of high risks (which is rare), or it results from inadequate risk assessment, poor selection of security controls, or ineffective implementation of those controls (which is common).

Compliance with or external certification to ISO 27001 does not mean an organization is secure. Rather, it means the organization is managing security in line with the standard and to the level it deems appropriate. If the risk assessment is flawed, if sufficient security and risk assessment expertise is lacking, or if management and organizational commitment to implement security is absent, then it is perfectly possible to be fully compliant with the standard while remaining insecure.

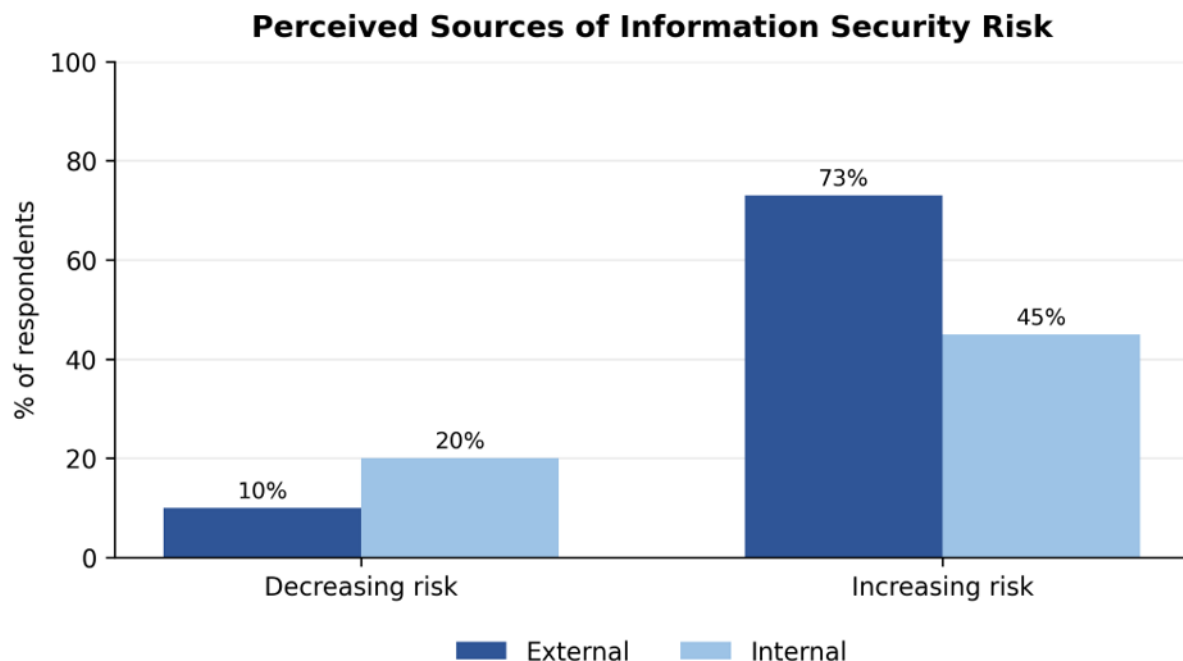
Figure 4. Perceived sources of increasing and decreasing information security risks

Figure 4 compares perceived internal and external sources of increasing and decreasing information security risks. The results indicate that external threats are the dominant source of increasing risk, while internal threats also remain significant. In contrast, the proportion of respondents reporting decreasing risk is much lower. This supports the discussion that organizations face a rising and increasingly dynamic threat environment, and that ISO 27001-certified organizations must continuously update their risk assessment, monitoring and control mechanisms rather than relying on certification alone.

Ultimately, an organization can only implement information security effectively if it fosters a culture that understands the value of information and is committed to protecting it. This requires visible management commitment, individual ownership, and personal responsibility, supported by effective security education and awareness. Without such a culture, an ISO 27001-based ISMS is unlikely to be effective, and consequently, information

will not be adequately protected.

ISO 27001 provides a best-practice management framework for implementing and maintaining security. It also offers a baseline for compliance—either for internal demonstration of conformity or for external certification against the standard. However, compliance or certification does not mean an organization is secure. Rather, it indicates that the organization is managing security in line with the standard and to the level it deems appropriate for its context. If the risk assessment is flawed, if sufficient security and risk assessment expertise is lacking, or if management and organizational commitment to implement security are absent, then it is entirely possible to be fully compliant with the standard while remaining insecure.

FINDINGS

It was not easy to find organizations to validate the proposed method. The organizations allocated too little time to invest in this research due to other priorities.

Across all case study organizations, complying with legislation and regulation was considered the top driver for information security. Furthermore, the business viewed information security as a cost center, reflecting the traditional approach to managing information security activities within these organizations.

The level of information security maturity was low across all case study organizations. Information security was implemented primarily to achieve legislative compliance. Moreover, information security was delivered based on a supply strategy rather than a demand strategy in all case study organizations. As a consequence, information security was often applied too heavily, and thus too expensively, within the IT organization.

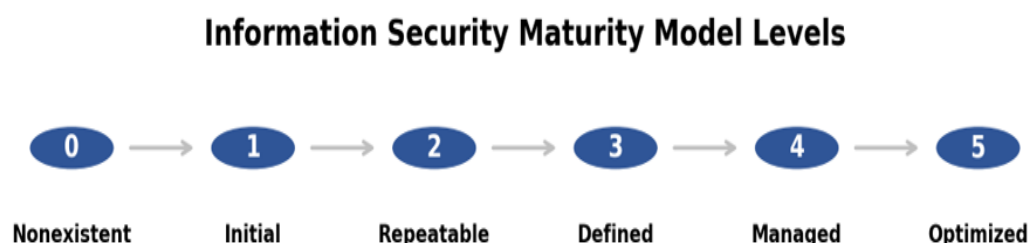
All organizations made information security investment decisions in an economically independent manner. Instead of conducting economic evaluations to justify selected information mitigation solutions, the case study organizations chose solutions based on expert judgment and intuition. A lack of relevant content across all organizations meant that not all steps of the proposed method could be completed. For example, relevant past experience, statistical data, and results from earlier inspections were missing in these organizations. Due to the unavailability of this relevant content, it was

difficult to assess the cost-effectiveness of the mitigation solutions. Consequently, evaluating information security from an economic perspective proved challenging.

Despite these difficulties, all organizations indicated that the proposed method was clear and complete. The steps of the method were described as clear and logical. In addition, the method resulted in better focus, improved analysis, and stronger argumentation. The method was considered implementable and capable of enhancing the organization's understanding of the economic evaluation of information security. However, organizations must meet certain conditions to use the method and to evaluate information security from an economic perspective.

Implementing ISO 27001 is a sound way forward to ensure organizational security. Successful implementation requires careful thought, planning, and coordination to ensure smooth adoption of controls. The decision of when and how to implement the standard may be influenced by a number of factors, including different business objectives, existing levels of IT maturity and compliance efforts, user acceptability and awareness, customer requirements or contractual obligations, and the organization's ability to adapt to change and adhere to internal processes.

Figure 5. Information security maturity model levels



Progression from ad hoc practices to documented, measured and continuously improved information security management

Figure 5 illustrates the information security maturity model as a progression from Level 0 to Level 5. At Level 0, formal processes are nonexistent, while Level 1 reflects ad hoc and reactive practices. Level 2 indicates repeatable practices, Level 3 represents documented and communicated processes, Level 4 reflects monitored and measured processes, and Level 5 represents optimized practices supported by continuous improvement and automation. This conceptual figure is more appropriate than a numerical line chart because the maturity model describes stages of organizational development rather than measured percentage values.

After analyzing and concluding the research, this chapter presents recommendations for organizations seeking to avoid operational risks and improve their current information security systems. To decrease the probability of operational risks and enhance information security, several practical measures are recommended. Any information that users consider sensitive or vulnerable should be encrypted. Passwords should be kept secure, and user accounts should not be shared, as authorized users are responsible for the security of their own passwords and accounts. User-level and system-level passwords should be changed frequently. To maintain privacy and confidentiality, installing desktop sharing tools or software on company resources should not be permitted. Only necessary and licensed software should be installed on organizational machines, while unwanted and unauthorized software should be removed. If new software is required that is not on the company's approved list, the user must follow a formal request procedure. Every workstation should be equipped with the best available antivirus software, with virus definition files kept updated at all times, and every workstation should also be kept current with the latest operating system patches and updates. Additionally, employees must

exercise caution when opening email attachments from unknown senders, as such attachments may contain viruses, email bombs, or Trojan horse code.

The Plan-Do-Check-Act (PDCA) cycle forms the structural core of the ISO 27001 standard in the context of an Information Security Management System (ISMS). The four stages are identified as follows: Plan involves establishing the ISMS by defining requirements, assessing risks, and deciding which controls are applicable. Do refers to implementing and operating the ISMS. Check involves monitoring and reviewing the ISMS. Act refers to maintaining and continuously improving the ISMS. The standard also specifies certain documents that must be controlled and requires that records be generated and maintained to demonstrate the operation of the ISMS, for example, for certification audit purposes. Management must demonstrate their commitment to the ISMS, principally by allocating adequate resources to implement and operate it. The organization must conduct periodic internal audits to ensure the ISMS incorporates adequate controls that operate effectively. Management must review the suitability, adequacy, and effectiveness of the ISMS at least once a year, assessing opportunities for improvement and the need for changes. Finally, the organization must continually improve the ISMS by evaluating and, where necessary, making changes to ensure its suitability and effectiveness, addressing nonconformances, and preventing recurring issues where possible.

A key question is whether the mere presence of information security standards is sufficient to ensure information security, or whether a broader perspective is required. Critical success factors for information security include senior management commitment and the widespread dissemination of awareness across the organization. Information security also has a cultural dimension, as depending on the cultural context, a particular security

requirement may or may not be implemented in the right spirit.

Across all organizations that participated in this study, several consistent patterns were observed. Complying with legislation and regulation was considered the top driver for information security. The business viewed information security as a cost center, reflecting the traditional approach to managing information security activities. The level of information security maturity was low across all participating organizations, and information security was implemented mainly to comply with legislation. Furthermore, information security was delivered based on a supply strategy rather than a demand strategy, and as a consequence, it was often applied too heavily, and thus too expensively, within the IT organization. All participating organizations made information security investment decisions in an economically independent manner. Instead of conducting economic evaluations to justify selected mitigation solutions, solutions were chosen based on expert judgment and intuition. A lack of relevant content across organizations meant that not all steps of the proposed method could be completed. For example, relevant past experience, statistical data, and results from earlier inspections were missing. Consequently, it was difficult to assess the cost-effectiveness of mitigation solutions, making it hard to evaluate information security from an economic perspective.

Despite these challenges, all studies indicated that the proposed method was clear and complete. The method's steps were described as clear and logical. In addition, the method resulted in better focus, improved analysis, and stronger argumentation. The method was considered implementable and capable of enhancing the organization's understanding of the economic evaluation of information security. However, organizations must meet certain conditions to use the method and to evaluate information security from an

economic perspective. In conclusion, the results of this research support organizations and security managers in identifying systems that can be used to achieve greater efficiency in the information security management process.

RECOMMENDATIONS

In summary, the research findings lead to the following recommendations for organizations wishing to proceed with the economic evaluation of information security.

First, organizations should determine the information security maturity level they wish to achieve and identify how that level can be reached. Metrics for information security should be defined, measured, collected, and communicated, as information security requires measurement in order to generate the necessary feedback for improvement.

Second, organizations should review the methods used internally to obtain relevant content and investigate how tooling can be employed to record that content. Specifically, organizations should collect information security incident data from both before and after the implementation of security controls, as well as related business loss and cost data.

Third, business management must be actively involved in information security. Information security should not be viewed as an IT issue alone, but rather as an integral part of the organization as a whole. Business management support may take the form of guidance during planning, participation during design, or involvement during deployment.

Fourth, organizations should reserve sufficient time to conduct economic evaluations of information security and to carry out training sessions. Efforts should be initiated to establish training sessions for employees and management on how to apply economic principles to information

security investment decisions.

Implementation Considerations for ISO 27001

Implementing ISO 27001 can take considerable time and consume unforeseen resources, especially if companies do not have an implementation plan early in the compliance process. To enhance compliance efforts, internal auditors can help companies identify their primary business objectives and the scope of implementation. Auditors should work with IT departments to determine current compliance maturity levels and analyze the return on investment of the compliance process. A team of staff members or external consultants who have prior experience implementing the standard can conduct these steps. External consultants should work in collaboration with an internal team of representatives from the company's major business units.

Identifying Business Objectives

Plans to adopt ISO 27001 must be supported by a concrete business analysis that involves listing primary business objectives and ensuring that consensus is reached with key stakeholders. Business objectives can be derived from the company's mission, strategic plan, and existing IT goals. These objectives may include ensuring effective risk management, such as identifying information assets and conducting accurate risk assessments; maintaining the company's competitive advantage, particularly if the industry as a whole deals with sensitive information; preserving the organization's reputation and standing among industry leaders; providing assurance to customers and partners about the organization's commitment to protecting data; and increasing the company's revenue, profitability, and savings in areas where protective controls operate effectively. The standard also emphasizes compliance with contractual obligations, which may be considered

another key business objective. For instance, for an online banking division, implementing the standard would provide customers and partners with greater assurance that risks stemming from the use of information systems are managed properly.

CONCLUSIONS AND FUTURE WORK

Information security, and in particular the handling of personal information, has regularly made headlines over the last few months. Notable incidents have occurred at HM Revenue and Customs, the Ministry of Defence, Nationwide Building Society, and Marks and Spencer, among others. These are all large organizations that have implemented information security management systems at least compliant with, if not certified against, the international standard for information security management, ISO 27001.

It has been found that companies with ISO 27001 audits and certification gain an improved risk-based approach to information security management through an ongoing process of risk assessment and mitigation. This helps them to adequately prioritize the implementation of countermeasures and strengthen their security posture through the rigorous testing required by ISO. Organizations are then able to demonstrate that they have sound internal controls over financial processes and, more importantly, that they can mitigate information security risks by operating under a single, integrated system rather than two separate ones. This approach complements the Plan-Do-Check-Act (PDCA) process, a widely accepted framework for driving continual improvement.

This presents a significant opportunity to get involved and influence the future direction of this well-respected information security standard. However, because ISO/IEC 27001 is an active certification standard, major or structural changes are very difficult. Even

minor changes must be justified to retain "backwards compatibility" with the existing standard wherever possible.

In any business or organization across every industry, protecting sensitive and confidential data is a top priority in information security. A number of laws, regulations, and standards address these concerns. However, does complying with one law, regulation, or standard mean that an organization is fully secure against all security attacks? The logical answer is not necessarily. Many regulations pertain to particular industries or types of data security, so there is almost always a chance that other parts of an information system remain vulnerable. The Payment Card Industry (PCI) provides a good example. Although PCI has mandated its own strict standards for establishments that handle cardholder information, being compliant with only this standard may not be sufficient to keep an entire system secure.

In today's technological society, organizations are becoming increasingly dependent on their information systems. Information is, by and large, the lifeline of the modern enterprise. Organizations need to prove that they are secure. If the proper steps are taken and security can be demonstrated, the additional reporting and inspections can facilitate the integration of security and compliance programs, helping to control costs, keep systems and networks secure, and sustain compliance. Security has become a crucial initiative for all businesses. With new challenges and threats emerging almost daily, any breach of security can have a severe impact on the function, reputation, or even survival of an organization. Appropriate steps must be taken to secure and protect information assets; it is no longer acceptable merely to be compliant.

FUTURE RESEARCH DIRECTIONS

Based on the experiences presented in this research, a number of recommendations for

future research have been formulated. Above all, the fact that this research constitutes a first study in this field implies that further research is necessary to validate its conclusions and recommendations. To extend the understanding gained, additional research is required in which several aspects of this research area are examined more closely. During the research, various areas of attention were identified that warrant further investigation to increase understanding of the economic evaluation of information security.

First, it is necessary to study in practice how to assess the true effectiveness of proposed mitigation solutions. It was difficult to assess the cost-effectiveness of security controls due to the unavailability of relevant content. Developing meaningful content to estimate the cost-effectiveness of mitigation solutions was not a simple task. At the time of performing the case studies, there were no standardized methods for determining risk mitigation effectiveness expressed in a value. The key question is: How can organizations be encouraged to recognize, record, and analyze relevant content in order to obtain realistic figures for evaluating information security from an economic standpoint?

Second, the lack of relevant content within the case study organizations meant that not all steps of the proposed method could be completed. One such step was the economic evaluation of proposed mitigation options. Further research should investigate whether the method leads to more economically grounded investment decisions.

Third, alignment is important to information security. Future research could explore how developments and models in the area of Business-IT Alignment can be applied to align business objectives with information security.

Fourth, the case study organizations did not achieve a maturity level higher than 1 or 2.

Further research could investigate why organizations remain at these low levels of maturity and how they can reach higher levels. According to several researchers, software development in India, for instance, operates at a higher maturity level, and it might be expected that information security there is also at a more advanced level. Information security surveys have shown that the integration of information security into the overall risk management function is increasing among Indian organizations. The findings indicate that Indian companies are increasingly using information security and risk management in a more strategic role to address business objectives. Additional research could verify whether this is indeed the case and explore how organizations in other contexts, such as the Netherlands, can achieve higher maturity levels.

Fifth, the term "On-going Effectiveness Evaluation" (OEE) in this section refers to the ex-post consideration of information security investment levels. In other words, activities carried out to evaluate the effectiveness of the planned information security level (ex-ante) are performed after information security implementation has taken place. In general, researchers agree that an important function of evaluation is to

provide information for decision-making. Further research should identify what the content of the On-going Effectiveness Evaluation should consist of.

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NAVIGATING THE VALLEY OF DEATH: BARRIERS TO COMMERCIALIZING RESEARCH PRODUCTS IN SRI LANKA

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ABSTRACT

Transforming scientific research into commercially available products remains a critical catalyst for national economic growth, driving the shift from basic factor-driven economies to knowledge-based economies. In Sri Lanka, the higher education and research sectors possess with a large intellectual capital, yet the successful commercialization of research outcomes is persistently experiencing at a lower level. This article tries to critically examine the systemic, institutional, and cultural barriers obstructing the transition of research products from the laboratory to the marketplace in the Sri Lankan context. By exploring the dynamics of the Triple Helix model, encompassing academia, industry, and government, this study identifies key bottlenecks, including weak university-industry linkages, pervasive intellectual property challenges, systemic funding deficits, and bureaucratic inertia within state-funded institutions. Through a detailed analysis of recent policy initiatives, such as the establishment of Institutional Business centers, the article proposes strategic interventions necessary to foster an entrepreneurial academic culture and a robust national innovation ecosystem in Sri Lanka.

Keywords: Industry Linkages, Commercialization Business centers, Policy, intellectual Property

INTRODUCTION

In the contemporary global economy, the competitive advantage of a nation is increasingly dictated by its capacity to generate, protect, and commercialize new knowledge. Research commercialization, the process of transforming scientific findings and intellectual property (IP) into marketable products, services, or processes, serves as the primary conduit for this knowledge transfer. For developing nations like Sri Lanka, which are attempting to pivot toward innovation-driven economic frameworks, universities and state-funded research institutions are expected to act as vital local knowledge hubs. However, the translation of cutting-edge research into tangible socioeconomic value is a highly complex, multi-stage process characterized by high risks, substantial capital requirements, and the need for seamless cross-sectoral collaboration.

Despite the fact that Sri Lankan universities engage in high-quality theoretical and

applied research, the volume of university inventions that successfully traverse the "Valley of Death" (the gap between academic research and commercial application) remains distressingly low. A myriad of overlapping structural, cultural, and financial barriers hinders this transition. While policy initiatives have begun to acknowledge the critical importance of a cohesive National Innovation System (NIS), the ground reality reveals a fragmented ecosystem where academia and industry often operate in isolated silos with differing institutional logics.

This paper details the multi-dimensional barriers faced by Sri Lankan researchers and institutions in commercializing their innovations. It breaks down the challenges into four primary domains: University-Industry Linkages (UILs), Intellectual Property and Regulatory Roadblocks, Financial Constraints, and Academic Culture.

The Current Innovation and Policy Landscape in Sri Lanka

Historically, the Sri Lankan higher education system has emphasized the traditional dual missions of universities: mainly teaching and other as the fundamental research. The "third mission" of the university is academic entrepreneurship and direct contribution to societal economic development is a relatively recent policy decision.

To bridge the chasm between academic outputs and industrial needs, the Sri Lankan government, often supported by several international frameworks like the World Bank-funded Accelerating Higher Education Expansion and Development (AHEAD) project which has introduced significant systemic reforms. A pivotal milestone was the mandate to establish University Business Linkage (UBL) Cells across state universities (Abeytunga et al., 2024). These UBL cells effectively act as Technology Transfer Offices (TTOs), tasked with managing IP portfolios, facilitating industry partnerships, and guiding researchers through the arduous commercialization process. However comparatively government research funding observed at higher state than the private grants for research.

However, despite these institutional frameworks, the maturity of the commercialization pipeline remains nascent. Analyses utilizing the Triple Helix model of innovation, which examines the intertwined roles of academia, industry, and government, reveal that while the government has laid foundational policies, the active operational synergy between the three helices is critically weak. The lack of an integrated "Penta Helix" approach (which would also include media and community stakeholders) further isolates research products from the end-consumer market.

Key Barricades to Commercialization

The journey from a viable prototype to a scalable commercial product requires overcoming a complex matrix of obstacles. In Sri Lanka, these barriers are obvious and deeply embedded in both the macroeconomic environment and institutional structures.

Weak Industry Linkages

The most glaring impediment to successful research commercialization in Sri Lanka is the weak interface between universities and public research institutes and the industrial sector (Esham, 2008). This disconnect is rooted in divergent objectives, timelines, and risk appetites.

Divergent Institutional Logics: Academic researchers are primarily driven by the pursuit of novel knowledge, academic freedom, and publication in high-impact, peer-reviewed journals. In contrast, the industry is driven by market demand, profit margins, cost efficiency, and rapid time-to-market. These conflicting priorities often lead to mismatched expectations when collaborative projects are initiated.

Lack of Trust and Information Asymmetry: There is a pervasive lack of mutual trust. Industries often perceive university research as overly theoretical, lacking commercial viability, and detached from ground-level market realities. Conversely, academics frequently harbor concerns that industry partners might exploit their IP without providing fair financial compensation or proper academic acknowledgment.

Absence of Boundary-Spanning Mechanisms: While UBL cells have been established to act as intermediaries, many lack the experienced personnel required to negotiate complex licensing agreements or evaluate the commercial readiness of a technology. Without seasoned technology brokers, research remains trapped within the university walls.

Intellectual Property (IP) and Regulatory Impediments

A robust Intellectual Property Rights (IPR) regime is the bedrock of technology commercialization. It ensures that inventors can safely disclose and monetize their creations. However, the IP landscape in the Sri Lankan academic sector faces significant hurdles.

Low IP Literacy Among Researchers: A substantial barrier is the inadequate understanding of IP laws among academic staff and student researchers. Many researchers prematurely publish their findings in journals or present them at conferences before filing for patent protection, inadvertently destroying the "novelty" requirement crucial for patentability (Weerakoan, et al., 2024).

Complexity and Cost of Patenting: The procedural requirements for filing patents, particularly through the Patent Cooperation Treaty (PCT) for international protection, are convoluted and prohibitively expensive for individual researchers. The lack of dedicated mentorship and legal support to draft technical patent applications frequently discourages innovators.

Bureaucratic Policies: Even when funding is available, the bureaucratic red tape within state universities and research institutes slows down the commercialization process. Ambiguous IP policies regarding the ownership of inventions and the distribution of royalty revenues often create disputes. When inventors feel that retention of unfair share of the commercial benefits, their incentives in commercialization could drop precipitously.

Bio-piracy concerns: In specific sectors like indigenous medicine and agriculture, researchers exhibit high hesitancy to collaborate with foreign entities or large corporations due to historical fears of bio-piracy. The inadequacy of existing legal frameworks to seamlessly protect traditional knowledge alongside modern patent systems complicates the

commercialization of such localized research (Weerasinghe & Dedunu, 2021).

Financial Constraints and the "Valley of Death"

Taking a product from a Technology Readiness Level (TRL) of 3 or 4 (proof of concept) to TRL 8 or 9 (system complete and qualified) requires massive capital injection, commonly referred to as "risk capital."

Lack of Specialized Venture Capital (VC):

The Sri Lankan financial ecosystem is highly risk-averse and predominantly reliant on traditional bank lending, which demands collateral that academic spin-offs and startups simply do not possess. There is a severe dearth of specialized venture capitalists, angel investors, or seed funding mechanisms willing to invest in deep-tech, high-risk university spin-offs.

Inadequate R&D Funding: Government allocations for Research and Development (R&D) as a percentage of the Gross Domestic Product (GDP) remain below global averages. The limited research grants provided by bodies like the National Science Foundation (NSF) and National Research Council are highly competitive and often restrict fund usage to basic consumables and equipment, explicitly excluding expenses related to market testing, prototype scaling, or business development. The price of equipment and testing instruments in the global market splashes at multiple rates.

Deficient Scaling Infrastructure: Research institutes and universities often lack the high-end specialized equipment, limited accredited testing laboratories, and incubation spaces necessary to develop industrial-grade prototypes. However professional research institutes like Industrial Technology Institute (ITI) have built their capacities over decades but still further developments needed compared with global sicario. Consequently, researchers cannot validate their products under real-

world conditions, making industry partners hesitant to license unproven technologies.

3.4 Academic Culture and the "Traditional" Mindset.

The internal culture of Sri Lankan academic institutions also acts as a latent barrier to fostering a vibrant commercialization ecosystem.

The "Publish or Perish" Paradigm: The academic promotion criteria in Sri Lanka are heavily skewed toward assessing the number of peer-reviewed publications and citation metrics. Commercialization efforts, patenting, and the creation of spin-offs carry significantly less weight in performance evaluations. This misaligned incentive structure structurally discourages academics from investing the massive time and energy required for technology transfer.

Heavy Teaching Workloads:

Academics and scientists are heavily burdened with either in teaching,

administrative duties, and other day to day activities. The sheer lack of discretionary time prevents them from engaging in the long-term, iterative processes required for entrepreneurial ventures and industry consultations (Esham, et al., 2013).

Resistance to Entrepreneurialism:

A segment of the academic community remains ideologically resistant to the concept of the "entrepreneurial university." There is a lingering traditionalist view that commercializing knowledge commodifies higher education and detracts from the moral purpose of creating public-good knowledge.

Summary of Barriers and Strategic Mitigations

To synthesize the challenges and potential remedies, the following table maps the identified barriers to required strategic interventions within the Sri Lankan context. See the Table 01.

Table – 01

BARRIER CATEGORY	SPECIFIC CHALLENGE	STRATEGIC MITIGATION / INTERVENTION
INDUSTRY LINKAGES	Misaligned goals; lack of trust; limited interaction.	Institutionalize joint R&D labs; promote industry sabbaticals for academics
INTELLECTUAL PROPERTY	Premature disclosure; high patenting costs; complex ownership rules.	Integrate IP education into postgraduate curricula; provide subsidized patent drafting services, clarify royalty-sharing formulas.
FINANCIAL & INFRASTRUCTURE	Absence of venture capital; poor prototype funding.	Establish state-backed deep-tech seed funds; create tax incentives for corporate R&D investments; build shared incubation hubs.
ACADEMIC CULTURE	Promotion tied only to publications; heavy teaching loads.	Revise guidelines and policy to weigh patents and spin-offs equally with publications; provide "teaching buy-outs" for entrepreneurial researchers.

Strategic Interventions and the Way Forward

To dismantle these barriers, Sri Lanka must move beyond isolated policy drafting and implement systemic, structural reforms that harmonize the National Innovation System.

"Commercialization of the researches and innovations becomes more and more important in this era of volatile changes. Every day we could feel the challenges associated with this process in any knowledge-based institute."

Firstly, the empowerment of Business centers or UBL Cells is non-negotiable. These entities must transition from being mere administrative compliance offices to becoming dynamic, aggressive commercialization engines. This requires staffing them with vivid experts, professionals who understand deep science but possess a ruthless acumen for business development and contract negotiation (Abeytunga et al., 2024).

Secondly, the concept of "patronage" must be formally introduced into the ecosystem. Academic innovators require dedicated mentorship from successful industrial veterans who can guide them through market validation, supply chain logistics, and regulatory approvals. Creating a national network of alumni entrepreneurs to mentor current researchers could bridge this gap with minimal financial outlay.

Thirdly, alternative financing models must be explored. The government should consider establishing matching-grant frameworks where the state matches the R&D funds invested by private corporations in research projects. Furthermore, initiating specific venture funds, capitalized by private sector investments and managed by independent fund managers, can provide the critical early-stage lifeblood that spin-offs desperately need.

Finally, a profound cultural shift must be engineered by the policy makers. By officially recognizing patents, licensing revenues, and startup creation as primary criteria creating a research culture, the system will naturally incentivize the brightest minds to look beyond the laboratory and toward the marketplace.

CONCLUSION

Commercialization of research products in Sri Lanka is not merely a technical challenge; it is a systemic bottleneck that stifles the nation's economic evolution. The barriers, ranging from the structural weaknesses in research bodies-industry linkages and the labyrinthine intellectual property landscape to chronic underfunding and entrenched academic traditionalism, are formidable but not insurmountable.

Transitioning from a traditional academic framework to an entrepreneurial institutional research model requires a synchronized effort across the Triple Helix. The government obligation in providing de-risking capital and streamlined policies; the industry must shift from viewing universities/research institutes solely as

talent pipelines to seeing them as co-creators of technology; and they must drastically overhaul their incentive structures to reward commercialization. By fortifying boundary-spanning institutions and fostering an ecosystem of trust and mutual benefit, Sri Lanka can unlock the immense latent value of its academic institutions, translating localized research into global socio-economic prosperity.

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ARE WE READY? A CRITICAL REVIEW OF SRI LANKA'S TERTIARY EDUCATION SYSTEM AND ITS READINESS FOR THE LABOUR MARKET

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ABSTRACT

Sri Lanka's tertiary education ecosystem, state universities, non-state higher education providers, and the Technical, Vocational Education and Training (TVET) system, stands at a pivotal juncture. Despite notable progress in access and credentialing, a persistent disconnect remains between what graduates know and what employers need. This review synthesises recent labour force statistics and policy developments to assess readiness, focusing on three problem signals, declining labour force participation, an entrenched gender gap, and elevated youth unemployment, and three supply-side realities, fragmented pathways, uneven programme quality, and constrained work-based learning. It evaluates the National Education Policy Framework (NEPF 2023–2033), quality assurance through SLQF/NVQ, and proposed system investments such as the ADB-supported TVET transformation, to distil where execution must improve. The paper advances a practical five-pillar readiness agenda: (1) Curriculum-to-Competency (C2C) mapping aligned to occupational standards; (2) Work-Based Learning (WBL) at scale; (3) a national Skills Data Commons to guide intakes and curricula; (4) Recognition of Prior Learning (RPL) bridges between TVET and higher education; and (5) Assurance-by-Design with employability KPIs embedded into programme review. Sequencing across four quarters from Q2-2026 provides an actionable roadmap to shift from qualification-centric to competency-and-employment-centric outcomes while promoting inclusion and productivity.

Keywords: graduate employability, skills mismatch, SLQF, NVQ, TVET, NEPF, labour force participation, youth unemployment, Sri Lanka.

INTRODUCTION

Sri Lanka's growth prospects in 2026 and beyond will be shaped as much by macroeconomic stabilisation as by the quality and utilisation of its human capital. The post-crisis rebound has created a narrow but valuable window in which the country can re-architect the tertiary-labour market interface. In this context, readiness is not a snapshot of how many graduates are produced; it is the institutional capability to continuously align learning outcomes with changing job demands, reduce transition frictions for youth, and broaden participation, especially among women. This paper adopts that operational definition of readiness and uses official labour market indicators and recent policy moves as a

lens. It first interprets the labour signals that matter for tertiary providers, then reviews the supply-side structure and quality, articulates employer needs, and finally proposes a sequenced agenda for implementation in 2026.

THE CURRENT LABOUR MARKET SIGNALS

Three facts stand out in the latest series. First, total labour force participation has trended downward over the past five years, reaching the mid-40s as a share of the population aged 15+ by 2024. Second, the gender gap remains stark: male participation hovers near two-thirds of working-age men whereas fewer than one-third of women are economically active, with only marginal movement across the period. Third, unemployment is

concentrated among the young and among those with higher educational attainment (A/L and above), suggesting that the transition from schooling to stable work is a structural choke point. At an industry level, the economy continues to be services-heavy but with sizable agricultural and industrial employment; such a structure requires both higher-order cognitive skills and strong middle-skill technical capacity. For providers, these signals translate into three imperatives: (i) embed practical experience early to accelerate youth transitions; (ii) design flexible, low-interruption learning for women; and (iii) steer intakes and curricula using timely skills intelligence rather than historic tradition. Pls refer the table 01.

Table 1: Selected labour indicators for Sri Lanka (2020–2024)

Indicator	2020	2021	2022	2023	2024
LFPR – Total (%)	50.6	49.9	49.8	48.6	47.4
LFPR – Male (%)	71.9	71.0	70.5	68.6	67.4
LFPR – Female (%)	32.0	31.8	32.1	31.3	29.8
Unemployment Rate – Total (%)	5.5	5.1	4.7	4.7	4.4
Unemployment Rate – Male (%)	4.0	3.7	3.7	3.6	3.0
Unemployment Rate – Female (%)	8.5	7.9	6.5	7.0	7.1
Unemployment 20–24 yrs (%)	25.2	26.8	21.8	21.6	20.7
Unemployment 25–29 yrs (%)	12.0	11.4	11.7	13.0	12.5
Unemployment – A/L & above Total (%)	9.8	9.1	7.8	8.0	7.8

SUPPLY SIDE: TERTIARY STRUCTURE, OUTPUTS, AND QUALITY

Sri Lanka's tertiary system is diverse by design. State universities occupy the apex of degree provision, complemented by non-state higher education institutions that have expanded capacity in market-relevant fields such as ICT, business, and health. Open and Distance Learning (ODL) models, notably those of the Open University of Sri Lanka, broaden access for working learners and for those outside urban cores, offering flexible progression pathways. Alongside this sits a wide TVET landscape, administered and quality assured primarily through TVEC, NAITA, VTA, DTET and other agencies, with hundreds of registered providers offering thousands of accredited courses mapped to the National Vocational Qualifications (NVQ) framework. Two cross-cutting quality instruments bind this ecosystem: the Sri Lanka Qualifications Framework (SLQF), which articulates expected learning outcomes and credit volumes at each academic level, and the NVQ framework, which codifies occupational competencies and assessment standards. In theory, SLQF and NVQ enable mobility and signalling; in practice, three issues limit their full potential. First, credit recognition and RPL are not yet widely operationalised across institutions, so learners who acquire competencies in TVET cannot always climb smoothly into degree pathways. Second, programme quality varies: tracer studies reveal strong employability pockets in professionally oriented faculties and programmes with embedded industry projects, while other programmes continue to emphasise theory over application. Third, data on outcomes are siloed, graduate tracer studies, vacancy analytics, and LFS indicators do not feed a common decision system, weakening the ability to steer intakes, pedagogy, and funding.

DEMAND SIDE: WHAT EMPLOYERS NEED IN 2026

Employers across sectors consistently signal three families of skills. The first is domain-specific technical competence, ranging from software development, data analysis, and cybersecurity in ICT, to CAD/BIM and site safety in construction, to revenue management and service operations in tourism and hospitality, and clinical protocols in healthcare. The second is a bundle of transversal capabilities, communication, collaboration, problem-solving, and the ability to work with data, that govern productivity and adaptability regardless of field. The third is work readiness, professional dispositions, ethics, reliability, and familiarity with real production tools and workflows, that reduces induction time and early attrition. The macro recovery underscores the need for both higher-order and middle-skills: services growth requires digitally fluent graduates; manufacturing and construction need supervisors and technicians who can translate designs into safe, efficient execution; tourism's rebound requires language, customer-centricity, and cross-cultural competencies. Such requirements argue for tighter co-production of curricula with employers, co-assessment during WBL, and rapid-cycle micro-credentialing to close specific gaps in live cohorts rather than in the next intake.

POLICY AND REFORM TRAJECTORY

The reform landscape provides a workable scaffold. The National Education Policy Framework (NEPF 2023–2033) sets the direction for diversified pathways, credentialing reform, and improved governance of the education system. On the skills side, a proposed ADB-supported Skills Development System Transformation Program (2024–2029) targets expansion of employment-oriented TVET, stronger employer engagement, and digital platforms

to improve quality and efficiency. Complementing these, the Labour Market Recovery and Transformation Strategy places jobs, especially decent work for youth and women, at the heart of recovery, calling for inter-ministerial coordination. Yet, policy on paper is insufficient: the critical question is whether providers can execute changes at the course and assessment levels, whether employers can commit to co-design and supervision at scale, and whether data systems can continuously guide choices.

ARE WE READY? GAPS THAT STILL MATTER

Five readiness gaps persist. (1) Curriculum–demand misalignment: not enough programmes are mapped to explicit, industry-validated competency standards, leaving assessments weak predictors of job performance. (2) Weak industry co-production: curriculum reviews still occur episodically and often without line-of-business practitioners who understand current workflows and tools. (3) Limited work-based learning: internships and apprenticeships are not yet universal or credit-bearing; where they exist, assessment rubrics seldom capture performance on real tasks. (4) Gendered participation barriers: time, mobility, safety, and care responsibilities disproportionately affect women's transitions; without flexible delivery and targeted supports, female LFPR will not improve materially. (5) Fragmented data for decisions: providers do not have a shared skills intelligence layer that merges LFS indicators, vacancy analytics, and programme-level outcomes.

A PRACTICAL “READINESS AGENDA” FOR 2026

Pillar 1 — Curriculum-to-Competency (C2C) Mapping. Map each programme's intended learning outcomes to an occupational competency standard (where available via TVEC/NCS or sector bodies).

Publish a C2C matrix for each programme showing: (a) the competency; (b) the learning unit(s) where it is taught; (c) the assessment evidence; and (d) performance standards. Introduce micro-credentials that are stackable to SLQF levels to close live skills gaps, for example, data analytics for business undergraduates, safety leadership for construction supervisors, or digital health basics for nursing.

Pillar 2 — Work-Based Learning (WBL) at Scale. Institutionalise credit-bearing internships or apprenticeships covering at least 70% of undergraduate and diploma programmes. Standardise WBL learning agreements that specify tasks, tools, and expected evidence. Require employer supervisors to co-assess students using rubrics that measure productivity, quality, safety, teamwork, and communication. Provide small stipends and travel/childcare support to increase female participation.

Pillar 3 — Skills Data Commons. Establish a national data layer that combines LFS indicators, graduate tracer studies, vacancy analytics (including online postings), and

employer surveys using shared taxonomies. Publish quarterly Skills Barometers that advise providers on intake steering, module redesign, and micro-credential priorities. Use dashboards to detect emerging shortages (e.g., clinical coders, solar technicians) and to trigger rapid content updates.

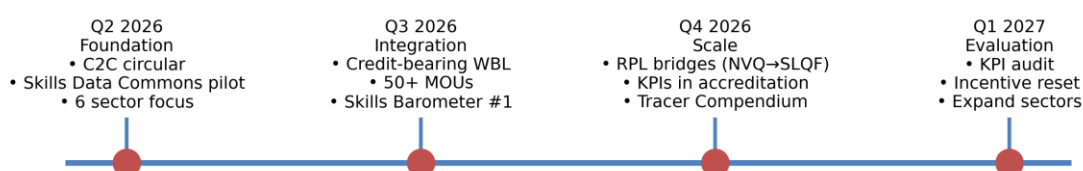
Pillar 4 — RPL and Mobility (SLQF–NVQ). Operationalise Recognition of Prior Learning pathways to allow NVQ Level 5/6 holders to enter degree programmes with defined credit, and to let experienced workers demonstrate competence for advanced standing. Publish transfer maps and cap credit volumes to maintain academic integrity while rewarding proven competence.

Pillar 5 — Assurance-by-Design. Bake employability KPIs into programme review: six-month placement rates; median starting salary band by field; employer satisfaction at 3 and 12 months; WBL coverage; female placement rate. Link public funding and incentives to improvements on these indicators, with transparent reporting.

A 12-MONTH SEQUENCED ROADMAP (2026)

The readiness agenda should be executed in four waves to balance ambition with feasibility and to generate early wins that build momentum.

Figure 1: 12-month roadmap for tertiary–labour market readiness (2026–Q1 2027)



Note: This schematic is indicative; milestones align to policy and programme actions described in the text.

Q2 2026 – Foundation. Issue a joint MoHE/UGC/TVEC circular requiring C2C matrices for all programmes undergoing

review. Stand up the Skills Data Commons technical working group; adopt common skills taxonomies and data-sharing

protocols. Select six priority sectors (ICT, construction, tourism/hospitality, healthcare, manufacturing, green energy) and recruit employer champions to co-design WBL.

Q3 2026 – Integration. Launch the national WBL scheme with standard credit templates and protection policies for learners. Conclude 50+ employer MOUs via chambers and sector associations. Publish Skills Barometer #1 advising on 2027 intake steering and syllabus tweaks based on vacancy analytics and tracer data.

Q4 2026 – Scale. Implement RPL bridges (NVQ→SLQF) at pilot universities; evaluate student and employer experience to refine rubrics and credit caps. Embed employability KPIs into programme accreditation reviews. Publish a national Tracer Study Compendium for 2026 to benchmark outcomes by field and provider type.

Q1 2027 – Evaluation. Commission an independent audit of KPIs; conduct lessons-learned clinics with providers and employers; recalibrate incentives and expand to additional sectors and regions.

DISCUSSION: RISKS AND MITIGATIONS

Capacity and change management. Curriculum redesign and WBL supervision require staff time and new competencies. Mitigation: targeted development funding tied to deliverables; peer-to-peer clinics; workload models that recognise supervision.

Data governance and quality. Merging LFS, tracer, and vacancy data raises comparability and privacy issues. Mitigation: common taxonomies, anonymisation protocols, and a clear steward (e.g., MoHE in partnership with DCS and TVEC).

Equity and gender. Without stipends, transport support, and flexible scheduling,

WBL may exclude women and disadvantaged learners. Mitigation: targeted supports, safety and anti-harassment policies, and remote/hybrid WBL where appropriate.

Sustaining employer engagement. Employers need clear value to co-produce curricula and assessments. Mitigation: outcome-based MOUs, recognition programmes, and tax/visibility incentives for high-performing partners.

CONCLUSION

Sri Lanka can convert today's challenges into a durable advantage if its tertiary system learns to sense, respond, and adapt at the pace of labour market change. The statistics underline the urgency; the policy frameworks supply direction; employer needs provide the test. What remains is execution: mapping curricula to competencies, placing students in real workplaces at scale, building a living data asset to steer decisions, unlocking mobility for experienced workers, and holding ourselves to outcome-based standards. By sequencing these actions across 2026, the system can measurably improve youth transitions, raise female participation, and provide the skills that fuel an inclusive recovery.

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BEYOND THE BAN: A CRITICAL REVIEW OF PALM OIL CONSUMPTION PERCEPTION IN THE SRI LANKAN COMMUNITY AGAINST GLOBAL EVIDENCE

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ABSTRACT

Palm oil represents a contradiction in Sri Lanka, being deeply rooted in domestic and industrial food systems however simultaneously one of the most controversial agricultural commodities. Considering the 2021 ban on growing oil palm and importing palm oil, the public discourse in the country is colored with considerations of human health, water scarcity, species extinction, and sustainability within the plantation industry. This critical review analyzes recent academic literature and credible institutional sources available from 2018 to 2025 in order to explore the impact of nutritional, environmental, and economic discussions on community attitudes toward the consumption of palm oil in Sri Lanka. It is revealed that negative public opinion about palm oil tends to be fueled by global dialogues of deforestation and general health risks. Evidence base controlled cultivation, edible oil security, efficient land use, and import dependency in Sri Lanka being inadequately incorporated into the public concerns. At the same time, Sri Lanka continues to consume palm oil largely through imported food and industrial supply chains, creating a policy contradiction between restriction and reliance.

Keywords: palm oil; consumer perception; Sri Lanka; oil palm cultivation; sustainability; edible-oil security

INTRODUCTION

Palm oil derived from the African oil palm (*Elaeis guineensis*) is the most widely traded vegetable oil globally, found in most of the packaged consumer products as well as cosmetics, baked goods, and biofuels (Alhaji et al., 2024). However, palm oil remains one of the most polarizing commodities in contemporary food and agricultural discourse. In April 2021, Sri Lanka became the only country in the world to ban both oil palm cultivation and palm oil imports, citing concerns about soil erosion, drying springs, and biodiversity loss (Rodrigo, 2021). Five years later, government and industry actors are trying to lift the imposed restrictions, and answer the question of whether palm oil should occupy a regular place in the Sri Lankan diet. Yet, on Sri Lankan land these issues remain unresolved (Daily Mirror, 2026).

This review examines how Sri Lankan community perceptions on palm oil consumption have been shaped by three interacting forces: international scientific evidence on health and the environment, locally led environmental resistance, and rising economic and food-security pressures. Drawing on peer-reviewed literature published between 2018 and 2025 and credible institutional reports, the review argues that current perceptions are increasingly disconnected from country-specific evidence and that the way forward lies in measured, science-led reassessment rather than continued prohibition.

THE GLOBAL PALM OIL LANDSCAPE

Palm oil now accounts for roughly one-third of all edible oil consumed globally, with production projected to exceed 80 million

metric tons in marketing year 2024/25 (Alhaji et al., 2024; United States Department of Agriculture [USDA], 2025). Indonesia and Malaysia together supply more than 80% of world exports, while Thailand, Colombia, and Nigeria fill smaller niches (Murphy, 2025). Demand is sustained mainly by the crop's exceptional land efficiency: oil palm

produces approximately 3 to 4 metric tons of oil per hectare per year and that is several times the yield of coconut, soybean, sunflower, or rapeseed (Murphy, 2025). Table 1 summarizes comparative oil yields across the major vegetable oil crops to contextualize this dominance.

Table 1. Comparative oil yield and land requirement of major vegetable-oil crops. Values are typical ranges compiled from Murphy (2025) and Alhaji et al. (2024).

Vegetable Oil Crop	Average Oil Yield (t/ha/year)	Land Required per Tonne of Oil (ha)
Oil palm (<i>Elaeis guineensis</i>)	3.0 - 4.0	0.3
Rapeseed / Canola	0.7	1.4
Sunflower	0.7	1.4
Soybean	0.4 - 0.5	2.2
Coconut	0.3	3.7

This dominance has not been free of controversy. Approximately 23% of Indonesian deforestation between 2001 and 2016 was attributable to oil palm, peaking in 2008 - 2009 before declining substantially as zero deforestation pledges and the roundtable on sustainable palm oil (RSPO) certification scheme took effect (Ostfeld & Reiner, 2024). The European Union's 2023 deforestation-free products regulation has further reshaped global sourcing. Researchers nevertheless caution that simply restricting oil palm from one geography does not protect global biodiversity; owing to its yield advantage, replacing palm oil with lower yielding oils typically requires four to ten times more land elsewhere (Murphy, 2025). This contrast is important for understanding Sri Lankan perceptions of palm oil. While palm oil has caused serious ecological damage in some major producing regions, it also remains the most land-efficient vegetable oil crop at the global level. Therefore, Sri Lankan debates should not directly adopt environmental narratives from Borneo and Sumatra without considering the country's very different

cultivation history, land-use context, and regulatory conditions.

NUTRITIONAL AND HEALTH PERSPECTIVES

Sri Lankan public perception, like that of much of South Asia, frequently associates palm oil with cardiovascular harm because palm oil contains a higher proportion of saturated fatty acids than most consumed liquid vegetable oils such as soybean, sunflower, canola, and olive oil. However, this comparison should be interpreted carefully, since palm oil is less saturated than coconut oil and palm kernel oil, both of which are also widely used in tropical food systems. Chemically, palm oil contains approximately 49 - 50% saturated fatty acids, with palmitic acid as the dominant fatty acid at around 44%, while the remaining fraction consists largely of unsaturated fatty acids, particularly oleic and linoleic acids (Boateng et al., 2016; Alhaji et al., 2024). Therefore, the peer-reviewed evidence is considerably more nuanced than the popular narrative. A systematic review of palm oil intake and

cardiovascular outcomes found no clear, pooled association between total saturated fatty-acid intake and risk of myocardial infarction (Ismail et al., 2018). An umbrella review of nine meta-analyses similarly concluded that, when palm oil substitutes for trans fats or animal fats, lipid profile changes are modest and considerably less harmful than the substitutes it replaces (Unhapipatpong et al., 2021). A recent critical synthesis of clinical and animal evidence reported that just over half of animal studies, but a smaller share of well-controlled human trials, supported a meaningful link with cardiovascular disease, prompting calls for moderation rather than elimination (Abdulwaliyu et al., 2023). The World Health Organization's (2024) rapid overview emphasized that palm oil findings must be interpreted against the comparator oil rather than in isolation.

In parallel, palm oil's micronutrient profile is increasingly recognized as a public health asset, particularly in lower- and middle-income settings. Crude red palm oil is among the densest natural sources of pro-vitamin A carotenoids (typically 500 - 700 mg/kg) and tocotrienols, a potent form of vitamin E associated with cardioprotective and anti-inflammatory effects (Alhaji et al., 2024). A systematic review of randomized controlled trials involving 2,646 participants reported consistent reductions in inflammatory and lipid-peroxidation markers with palm tocotrienol-rich fraction supplementation (Looi et al., 2025). For Sri Lanka, where vitamin A deficiency persists in some rural and estate populations, this nutritional dimension is rarely surfaced. Refined palm olein, the predominant culinary form, loses most carotenoids during processing, while minimally processed red palm oil retains them. The dominant Sri Lankan perception, however, remains shaped by a binary saturated-fat-equals-bad frame that recent evidence increasingly challenges.

THE SRI LANKAN RESISTANCE: ROOTS AND ARGUMENTS

The 2021 prohibition rested on a 2018 expert panel report from the Central Environmental Authority (CEA) that identified soil erosion, drying of springs, and biodiversity threats as potentially irreversible consequences of oil palm cultivation in the wet zone (Rodrigo, 2021). Civil society organizations including the centre for environmental justice argued that local agro-ecological systems and rural livelihoods were being displaced by monoculture and welcomed the ban as protective of community water resources (Friends of the Earth Asia Pacific, 2021). Sri Lankan studies have echoed concerns about elevated evapotranspiration in mature oil palm stands and complaints from villagers near plantations about wells drying earlier in the dry season (Institute of Policy Studies of Sri Lanka [IPS], 2023).

Resistance has nevertheless been contested on scientific grounds. Unlike in Indonesia, Sri Lankan oil palm cultivation has not driven primary deforestation; cultivation has been confined to roughly 11,000 to 12,000 hectares of marginal rubber lands managed by regional plantation companies (IPS, 2023; Solidaridad Network, 2021). Industry stakeholders and senior plantation scientists have noted that Sri Lanka is the only country to ban a crop that supplies more than one-third of the global edible oil market and have argued that water table effects observed in some districts coincide with broader rainfall variability rather than with palm physiology specifically (Daily Mirror, 2026; Rodrigo, 2021).

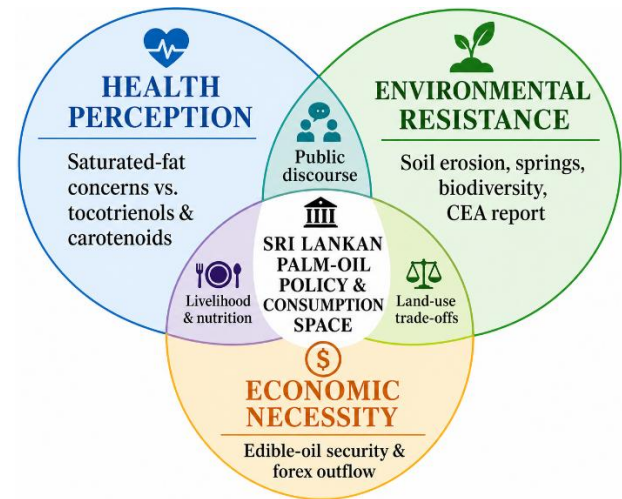
This polarization is also mirrored in consumer behavior. International evidence indicates that perception is heavily mediated by region: European consumers actively avoid palm oil while consumers in producing economies more readily accept sustainable palm oil. A pioneering Brazilian study using a Likert-scale instrument found that even where consumers held negative

associations, more than half were willing to try crude palm oil after exposure to nutritional information (Bispo et al., 2024). No equivalent peer-reviewed perception survey has yet been published for Sri Lanka, leaving policy debate dependent on advocacy positions rather than representative empirical data.

ECONOMIC AND FOOD SECURITY IMPLICATIONS

Sri Lanka remains heavily dependent on imported edible oils, as domestic production is insufficient to meet household and industrial demand. In 2021, total edible oil demand was estimated at 275,039 metric tons, while local production accounted for only 72,769 metric tons, leaving nearly 74% of the country's fats and oil requirements to be supplied through imports (Pathiraja et al., 2023). Following the cultivation ban, palm oil imports continued to climb, reaching 38,210 metric tons in 2025 against 34,708 metric tons in 2024 and costing the treasury approximately Rs. 140 billion (Daily Mirror, 2026). The Planters' Association of Ceylon estimates that more than USD 175 million was spent on edible oil imports between 2021 and 2025 (Planters' Association of Ceylon, 2025). For a country still recovering from a foreign exchange crisis, this represents a substantial drain that domestic cultivation could partly offset. Figure 1 conceptualizes the three intersecting forces; health perception, environmental resistance, and economic necessity, which together define the policy and consumption space for palm oil in Sri Lanka.

Figure 1. Conceptual model of the three intersecting forces shaping Sri Lankan public perception and policy on palm oil consumption



The economic case is reinforced by oil palm's land sparing properties. Producing one ton of vegetable oil requires roughly 0.3 hectares from oil palm but 3.7 hectares from coconut and even more from ground nut (Murphy, 2025). For a small island state with limited arable land, replacing imported palm oil with expanded coconut cultivation is mathematically constrained: only about 40,000 metric tons of the 240,000 metric tons annual coconut oil demand is locally produced, and existing coconut land cannot easily expand without displacing other food crops (Ministry of Agriculture and Plantation Industries, 2024). Investments that have already sunk into oil palm are over Rs. 23 billion in nurseries, mills, and research, alongside Rs. 550 million unused seedlings, representing both stranded capital and forgone fiscal revenue (Planters' Association of Ceylon, 2025).

TOWARD EVIDENCE-BASED LOCAL CULTIVATION

A reasonable middle path treats palm oil neither as a public health enemy nor as an unconditional savior, but as one component of a diversified edible oil portfolio. Three principles can guide reconciliation. First, regulated cultivation should be confined to already converted plantation land (but not the primary forest) under transparent environmental impact assessment regimes that monitor groundwater, effluent, and biodiversity, drawing on lessons from RSPO limitations identified in recent reviews (Ostfeld & Reiner, 2024). Second, public health communication should move beyond the saturated fat dichotomy to explain how cooking

method, processing degree, and total dietary context determine cardiometabolic outcomes (Looi et al., 2025; Unhapipatpong et al., 2021). Third, smallholder inclusion; particularly among small and medium scale planters facing rubber sector decline could reap economic benefit while reducing the political vulnerability that comes with concentration in a few large estates (Solidaridad Network, 2021). Critically, all three pillars require Sri Lankan specific empirical evidence: longitudinal hydrological studies in cultivation districts, representative consumer perception surveys, and clinical nutrition data on local dietary patterns.

CONCLUSION

Sri Lankan perceptions of palm oil consumption are forged at the intersection of imported global narratives and locally specific environmental anxieties, both of which often outrun the available domestic evidence. The 2021 cultivation and import ban distinguishes Sri Lanka internationally but has not insulated households from palm oil consumption; rather, it has shifted the financial burden onto imports while leaving roughly Rs. 23 billion domestic investments idle. Recent peer-reviewed literature does not support an absolute rejection of palm oil on health or environmental grounds. The evidence becomes more balanced when palm oil is compared with realistic alternative oils and when the cultivation context is properly considered, especially in cases where oil palm is grown on already degraded estate land rather than through the conversion of rainforest. A measured policy reset combining regulated cultivation, transparent monitoring, smallholder participation, and honest nutritional communication offers Sri Lanka the best chance of converting an inherited controversy into a domain of evidence led public choice.

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THE IMPACT OF SOCIAL MEDIA USAGE ON ANXIETY AND DEPRESSION AMONG YOUNG ADULTS

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ABSTRACT

The widespread use of social media has significantly transformed the way individuals communicate and interact, particularly among young adults. While these platforms provide opportunities for social connection and information sharing, growing concerns have emerged regarding their potential impact on mental health. This study investigates the relationship between social media usage and levels of anxiety and depression among young adults aged 18 to 30. A quantitative research approach was employed, utilizing a structured questionnaire to collect data on daily social media usage and psychological well-being. Standardized measurement scales were used to assess anxiety and depression levels. The findings indicate a positive correlation between excessive social media use and increased symptoms of anxiety and depression. Participants who reported higher screen time and frequent engagement with social media platforms demonstrated greater emotional distress compared to moderate users. The study highlights the role of social comparison, fear of missing out (FoMO), and reduced face-to-face interactions as contributing factors. These results suggest the need for increased awareness of healthy social media habits and the promotion of digital well-being strategies among young adults. The study provides valuable insights for educators, policymakers, and mental health professionals in addressing the psychological effects of social media usage.

Keywords: Social Media Usage, Anxiety, Depression, Young Adults, Mental Health, Social Comparison

INTRODUCTION

The rapid advancement of digital technology has fundamentally transformed communication patterns, particularly through the widespread adoption of social media platforms. Social media refers to internet-based applications that allow users to create, share, and exchange information within virtual communities. Among young adults, these platforms have become deeply embedded in everyday life, shaping how individuals communicate, build relationships, and develop self-perceptions. According to Pew Research Center, a substantial proportion of young adults engage with multiple social media platforms on a daily basis, highlighting their pervasive influence in contemporary society.

Despite the advantages of enhanced connectivity and easy access to information, growing concerns have emerged regarding

the psychological consequences of excessive social media use. In particular, researchers have increasingly focused on its association with mental health issues such as anxiety and depression. Earlier studies by Jean M. Twenge et al. (2018) identified a significant relationship between increased screen time and reduced psychological well-being among adolescents and young adults. Similarly, Melissa G. Hunt et al. (2018) found that limiting social media usage can lead to a measurable reduction in loneliness and depressive symptoms. More recent research continues to support these findings, indicating that social media use is

significantly associated with anxiety, depression, and sleep disturbances (Ahmed, 2024), while increased engagement with social networking platforms is linked to higher levels of psychological distress (Alansari, 2025).

One of the primary mechanisms underlying these effects is social comparison. Users are frequently exposed to carefully curated and idealized portrayals of others' lives, which can foster feelings of inadequacy and diminished self-esteem. This phenomenon is explained by social comparison theory, proposed by Leon Festinger (1954), which posits that individuals evaluate themselves by comparing their attributes and achievements with those of others. In addition, the concept of Fear of Missing Out (FoMO) has been identified as a critical factor contributing to anxiety, as individuals feel compelled to remain continuously connected to avoid missing rewarding social experiences (Przybylski et al., 2013). Recent studies further indicate that problematic or excessive social media use is consistently associated with negative mental health outcomes, particularly anxiety and depression (Agyapong-Opoku, 2025; Yu, 2024).

Excessive engagement with social media can reduce meaningful face-to-face interactions and disrupt sleep patterns, both of which are essential for maintaining psychological well-being. Research conducted by Brian A. Primack et al. (2017) demonstrated a strong association between high social media usage and perceived social isolation. Emerging evidence also suggests that compulsive or addictive patterns of social media use are strongly linked to increased symptoms of anxiety and depression among young adults (Jameel, 2026). These findings imply that while social media fosters virtual connectivity, it may simultaneously contribute to emotional disconnection and psychological distress. Given the growing reliance on social media among young adults and the rising prevalence of mental health concerns, it is

essential to examine this relationship in greater depth. Therefore, this study aims to investigate the impact of social media usage on anxiety and depression among young adults. By identifying patterns, relationships, and contributing factors, the study seeks to enhance understanding of digital behavior and its implications for mental health, ultimately supporting the development of effective interventions and strategies to promote psychological well-being.

LITERATURE REVIEW

The relationship between social media usage and mental health has become a major focus within Psychology, particularly among young adults who are the most active users of digital platforms. Social media provides opportunities for communication, self-expression, and information sharing; however, growing evidence suggests that excessive or problematic use may negatively affect psychological well-being.

Early research established a foundation for understanding this relationship. For instance, Jean M. Twenge et al. (2018) reported that increased screen time, including social media use, was associated with higher levels of depressive symptoms and lower life satisfaction among adolescents. Similarly, Brian A. Primack et al. (2017) found that individuals with higher social media usage were more likely to experience perceived social isolation, suggesting that online interaction may not effectively replace real-world social connections.

One of the key theoretical frameworks explaining these outcomes is social comparison theory, introduced by Leon Festinger (1954). This theory posits that individuals evaluate themselves by comparing their lives with others. On social media, such comparisons are often based on idealized and selectively presented content, which can lead to negative self-evaluation, reduced self-esteem, and increased anxiety. Supporting this

perspective, Przybylski et al. (2013) introduced the concept of Fear of Missing Out (FoMO), describing it as a pervasive apprehension that others might be having rewarding experiences without oneself. FoMO has been strongly linked to increased social media engagement and heightened anxiety levels.

Recent studies have expanded on these findings by examining the intensity and patterns of social media use. Ahmed (2024) found that excessive social media usage is significantly associated with anxiety, depression, and sleep disturbances, highlighting the multifaceted impact of digital behavior on mental health. Similarly, Alansari (2025) identified a strong relationship between frequent social media engagement and psychological distress among young adults, emphasizing that both duration and type of usage play critical roles. Further evidence suggests that problematic or addictive social media use exacerbates mental health issues. Agyapong-Opoku (2025) reported that compulsive engagement with social media platforms is consistently associated with negative psychological outcomes, particularly anxiety and depression. This aligns with findings by Jameel (2026), who demonstrated that social media addiction significantly predicts higher levels of emotional distress among young adults. Additionally, Yu (2024) highlighted that active forms of engagement, such as frequent posting and interaction, may contribute differently to mental health outcomes compared to passive consumption, suggesting that not only the quantity but also the quality of social media use matters.

Another important factor identified in the literature is the impact of social media on lifestyle behaviors. Excessive use has been linked to reduced face-to-face interactions, poor sleep quality, and decreased physical activity, all of which are known contributors to mental health problems. These indirect effects further strengthen the association

between social media usage and psychological distress. Problematic social media use has been linked to increased levels of anxiety, depression, and emotional dysregulation among young adults (Keles et al., 2023). Passive consumption of social media content, such as scrolling without interaction, is associated with poorer mental health outcomes compared to active engagement (Verduyn et al., 2023). Higher frequency of nighttime social media use has been found to negatively impact sleep quality, which in turn contributes to anxiety and depressive symptoms (Scott & Woods, 2024). Social media exposure to idealized body images and lifestyles significantly predicts low self-esteem and depressive symptoms among young users (Holland & Tiggemann, 2024). Digital well-being interventions, including reduced screen time and mindful usage, have been shown to improve psychological outcomes among heavy social media users (Brailovskaia & Margraf, 2025).

Finally, the existing literature consistently demonstrates a significant relationship between social media use and mental health outcomes among young adults. While social media offers several benefits, excessive and unregulated use appears to contribute to increased anxiety, depression, and emotional instability. However, there remains a need for further research to better understand causal relationships, cultural differences, and the long-term psychological effects of social media usage. This study aims to address these gaps by examining the specific impact of social media usage patterns on anxiety and depression among young adults.

METHODOLOGY

This study adopts a quantitative research design to examine the relationship between social media usage and mental health outcomes among young adults. A quantitative approach is considered appropriate because it allows for objective measurement of variables and statistical

testing of hypotheses within the field of Psychology. The study follows a cross-sectional design, where data is collected at a single point in time to identify patterns and relationships between variables.

The research is based on a deductive approach, where hypotheses are developed from existing theories and prior empirical studies and then tested using collected data. This approach enables the researcher to move from general theoretical assumptions about social media and mental health to specific, testable predictions.

The target population of this study consists of young adults aged between 18 and 30 years, as this group represents the highest level of social media engagement. A sample of approximately 100 respondents will be selected using a convenience sampling technique, mainly from university students and online participants. This method is used due to its practicality and accessibility, although it may limit generalizability.

In this study, the independent variable is social media usage, which is measured in terms of daily time spent on social media, frequency of use, and type of engagement (active or passive use). The dependent variables are anxiety and depression, which represent the mental health outcomes being examined. These variables are analyzed to determine whether changes in social media usage influence psychological well-being. The study tests the following hypotheses: there is no significant relationship between social media usage and anxiety among young adults, and there is no significant relationship between social media usage and depression among young adults. The alternative hypotheses propose that a significant relationship exists between social media usage and both anxiety and depression.

H₀₁ (Null Hypothesis): There is no significant relationship between social media usage and anxiety among young adults.

H₁₁ (Alternative Hypothesis): There is a significant relationship between social media usage and anxiety among young adults.

H₀₂ (Null Hypothesis): There is no significant relationship between social media usage and depression among young adults.

H₁₂ (Alternative Hypothesis): There is a significant relationship between social media usage and depression among young adults.

Data will be collected using a structured questionnaire distributed online through platforms such as Google Forms. The questionnaire consists of three sections: demographic information, social media usage patterns, and mental health indicators related to anxiety and depression. Responses will be measured using a five-point Likert scale ranging from strongly disagree to strongly agree, allowing for quantitative analysis of attitudes and experiences.

For data analysis, statistical techniques such as descriptive statistics, correlation analysis, and regression analysis will be used. Software such as SPSS and Microsoft Excel will be used to process and analyze the data. Pearson correlation will be applied to test the relationship between variables, while regression analysis may be used to examine the predictive effect of social media usage on anxiety and depression.

The decision rule for hypothesis testing is based on a significance level of 0.05. If the p-value is less than 0.05, the null hypothesis will be rejected, indicating a statistically significant relationship between variables. If the p-value is greater than 0.05, the null hypothesis will not be rejected.

Ethical considerations are also taken into account in this study. Participation is voluntary, and respondents will remain anonymous throughout the research process. All data collected will be used strictly for academic purposes, and

informed consent will be obtained from all participants prior to data collection.

RESULTS

The data collected from 100 respondents were analyzed using descriptive statistics, Pearson correlation, and regression analysis using SPSS. The results were interpreted at a significance level of 0.05.

Descriptive Statistics

The analysis revealed that the majority of respondents (72%) used social media for more than 3 hours per day. The most frequently used platforms were Instagram, TikTok, and Facebook. Regarding mental health indicators, moderate levels of anxiety and depression were observed among participants, with mean scores indicating a generally elevated level of psychological distress among high-frequency users.

Correlation Analysis

Pearson correlation was conducted to examine the relationship between social media usage and mental health variables. A positive correlation was found between social media usage and anxiety ($r = 0.48$, $p < 0.001$).

A positive correlation was also found between social media usage and depression ($r = 0.52$, $p < 0.001$).

These results indicate that higher social media usage is significantly associated with increased levels of both anxiety and depression among young adults.

Regression Analysis

A linear regression analysis was conducted to determine the predictive effect of social media usage on mental health outcomes. Social media usage significantly predicted anxiety ($\beta = 0.46$, $p < 0.001$), explaining approximately 22% of the variance ($R^2 = 0.22$).

Social media usage also significantly predicted depression ($\beta = 0.51$, $p < 0.001$), explaining approximately 26% of the variance ($R^2 = 0.26$).

Hypothesis Testing

Based on the results: The null hypothesis (H_{01}) was rejected, indicating a significant relationship between social media usage and anxiety.

The null hypothesis (H_{02}) was also rejected, indicating a significant relationship between social media usage and depression.

The findings suggest that increased social media usage is strongly associated with higher levels of anxiety and depression among young adults. The results support existing literature in Psychology, confirming that excessive engagement with social media platforms can negatively affect mental health outcomes.

DISCUSSION

The findings of this study indicate a significant positive relationship between social media usage and levels of anxiety and depression among young adults. Specifically, higher daily engagement with social media platforms was associated with increased psychological distress. These results are consistent with previous research in Psychology, which has repeatedly shown that excessive or problematic social media use can negatively affect mental health outcomes.

One possible explanation for this relationship is the role of social comparison theory, proposed by Leon Festinger. On social media platforms, individuals are frequently exposed to idealized representations of others' lives, which can lead to upward social comparisons. These comparisons may result in feelings of inadequacy, low self-esteem, and emotional distress, ultimately contributing to higher levels of anxiety and depression.

Another important factor is Fear of Missing Out (FoMO), where individuals feel anxious about being excluded from rewarding experiences others may be having online. This constant need to stay connected can increase stress levels and reduce psychological well-being. In addition, excessive social media use may contribute to reduced sleep quality and limited face-to-face interactions, both of which are essential for maintaining mental health stability.

The results of this study are also consistent with earlier empirical findings. Studies by Jean M. Twenge and colleagues (2018) and Brian A. Primack (2017) similarly reported that higher screen time and social media use are associated with increased depressive symptoms and perceived social isolation. More recent studies (Ahmed, 2024; Alansari, 2025) further support the idea that frequent social media engagement is linked to psychological distress, particularly among young adults.

However, it is important to note that social media does not affect all individuals in the same way. Some users may benefit from online social support, self-expression, and access to information, which can have positive psychological effects. This suggests that the impact of social media usage depends not only on the amount of time spent online but also on the type of engagement (active vs passive use) and individual personality differences.

Despite these insights, this study has certain limitations. The use of convenience sampling may limit the generalizability of the findings. Additionally, the cross-sectional design does not allow for causal conclusions, meaning it cannot be confirmed whether social media usage directly causes anxiety and depression or merely correlates with them.

The findings highlight the importance of understanding how digital behavior influences mental health. They suggest that excessive social media use may be a contributing factor to psychological distress

among young adults, reinforcing the need for awareness programs, digital well-being education, and responsible usage practices.

CONCLUSION & RECOMMENDATIONS

Conclusion

This study aimed to examine the impact of social media usage on anxiety and depression among young adults. The findings indicate a significant positive relationship between social media usage and mental health outcomes, particularly anxiety and depression. Higher levels of daily social media engagement were associated with increased psychological distress, supporting existing literature in Psychology.

The results suggest that excessive social media use may contribute to emotional difficulties through mechanisms such as social comparison, Fear of Missing Out (FoMO), reduced sleep quality, and decreased face-to-face social interaction. These factors collectively influence an individual's psychological well-being and may increase vulnerability to anxiety and depressive symptoms.

However, the study also acknowledges that social media is not inherently harmful. When used in a balanced and purposeful manner, it can provide social support, information access, and opportunities for self-expression. Therefore, the impact of social media depends largely on the intensity, type of usage, and individual differences among users.

Recommendations

Based on the findings of this study, several recommendations are proposed. Firstly, young adults should be encouraged to practice controlled and mindful social media use, including limiting daily screen time and avoiding excessive passive scrolling. Establishing healthy digital habits may help reduce psychological distress.

Secondly, educational institutions and mental health professionals should implement awareness programs on digital well-being, highlighting the potential psychological risks of excessive social media engagement and promoting healthier online behaviors.

Thirdly, social media platforms should consider integrating well-being features, such as screen-time reminders, usage tracking tools, and mental health support resources to encourage responsible usage. Finally, future research should explore longitudinal and experimental studies to better understand the causal relationship between social media usage and mental health outcomes. It is also recommended to investigate moderating factors such as personality traits, coping strategies, and cultural influences.

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A HIERARCHICAL MULTIMODAL FRAMEWORK FOR EMOTION POLARITY DETECTION AND MENTAL ILLNESS PREDICTION USING AUDIO-TEXT FUSION

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ABSTRACT

This study proposes a two-stage hierarchical framework for early mental health assessment using multimodal emotion polarity recognition and text-based mental illness prediction. In the first stage, audio and text features from speech signals are extracted using BERT and Wav2Vec2.0 pretrained models. Then, the extracted features are fused using a cross-modal attention fusion approach to recognize the seven Ekman emotions, i.e., happiness, sadness, anger, fear, disgust, surprise, and neutral, using the IEMOCAP, MELD, and RAVDESS benchmark datasets. The detected emotions are then mapped into three emotional polarity classes, which are positive, negative, and neutral, achieving an overall accuracy of 71.46%. If a neutral emotional state is identified, then the system forwards the conversation with the system to a second-stage text-based classifier, which has been trained on a Reddit-based mental illness text classification dataset that can detect seven mental illness categories, i.e., adhd, anxiety, bipolar, bpd, depression, non, ocd, and ptsd. This dataset consists of around 52000 Reddit posts, which are collected from mental health communities. A BERT-based tokenizer was used to convert text into tokens, and a pretrained DistilBERT model was used to train the model, which yielded an overall accuracy of 84.35%. The proposed framework integrates multimodal emotional understanding with transformer-based language understanding for mental health analysis. This study opens pathways for implementing a scalable pipeline for emotion-aware mental illness screening.

KEYWORDS: multimodal emotion recognition, mental health, cross-modal attention, audio-text fusion

INTRODUCTION

Mental health disorders have become a major global concern due to their increasing impact on the well-being of individuals, productivity, and quality of life. Psychological disorders such as depression, anxiety, bipolar disorder, and stress-related illnesses affect millions of people around the world and often remain undetected during the early stages. So, as a result, it creates a challenging situation to treat such patients when the illness has been detected at a later stage (Adithya et al., 2025). Nowadays, with the development of intelligent systems, there's a growing interest in implementing scalable frameworks to support the early detection of psychological illnesses and mental health monitoring (Dogan & Akbulut, 2023).

Moreover, the integration of emotion recognition technologies with mental health analysis is a promising direction of research these days, as emotional states reflect underlying psychological conditions and behavioral patterns in human cognition (Gupta et al., 2025).

Emotion recognition from multimodal signals is an active research area because emotions provide valuable insights into an individual's psychological state. Human emotions are basically expressed through different modalities such as speech, facial expressions, linguistic patterns, and physiological signals. In addition, speech and language modalities contain rich emotional information that may provide

indicators of mental stress or instability. For instance, negative emotional states such as sadness, fear, anger, and frustration are frequently associated with mental health illnesses. Therefore, identifying emotional states can be considered an important approach for identifying mental disorders at an early stage. (Christ et al., 2022).

Traditional emotion recognition systems have basically relied on unimodal approaches, where emotional information is extracted through a single channel, such as speech, text, or facial expressions alone. Even if they demonstrated high performance, sometimes they suffer from limitations related to incomplete emotional representations and reduced robustness and generalization. (Park et al., 2025) Speech-based systems capture vocal characteristics such as pitch, tone, intensity, and speaking rate, but may fail to interpret contextual meaning contained in the language. Similarly, text-based systems are effective at understanding semantic and contextual information, but often ignore vocal cues that reflect emotional intensity. So such limitations reduce the reliability of unimodal systems in real-world mental health applications. (M. Bodaghi et al., 2024).

To overcome these limitations, multimodal emotion recognition has emerged as a more effective strategy that focuses on combining different modalities. Moreover, the combination of speech audio and textual content enables a more comprehensive understanding of an emotional expression (G. Tiwary et al., 2023). The fusion of these modalities can significantly improve emotion recognition performance compared to unimodal approaches. In addition, advanced fusion strategies such as cross-modal attention have demonstrated enhanced capability in learning complex emotional interactions between modalities by simultaneously attending to different modalities while understanding the emotional representations. (Ben-Ismaïl et al., 2025).

Even though there are advancements in the field of multimodal emotion recognition, limited research has explored hierarchical frameworks that bridge emotion recognition and mental illness prediction in a unified pipeline. Existing studies focus on either emotion classification or mental health detection as independent tasks without considering how emotional polarity may be used as an indicator for psychological assessment. (Mao et al., 2025).

Motivated by these limitations, this study proposes a hierarchical multimodal framework for emotion-aware mental health assessment. In the first stage, multimodal audio and textual features are fused using a cross-modal attention mechanism to recognize seven Ekman emotions using benchmark emotional datasets, namely IEMOCAP, MELD, and RAVDESS. Then, recognized emotion is transferred into three broader emotional polarity categories: positive, negative, and neutral. The second stage of the framework is activated only when a negative emotion is detected in the first stage, to recognize emotional vulnerabilities for mental health assessment through text-based analysis.

LITERATURE REVIEW

Recent advances in Artificial Intelligence has significantly contributed to the development of automated mental health assessment systems. Many researchers have investigated different techniques to identify psychological distress from textual and speech-based data. Early studies have primarily focused on text-based analysis where linguistic features were analyzed using machine learning techniques to detect symptoms of stress, depression and other mental health related problems. Bharti et al., (2022) proposed a hybrid framework that combines Convolutional Neural Networks (CNNs), Bidirectional Gated Recurrent Units (Bi-GRU), and Support Vector Machines for emotion detection from textual data. Their findings demonstrated that deep learning techniques can effectively capture

emotional patterns from text and achieved an accuracy of 80.11%. However, text-only approaches ignore important emotional cues embedded in speech.

The growing availability of speech data has opened up new path ways to the researchers to investigate speech emotion recognition. Kilimci et al., (2025) proposed a deep learning framework that directly processes raw audio waveforms without relying on handcrafted feature extraction techniques such as Mel-Frequency Cepstral Coefficients (MFCCs), and their approach achieved competitive performance across multiple benchmark datasets.

Multimodal approaches integrate information from multiple modalities that enable models to capture richer emotional representations. Vlasenko et al., (2021) explored the fusion of acoustic and linguistic information using supervised autoencoders and reported that combining speech and text information improves emotion recognition performance compared to unimodal approaches. Wang et al., (2021) introduced Multimodal Emotion-Cause Pair Extraction in Conversations, incorporating textual, audio, and visual information to identify emotions and their underlying causes. Their work demonstrated that multimodal fusion provides a more comprehensive understanding of emotional interactions in conversational settings compared to text-only methods.

Recent studies focused more on advanced fusion mechanisms for multimodal emotion recognition. Yin et al., (2022) proposed X-Norm, a bimodal fusion technique that exchanges normalization parameters between modalities to improve feature alignment while reducing computational complexity. The study demonstrated that efficient information exchange between modalities can improve emotion recognition performance without significantly increasing training costs. Similarly, Yi et al., (2025) developed HyFusER, a Hybrid Multimodal Transformer that utilizes Dual

Cross-Modal Attention to strengthen interactions between speech and textual features. Their findings showcased that cross-modal attention effectively captures complementary emotional information and achieves superior performance compared with traditional fusion strategies. Xie et al., (2025) proposed a Dual Contrastive Learning Framework (DCLF) for Multimodal Emotion Recognition in Conversations. Their framework addressed challenges such as emotion shifts and modality contribution imbalance by introducing contrastive learning at the utterance, context, and modality levels. These studies emphasize the importance of advanced modality interaction mechanisms in multimodal emotion recognition systems.

The relationship between emotions and mental health has also attracted considerable research attention in recent era. Xu et al., (2023) analyzed graduate students' academic emotions using a BiGRU-Attention model and found that negative emotions were strongly associated with academic pressure, interpersonal relationships, and career-related concerns. Their study emphasized the importance of emotion recognition for identifying potential psychological risks and achieved a performance with precision, recall, and F1score of more than 95%. Yang & Gong, (2026) developed a multimodal spatiotemporal convolutional network with attention mechanisms for athlete anxiety recognition. By integrating physiological, visual, and behavioral data, their model achieved 94.6% recognition accuracy and demonstrated the effectiveness of multimodal learning in mental health monitoring applications.

Although significant progress has been achieved in emotion recognition and mental health assessment, several research gaps can be identified in the existing literature. Most of the studies focus on either emotion recognition or mental health prediction as independent tasks. Also, many multimodal frameworks have attempted to classify

conversations directly without first identifying emotionally vulnerable instances. This may introduce unnecessary computational complexity and increase the influence of irrelevant emotional information. Even if, studies have demonstrated the effectiveness of

multimodal fusion and transformer-based architectures, limited research has explored a hierarchical framework in which emotional polarity serves as a filtering mechanism for mental health assessment.

METHODOLOGY

Overview of the Proposed Framework

This study proposes a hierarchical multimodal framework for emotion-aware mental health assessment using audio and textual information. This framework mainly consists of two sequential stages: (1) multimodal emotion polarity detection and (2) text-based mental illness prediction. The proposed framework first performs multimodal emotion recognition using speech and textual information through a cross-modal attention mechanism. Conversations identified as having negative emotional polarity are then forwarded to a transformer-based classifier for mental illness prediction. The overall system architecture can be seen in Figure 1.

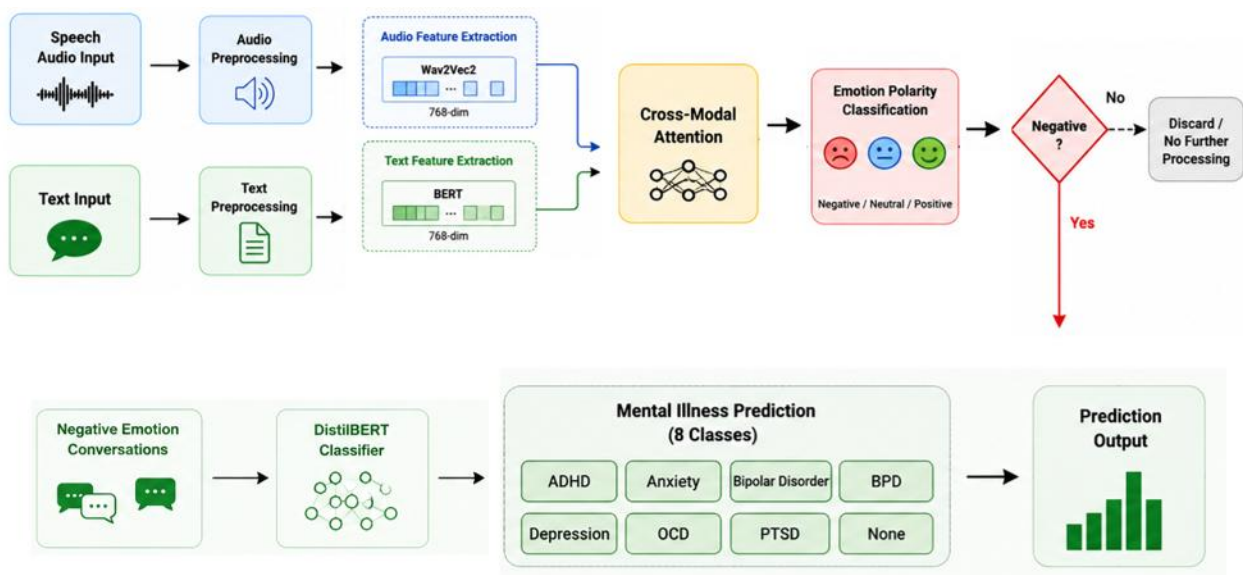


Figure 1: Overall System Architecture

Benchmark Datasets

To ensure robustness and generalizability, three benchmark multimodal datasets were used in this study: IEMOCAP, MELD, and RAVDESS. These datasets were selected because they provide diverse emotional speech samples and corresponding annotations suitable for multimodal emotion recognition.

- IEMOCAP Dataset3: The Interactive Emotional Dyadic Motion Capture (IEMOCAP) dataset contains multimodal emotional interactions collected through scripted dialogues performed by professional actors. The dataset includes audio recordings, textual transcripts, and emotion annotations, which makes it suitable for multimodal emotion recognition tasks.

- MELD Dataset4: The Multimodal EmotionLines (MELD) dataset consists of multimodal utterances that have been extracted from television dialogue scenarios. This dataset provides synchronized speech, textual utterances, and emotional labels across multiple speakers and conversational contexts.
- RAVDESS Dataset5: The Ryerson Audio-Visual Database for Emotional Speech and Song (RAVDESS) is a controlled emotional speech dataset consisting of professional recordings representing multiple emotional categories.

The integration of these datasets provides a diverse multimodal environment, improving model generalization across conversation, acted, and controlled emotional speech scenarios.

Data Preprocessing

Since emotional labels are different across the three benchmark datasets, a unified label mapping strategy was adopted. First, the emotion annotations from IEMOCAP, MELD, and RAVDESS were standardized into seven Ekman emotional categories, which are anger, disgust, fear, happiness, neutral, sadness, and surprise. Then the resulting datasets were highly imbalanced as shown in Figure 2.

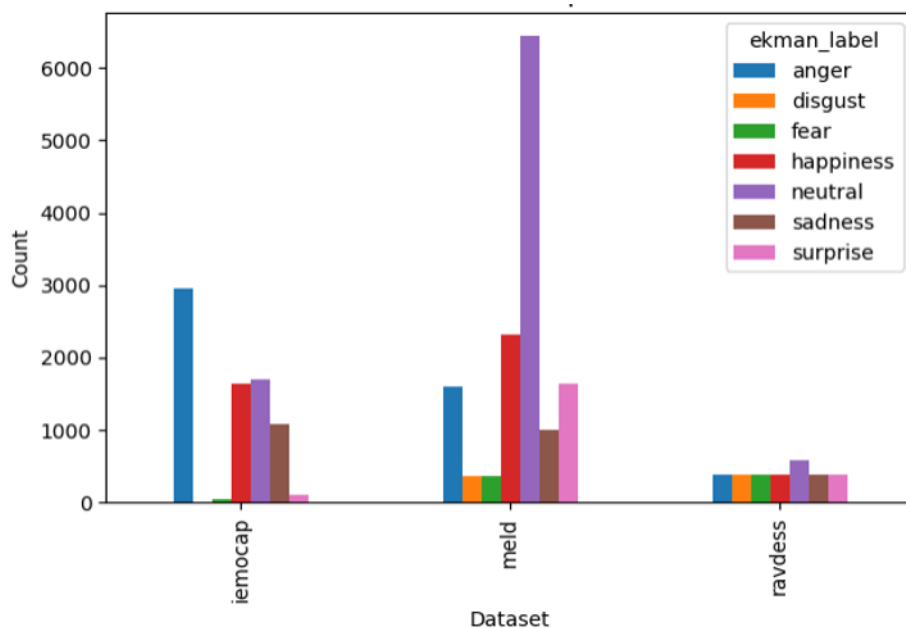


Figure 2: Distribution of Ekman emotion classes across the datasets

Then these classes were transformed into three emotional polarity groups to simplify emotional interpretation and to facilitate hierarchical mapping, as shown in Table 1.

Table 1: Emotion Label Mapping

Ekman Emotion	Emotional Polarity
Happiness, Joy, Excitement	Positive
Sadness, Anger, Fear, Disgust, Frustration	Negative
Neutral, Surprise, Calm	Neutral

To facilitate multimodal learning, both speech audio and textual information were preprocessed before model training. First, textual utterances corresponding to speech segments were cleaned and normalized before model training. Preprocessing included lowercase conversion, whitespace normalization, removal of invalid symbols, and missing text handling. Then, a BERT-based transformer tokenization was applied to convert textual sequences into contextual embeddings suitable for deep language

representation learning. Then, speech recording samples from the benchmark datasets were standardized to maintain consistency across heterogeneous audio formats. Here, audio samples were normalized, then resampled to 16 Hz with a maximum duration of 6 seconds prior to feature extraction using padding and truncation. Next, the preprocessed audio signals were normalized and transformed into model-compatible representations before feature extraction using the Wav2Vec2Processor.

Multimodal Learning

The proposed framework employs independent feature extraction pipelines for audio and text modalities to capture emotional information. Text Feature Extraction was performed using the pretrained BERT (Bidirectional Encoder Representations from Transformers) model, specifically bert-base-uncased. After preprocessing, the tokenized text sequences were passed through the BERT encoder to generate 768-dimensional contextual embeddings as the output. Audio Feature Extraction was performed by utilizing the pretrained facebook/wav2vec2-base audio model. Following preprocessing, normalized waveform signals were provided as input to the model to learn meaningful speech representations directly from raw audio. The extracted features include pitch variation, rhythm, speech intensity, prosody, and emotional vocal cues. Similar to the textual modality, Wav2Vec2 also generated 768-dimensional feature embeddings that can be used as rich acoustic representations for multimodal fusion and emotion polarity classification.

Multimodal Fusion Strategy

After extracting modality-specific representations, multimodal fusion was performed to integrate acoustic and textual emotional information. In this study, a cross-modal attention fusion strategy was utilized

to dynamically learn relationships between audio and textual features by allowing one modality to attend to emotionally relevant information from the other modality. Compared to conventional early and late fusion methods, cross-attention enables adaptive feature interaction rather than static representation concatenation. The fused multimodal representation is then passed through fully connected classification layers to predict emotional categories.

Emotion Polarity Classification

The multimodal classifier first predicts seven Ekman emotional categories. These predictions are then mapped into three emotional polarity groups: positive, negative, and neutral. The emotional polarity classification mechanism serves as an intermediate decision-making stage for hierarchical routing. If the first stage predicts a negative emotion, then the conversation will be passed to the second stage, where a text-based mental illness prediction module is activated. But if the prediction of the first module is a positive or a neutral emotion, then to reduce unnecessary computation overhead, the interaction with the system will be terminated without further processing at the first stage.

Training and Evaluation

The proposed multimodal framework was trained using supervised learning with categorical cross-entropy loss. To address the class imbalance across emotional categories, oversampling and class weighting strategies were employed. Model optimization was performed using adaptive optimization techniques with early stopping to prevent overfitting. Performance of the trained models was evaluated using Accuracy, Weighted Average Recall (WAR), Unweighted Average Recall (UAR), Precision, Recall, and F1-score.

RESULTS

The implemented system was evaluated using a cross-modal attention fusion mechanism to classify emotional polarity into three categories: positive, negative, and neutral. Model performance was assessed using Accuracy, Precision, Recall, F1-Score, Weighted Average Recall (WAR), and Unweighted Average Recall (UAR). Table 2 summarizes the classification performance of the proposed framework.

Table 2: Performance of the cross-modal attention model

Emotion Polarity	Precision	Recall	F1-Score	Support
Negative	0.6962	0.7206	0.7082	1231
Neutral	0.7883	0.7118	0.7481	1815
Positive	0.5827	0.7107	0.6404	605
Overall Accuracy			0.7146	3651
Macro Average	0.6891	0.7144	0.6989	3651
Weighted Average	0.7232	0.7146	0.7168	3651

The experimental results demonstrate that the proposed cross-modal attention framework effectively captures emotional information from speech and textual modalities. Moreover, the UAR score suggests that the model maintains classification capability across emotional categories, which is important in imbalanced datasets. Similarly, the F1-Score demonstrates the framework’s ability to maintain a balance between precision and recall during emotion prediction.

The confusion matrix analysis demonstrates that the proposed cross-modal attention framework effectively classified the majority of emotional polarity categories, as shown in Figure 3.

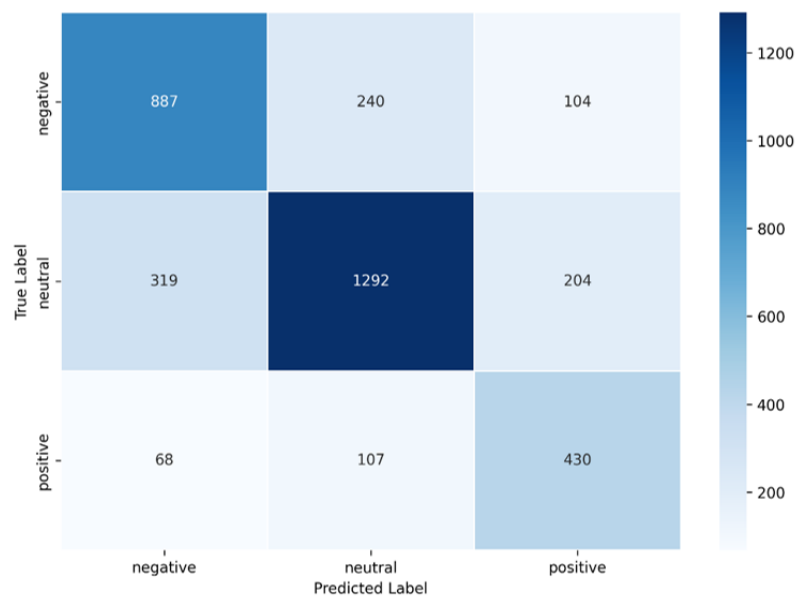


Figure 3: Confusion matrix for the cross-modal attention model

Figure 4 illustrates the normalized confusion matrix, which showcases that the proposed cross-modal attention framework achieved balanced classification performance across the three

emotional polarity categories. The model correctly classified approximately 72% of negative emotional instances, indicating strong capability in identifying emotionally vulnerable interactions in conversations.

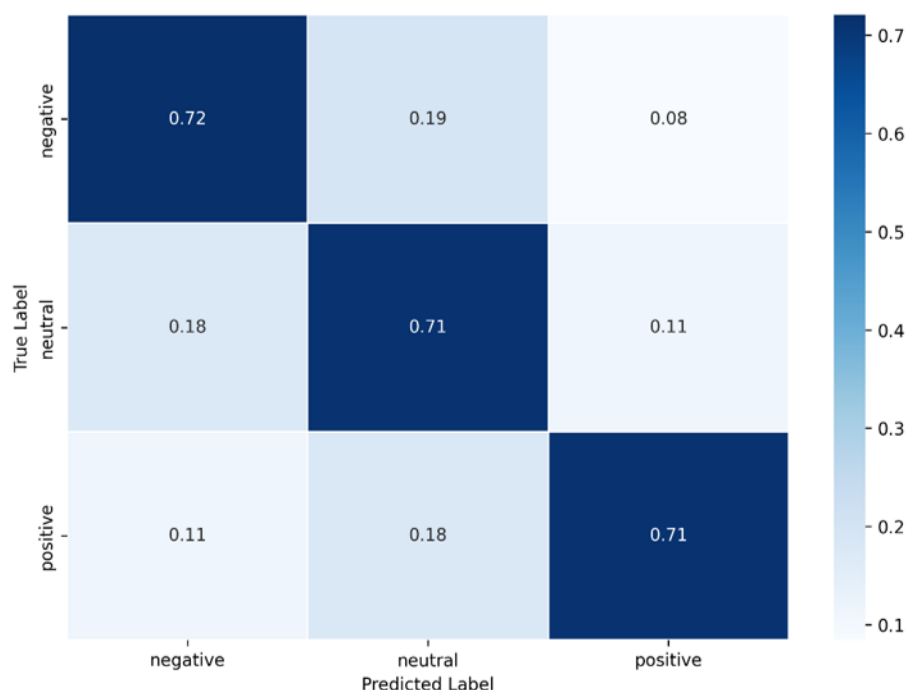


Figure 4: Normalized confusion matrix for the cross-modal attention model

The second stage of the proposed framework was designed to predict mental health conditions from conversational text after negative emotional polarity was identified in Stage 1. The list of variables used for this prediction is described in Table 3

Table 3: Variables used in stage 2 for mental illness prediction

Variable	Description
Input text	Conversational text data of identified negative samples.
Mental health label	Mental health illness associated with the conversation.
Predicted label	Mental health condition predicted by the transformer model.

Then, a transformer-based text classification model was fine-tuned using a counselling-related Reddit mental health dataset⁶ to classify seven psychological illnesses. The performance of the Stage 2 classifier was evaluated using Accuracy, Precision, Recall, and F1-Score to assess the model's ability to distinguish among mental illness categories, as shown in Table 4.

Table 4: Performance of the text-based mental illness prediction model

Mental Illness Category	Precision	Recall	F1-Score	Support
ADHD	0.8968	0.8854	0.8910	785
Anxiety	0.7719	0.8195	0.7950	698
Bipolar Disorder	0.7833	0.7427	0.7625	443
Borderline Personality Disorder (BPD)	0.7800	0.7811	0.7805	708

Depression	0.7335	0.7635	0.7482	613
None	0.9920	0.9909	0.9915	880
Obsessive–Compulsive Disorder (OCD)	0.8723	0.8723	0.8723	509
Post-Traumatic Stress Disorder (PTSD)	0.8550	0.8073	0.8305	628
Overall Accuracy			0.8435	5264
Macro Average	0.8356	0.8328	0.8339	5264
Weighted Average	0.8445	0.8435	0.8437	5264

The confusion matrix illustrated in Figure 5 and the normalized confusion matrix illustrated in Figure 6 showcase that the proposed model achieved strong classification performance across most mental illness categories. The dominant values over the diagonal prove this fact, and the “none” class exhibited the highest classification accuracy, which indicates that the model effectively differentiated mental-health-related content from non-mental-health-related content. Additionally, certain classes showed noticeable overlap, for instance, depression and anxiety-related disorders. Also, the number of BPD, anxiety, bipolar, and PTSD samples was misclassified as depression. However, the model maintained high overall performance with an accuracy of 84.35%, indicating that the proposed text-based model effectively learns contextual linguistic patterns associated with different psychological conditions.

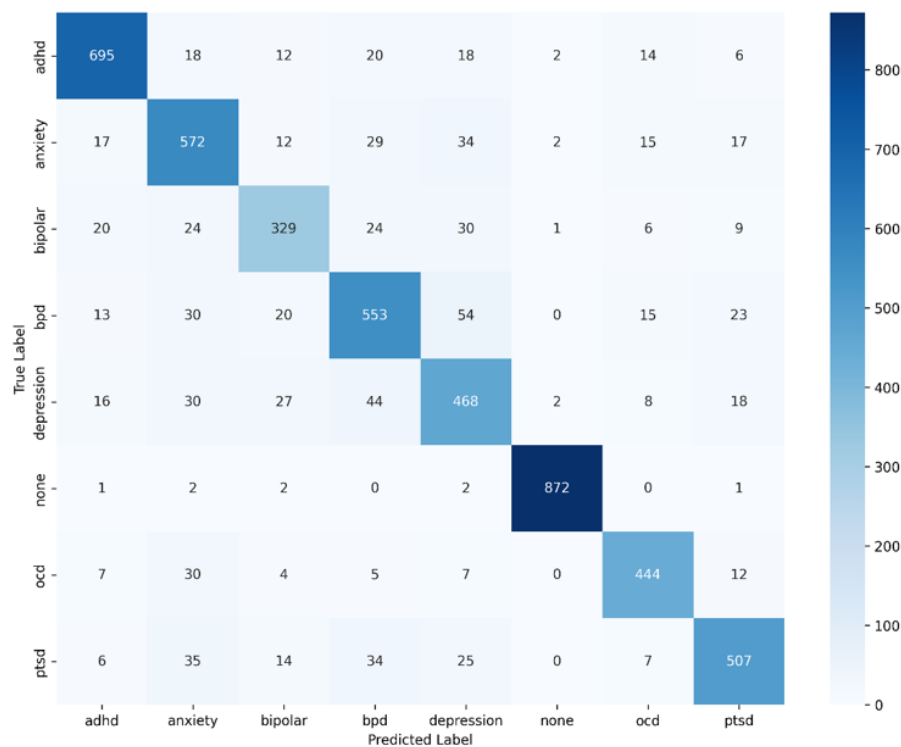


Figure 5: Confusion matrix for the text-based classification model



Figure 6: Normalized confusion matrix for the text-based classification model

Figure 7 illustrates the multi-class Receiver Operating Characteristic (ROC) curves for mental illnesses classification, which evaluates how well the model separates each health class from all other classes.

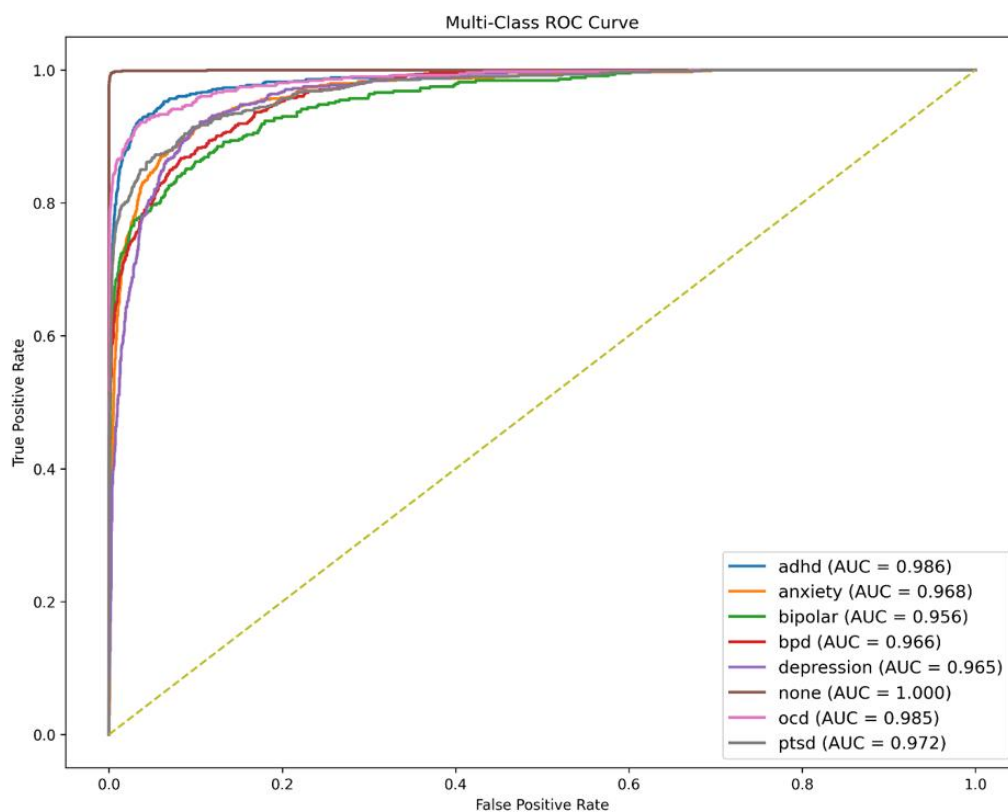


Figure 7: ROC curves for mental illnesses classification

According to the above curves, all classes have achieved AUC (area under the curve) values above 0.95, each with a curve closer to the top-left corner, which indicates excellent classification performance. The “none” class achieves an AUC of 1.000, suggesting that the model can almost perfectly distinguish non-mental-illness posts from mental illness categories. Similarly, ADHD (AUC = 0.986) and OCD (AUC = 0.985) achieved near-perfect discrimination. Although Bipolar disorder recorded the lowest AUC value (0.956), it still reflects excellent classification capability. Overall, the ROC analysis confirms that the proposed DistilBERT-based framework effectively learns class-specific textual patterns and provides highly accurate predictions.

DISCUSSION

This study proposed a hierarchical multimodal framework for emotion-aware mental health assessment by integrating multimodal emotion recognition with text-based mental illness prediction. The proposed framework consists of two sequential stages. The primary objective of the first stage is to identify emotionally vulnerable conversations, as processing all conversations directly for mental illness prediction may introduce unnecessary computational complexity. So, speech audio and textual information were fused through a cross-modal attention mechanism to classify emotional polarity into three categories: negative, neutral, and positive. In the second stage, conversations identified as emotionally vulnerable through negative emotional polarity were forwarded to a transformer-based text classification model for mental illness prediction. Here, emotional polarity serves as an important indicator of an individual's psychological state, as negative emotions such as sadness, fear, anger, disgust and frustration are frequently associated with mental health concerns.

The experimental findings demonstrate the effectiveness of the proposed framework for multimodal emotional understanding and psychological assessment. The stage 1 multimodal emotion polarity classifier achieved an overall accuracy of 71.46%, and the stage 2 mental illness prediction framework achieved an overall accuracy of 84.31%. These results indicate that effective integration of different modalities using transformer-based encoder architectures is effective in capturing complex emotional or mental states.

By selectively routing only emotionally vulnerable interactions to the mental illness prediction stage, this framework reduces unnecessary computational complexity while improving screening efficiency. Additionally, the integration of multimodal cues for emotional understanding is proving more comprehensive approach than the unimodal mechanisms.

Despite those advantages, several limitations remain in the proposed system. The emotion recognition stage relies on benchmark emotional datasets that may not fully reflect real-world psychological interactions, while the mental illness prediction stage is totally dependent on counseling-based textual datasets that represent only a subgroup of individuals. So, it might be challenging to generalize the findings of the proposed framework into the real world, especially when some psychological conditions overlap.

Future work will focus on improving the validity of the system through the use of real-world counseling conversations and clinical datasets. Also, the incorporation of facial expressions and physiological signals can be used to enhance the classification accuracy of the framework for effective psychological screening and intervention.

CONCLUSION

The proposed framework introduces a hierarchical routing mechanism that selectively activates mental illness prediction only when negative emotional polarity is detected. Rather than allocating computer processing power to psychologically analyze every conversation, the framework first performs emotional screening to identify vulnerable interactions. The main scientific basis behind triggering secondary analysis is supported by psychological evidence indicating that mental health disorders are frequently associated with negative emotions such as sadness, anger, fear, disgust, and frustration.

The findings of this study emphasize the importance of multimodal emotional understanding for mental health care applications. The integration of speech and textual modalities using novel cross-modal attention mechanisms improves emotional recognition capability compared to unimodal systems by enabling the models to understand complex emotional cues.

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ANALYSIS OF INTERNALLY DISPLACED PERSONS (IDPS) SITUATION AND SURAKSHA CAMPS ESTABLISHED IN – MATALE DISTRICT AFTER THE DITHWAH AND LANDSLIDES IN NOVEMBER 2025

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ABSTRACT

The severe rainfall that affected the Matale District in November 2025 resulted in devastating landslides that displaced numerous families, forcing them into temporary camps established at several locations throughout the district. The sudden displacement created an urgent need for organized healthcare support to address the immediate medical needs of internally displaced persons (IDPs) living under vulnerable conditions. In response, a coordinated health service delivery system was implemented to ensure the uninterrupted distribution of essential medicines and medical supplies to all identified camps. The timely provision of these resources played a critical role in maintaining continuity of care and preventing further deterioration of health among the displaced population. By ensuring access to treatment for acute illnesses, chronic disease management, maternal and child health services, and emergency medical needs, the intervention reduced the physical and emotional burden experienced by affected communities during a period of considerable uncertainty. Beyond meeting immediate healthcare demands, these efforts contributed to the stabilization of health conditions within the camps and minimized the risk of secondary public health complications. This experience highlights the importance of rapid, well-coordinated healthcare interventions in humanitarian emergencies and demonstrates how compassionate, responsive medical support can preserve dignity and improve resilience among populations affected by natural disasters.

Keywords: internally displaced persons (IDPs); non-communicable diseases (NCD); morbidity profile.

INTRODUCTION

Internally Displaced Persons (IDPs) are currently residing temporarily in camps established across multiple locations within the Matale District. These displacements were caused by catastrophic landslides triggered by the severe rainfall experienced in November 2025.

Essential medicines and medical supplies have been systematically distributed to all IDP camps to ensure timely access for those in need. Continuous provision of essential healthcare services has significantly reduced the hardships faced by the affected communities during this challenging period.

Further, these coordinated interventions have helped stabilize health conditions and mitigate immediate risks among the affected population.

GENERAL OBJECTIVE

To explore the distribution of Suraksha (IDP) camps to make sure the fair allocation of resources.

SPECIFIC OBJECTIVES

- 1) To identify the number of people displaced in each Medical Officer of Health (MOH) Area.
- 2) To identify the Gender Distribution among the people
- 3) To identify the Under 5 children distribution
- 4) To identify the people suffering with non-communicable diseases.
- 5) To identify the Missing or died people

METHODOLOGY

A Group consisting the researcher, Regional Epidemiologist, Medical officer non-communicable diseases (NCD), Medical Officer Mental Health (MH), Registered Medical Officer, Divisional pharmacist and a development officer used to visit all the Suraksha (IDP) camps established within the Matale district and collect daily situation of each and every camp using a pre designed Excel sheet within the month of December 2025. Collected data sheets were analyzed accordingly.

Table 1: Occupancy of IDP camps

MOH AREA	NO. OF CAMP SITES	NO. OF FAMILIES	TOTAL NO. OF PEOPLE	NO. OF DEATHS	NO. OF MISSING
ABANGANGAKORALE	4	108	292	0	0
RATTOTA	10	265	803	0	0
UKUWELA	12	58	150	0	0
YATAWATTE	2	32	86	0	0
NAULA	2	41	114	0	0
PALLEPOLA	2	23	68	7	0
MATALE	3	0	140	4	1
MATALE MC	1	27	82	0	0
GALEWELA	1	22	64	0	0
LAGGALA	5	81	562	1	0
DAMBULLA	2	15	58	0	0
TOTAL	44	672	2419	12	1

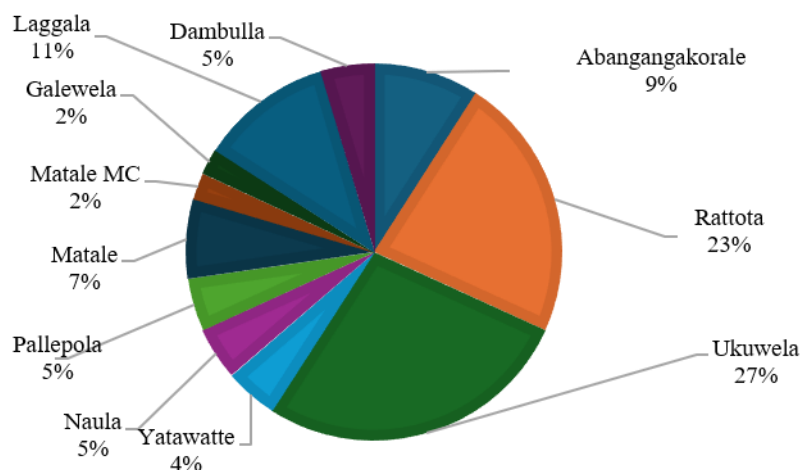


Figure 1: Distribution of number of camp sites.

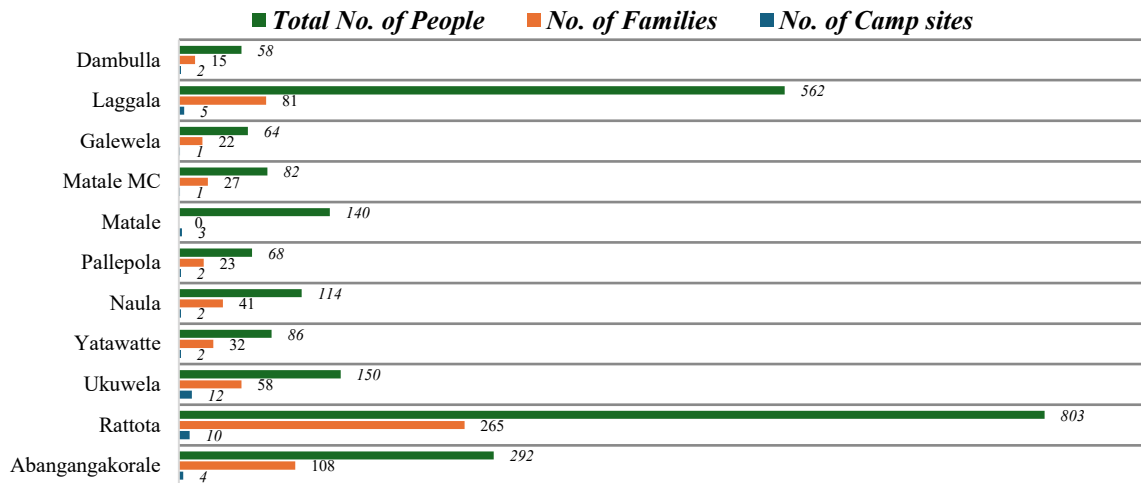


Figure 2: Distribution of Internally Displaced People at Various IDP Camps

MOH AREA	NO. OF CAMP SITES	NO. OF MALE	NO. OF FEMALE
ABANGANGAKORALE	4	149	143
RATTOTA	10	373	430
UKUWELA	12	86	64
YATAWATTE	2	37	49
NAULA	2	59	53
PALLEPOLA	2	38	30
MATALE	3	0	0
MATALE MC	1	41	41
GALEWELA	1	30	34
LAGGALA	5	80	77
DAMBULLA	2	0	0
TOTAL	44	893	921

Table 2: Male and female distribution among IDP camps

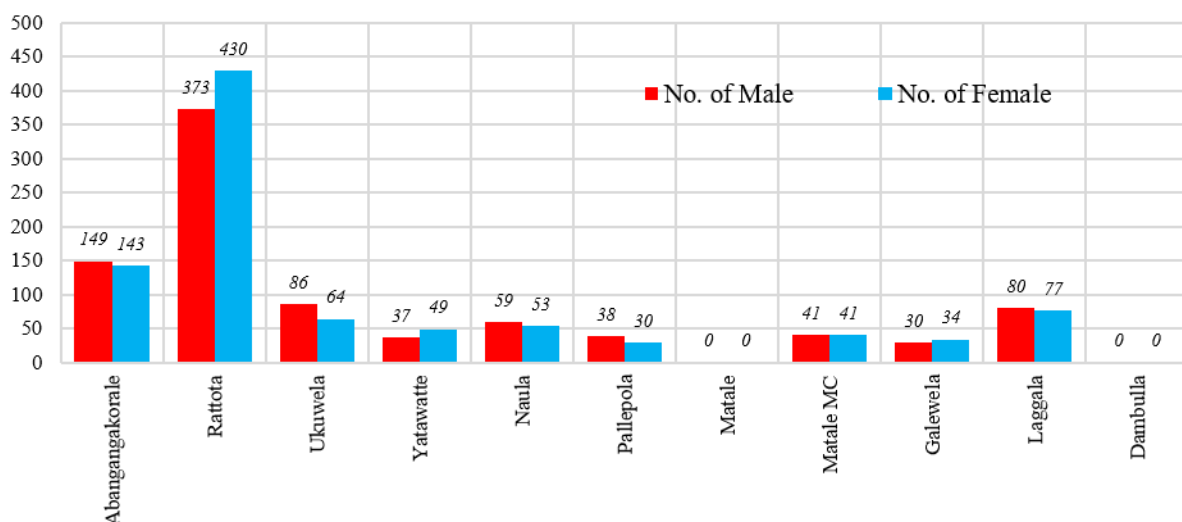


Figure 3: Number of Males and Females in IDP Camps

RESULTS

According to table 1, it is observed the occupancy of IDP camps and the health status of the displaced population. Figure 1 shows distribution of number of camp sites. The under mentioned analysis summarizes the demographic distribution, camp occupancy, and prevailing health conditions of displaced communities to support evidence-based planning and resource allocation.

KEY OBSERVATIONS

- A total of 2,419 individuals from 672 families were accommodated in 44 IDP camps across the district.
- 12 deaths and 1 missing person have been reported following the disaster.
- The displaced population includes 11 infants, 107 children under five, and 196 school-aged children (5–16 years), indicating the need for sustained maternal and child health services.
- 28 individuals have diabetes, with 3 dependents on insulin, while 133 persons require regular medication for non-communicable diseases (NCDs).
- Only one person has been identified with a mental health disorder and is receiving psychiatric medication, though continued psychosocial assessment is recommended.

TOTAL DISPLACED POPULATION, FAMILIES, AND CAMPS

As of the latest assessment, 2,419 individuals from 672 families are residing in 44 IDP camp sites across the district.

The presence of multiple camps indicates a geographically dispersed displacement pattern, requiring sustained logistical coordination to maintain equitable service delivery. Additionally, 12 deaths and one missing person have been reported in relation to the disaster, underscoring the

severity of the event and the continued need for humanitarian support.

CAMP SITES RELATIVE TO POPULATION

The district situation as at 31st December 2025 was 44 camps serving 2,419 people, representing approximately 1.8 camp sites per 100 displaced persons. On average, each camp accommodates about 55 individuals, suggesting that most camps are relatively small. While smaller camps may facilitate to reduce overcrowding and to mitigate the communicable disease risk, they can also create operational challenges by increasing the demand for distributed medical teams, supply chains, and monitoring mechanisms. Continued coordination is essential to ensure uniform standards of care across all locations.

MALE–FEMALE DISTRIBUTION

Among the displaced population, 893 males (36.9%) and 921 females (38.1%) have been reported. Females slightly outnumber males within the documented data, indicating the importance of maintaining gender-sensitive services, including maternal healthcare, protection services, and reproductive health support.

A portion of the population is not disaggregated by sex in the available records, highlighting a need for improved data completeness to enhance demographic analysis and targeted interventions.

AGE DISTRIBUTION AND CHILD VULNERABILITY

The displaced population includes:

- 11 infants (<1 year)
- 107 children under five years (4.4%)
- 196 children aged 5–16 years (8.1%)

This distribution reflects the presence of a significant number of vulnerable children requiring prioritized healthcare, nutrition

monitoring, vaccination coverage, and child protection services. The relatively higher number of school-aged children suggests the importance of establishing temporary

educational and psychosocial support programs to minimize long-term social disruption.

MOH Area	No. of Camp sites	No. of Infants <1yrs	No. of Under 5 Years	No. 5-16 yrs	No. Pregnant Women
Abangangakorale	4	6	16	86	0
Rattota	10	0	61	0	4
Ukuwela	12	0	8	30	1
Yatawatte	2	0	1	22	0
Naula	2	2	11	23	0
Pallepola	2	2	4	0	0
Matale	3	0	0	0	0
Matale MC	1	1	4	0	0
Galewela	1	0	2	8	1
Laggala	5	0	0	27	0
Dambulla	2	0	0	0	0
Total	44	11	107	196	6

Table 3: Age Distribution and Child Vulnerability in IDP camps

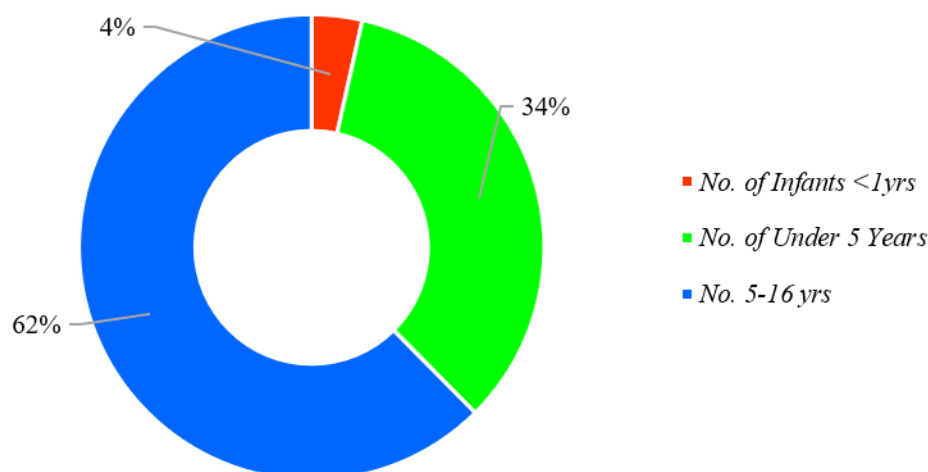


Figure 4: Number of Children in IDP Camps

MORBIDITY PROFILE AND ONGOING MEDICAL TREATMENT

Current health data indicate a notable burden of non-communicable diseases (NCDs) within the displaced population:

- 28 individuals diagnosed with diabetes, including 3 dependents on insulin
- 133 persons requiring regular monthly medication for chronic NCDs
- 1 individual diagnosed with a mental health disorder and receiving psychiatric medication
- No reported cases of chronic kidney disease (CKD)
- The continued provision of routine medications has been critical in preventing complications and avoiding secondary health

emergencies. The relatively low number of identified mental health cases may reflect under-detection rather than true prevalence; therefore, expanded psychosocial

screening is recommended, particularly given the trauma associated with sudden displacement.

Table 4: Morbidity Profile and the health status of the displaced population in IDP camps

MOH Area	No. of Camp sites	Total No. of People	No. of Persons already diagnosed with Mental Disorders	No. of Persons Receiving Routine Psychiatric Drugs	No. with CKD	No. of Diabetes Patients	Out of persons with diabetes, No. on Insulin	No. of patients on monthly NCD medications
Abangankorale	4	292	0	0	0	2	0	13
Rattota	10	803	0	0	0	4	2	32
Ukuwela	12	150	0	0	0	18	1	50
Yatawatte	2	86	0	0	0	2	0	0
Naula	2	114	0	0	0	0	0	21
Pallepola	2	68	0	0	0	2	0	7
Matale	3	140	0	0	0	0	0	0
Matale MC	1	82	0	0	0	0	0	5
Galewela	1	64	1	1	0	0	0	5
Laggala	5	562	0	0	0	0	0	0
Dambulla	2	58	0	0	0	0	0	0
Total	44	2419	1	1	0	28	3	133

Patients having menatal and physical disorders/ailments

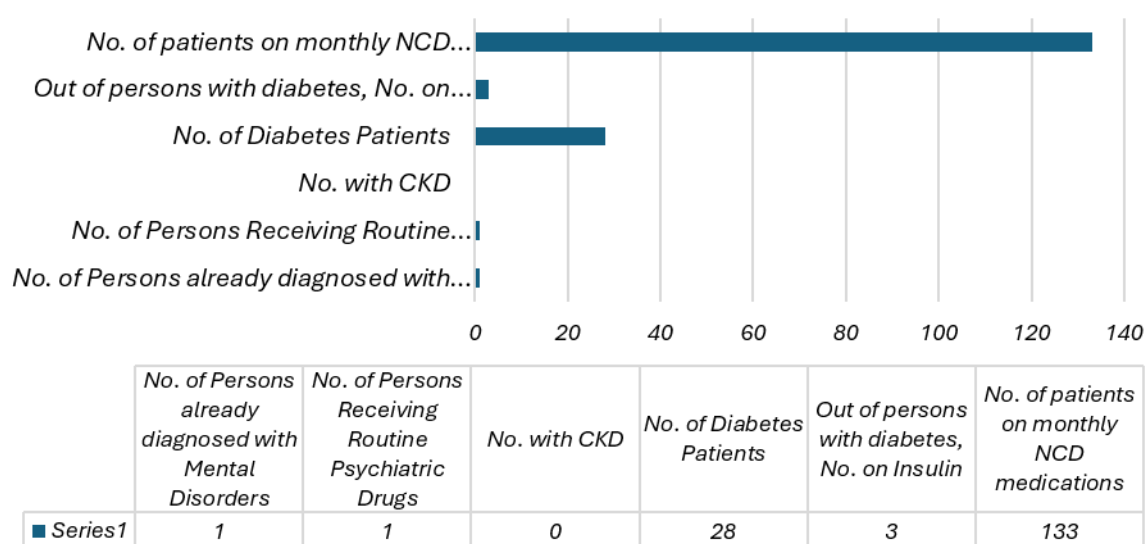


Figure 5: Patients having mental and physical disorders/ailments

Conclusion and Recommendations

The Matale District displacement response demonstrates effective early health-sector

coordination, particularly in the uninterrupted supply of essential medicines. However, the dispersed camp structure, presence of vulnerable age

groups, and ongoing need for chronic disease management emphasize the importance of sustained public health surveillance, mobile medical outreach, and strengthened data reporting systems.

Maintaining preventive services, maternal and child healthcare, mental health support, and NCD management should remain operational priorities as recovery efforts progress.

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INSTITUTIONAL COORDINATION AND EXPORT COMPETITIVENESS IN THE SRI LANKAN TEA INDUSTRY

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ABSTRACT

This study examines the association between institutional coordination and export competitiveness in the Sri Lankan tea industry. Using a mixed-methods approach (survey n=87, interviews n=22, secondary data 2013–2022), the study identifies a significant “coordination gap” across institutional actors. Findings reveal low mean institutional coordination (2.39/5), a difference in perceived effectiveness between private (3.75) and public (2.67) institutions of 1.08 on a 5 point scale. However, this difference was not statistically significant at $p < 0.05$ ($p = 0.091$), partly due to low statistical power (post hoc power = 0.52). Stakeholder experience varied significantly across institutional roles ($p = 0.002$). A descriptive, hypothesis generating trend analysis of secondary data (2013–2022) suggests that export earnings may be more closely associated with auction price than with production volume; this finding requires validation with larger samples. The study concludes that institutional fragmentation is associated with constrained innovation diffusion and may trap the industry in a commodity dependent export structure. Strengthening coordination mechanisms is essential for enhancing value chain upgrading and long term competitiveness.

Keywords: Institutional coordination, export competitiveness, tea industry, value chain upgrading, Sri Lanka

INTRODUCTION

The Sri Lankan tea industry remains one of the country's most important export sectors, contributing significantly to foreign exchange earnings and rural livelihoods. However, despite its strong historical positioning, the industry has experienced stagnation in productivity growth and declining relative competitiveness in global markets. Conventional explanations attribute this decline to factors such as rising production costs, labor shortages, and volatile global tea prices, yet these explanations fail to adequately capture the systemic governance issues that shape industry performance. Recent evidence suggests that institutional fragmentation, characterized by weak coordination among regulators, producers, brokers, and research institutions, has become a critical constraint on innovation adoption and value-chain upgrading. Consequently, this study argues

that export competitiveness is not solely a function of production efficiency but is deeply influenced by the effectiveness of institutional coordination mechanisms.

Research gap: Despite extensive theoretical work on institutional coordination and collective efficiency, no empirical study has quantitatively measured the relationship between institutional coordination scores and export performance in the Sri Lankan tea industry. The specific mechanisms through which public-private institutional fragmentation affects value-chain upgrading remain unexplored. This study directly addresses this gap by providing empirical evidence from Sri Lanka's tea sector.

LITERATURE REVIEW

Institutional theory emphasizes that economic outcomes are shaped by formal and informal structures governing organizational behavior (North, 1990; Scott,

2014). In sectoral systems, coordination among institutions plays a key role in reducing transaction costs and enabling collective efficiency (Williamson, 2000; Schmitz, 1995). In emerging economies, institutional voids often lead to fragmented governance systems where overlapping mandates reduce strategic alignment (Khanna & Palepu, 1997), and this fragmentation limits innovation diffusion and weakens value-chain integration. The concept of collective efficiency highlights that competitiveness depends not only on firm-level capabilities but also on inter-organizational coordination (Humphrey & Schmitz, 2002). Similarly, institutional complementarities suggest that governance structures, resource allocation, and stability must operate in alignment to produce systemic performance gains (Hall & Soskice, 2001). Despite these theoretical advances, empirical evidence linking institutional coordination directly to export performance in traditional commodity sectors remains limited, and this study addresses that gap using empirical evidence from Sri Lanka's tea industry.

METHODOLOGY

The study adopts a convergent parallel mixed-methods design, integrating quantitative statistical analysis with qualitative thematic interpretation. Figure 1 illustrates the research framework.

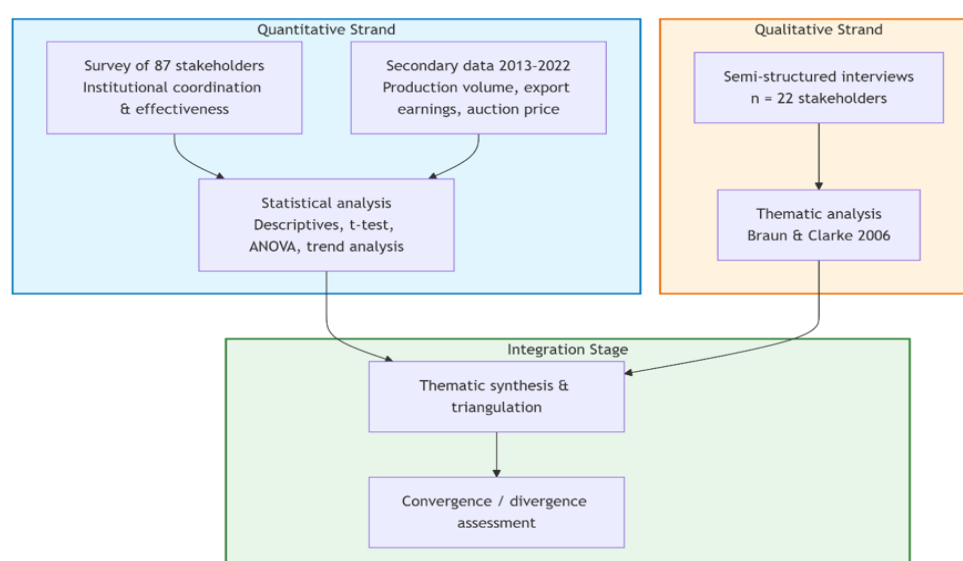


Figure 01 – Mixed Methods Research Framework

RESEARCH QUESTION

This study is guided by the following research question: How does institutional coordination influence export competitiveness in the Sri Lankan tea industry?

OBJECTIVES

The specific objectives of this study are:

- 1) To assess the level of institutional coordination within the Sri Lankan tea industry.
- 2) To examine differences in perceived effectiveness between public and private institutions.
- 3) To analyze the relationship between institutional factors and export performance.
- 4) To identify the structural “coordination gap” affecting value-chain upgrading.
- 5) To explore the relative association of auction price versus production volume with export earnings (hypothesis-generating).

Figure 1 presents the convergent parallel mixed methods design adopted in this study. In this design, quantitative and qualitative data are collected simultaneously, analyzed separately, and then integrated during the interpretation stage. The quantitative strand comprises two data sources. First, a structured survey administered to 87 stakeholders from five institutional categories (public regulators, tea brokers and auctioneers, producer associations, export firms, and research and extension personnel) measured institutional coordination via a five item composite index (Cronbach's $\alpha = 0.81$), perceived institutional effectiveness on a five point scale, and institution type (public versus private). Second, secondary annual data from 2013 to 2022 were obtained from the Sri Lanka Tea Board and Forbes & Walker Tea Brokers, including tea production volume (million kg), export earnings (USD million), and Colombo auction price (USD/kg). These quantitative data were analyzed using descriptive statistics, an independent samples t test comparing public and private institutional effectiveness (with post hoc power analysis), a one way ANOVA examining variation in stakeholder experience across institutional roles, and a descriptive trend analysis of the ten year secondary data. No inferential regression was performed due to the small sample size ($N=10$), and all quantitative findings are interpreted as hypothesis generating rather than conclusive.

In parallel, the qualitative strand involved semi structured interviews with 22 stakeholders purposively selected from the survey sample to ensure maximum variation in roles, experience levels, and geographic regions. Each interview lasted between 45 and 75 minutes and explored perceptions of coordination challenges, innovation diffusion barriers, and value chain upgrading constraints. The interview transcripts were analyzed using thematic analysis following Braun and Clarke's (2006) six phase framework. Two researchers independently coded the first five transcripts, achieving

substantial inter coder reliability ($\kappa = 0.84$), with discrepancies resolved through discussion. The analysis generated five primary themes: fragmented communication across institutions (endorsed by 86% of interviews), overlapping mandates or unclear responsibilities (77%), research to field transfer failure (73%), perceived greater effectiveness of private sector coordination (68%), and absence of any formal coordination mechanism (64%).

The two strands were integrated at the interpretation stage using thematic synthesis and triangulation. The integration aimed to identify convergence (where quantitative and qualitative findings agree) and divergence (where they disagree or complement each other). Strong convergence was observed: the low quantitative coordination score (mean = 2.39/5) aligned with 86% of interview participants describing fragmented communication, and the Coordination Gap Index of 0.522 (indicating 52.2% of potential coordination capacity unrealised) was directly explained by qualitative reports of research to field transfer failure. A soft divergence was noted regarding the private sector's perceived advantage: while qualitative data suggested a strong private sector advantage (68% endorsement), the t test comparing public (mean = 2.67) and private (mean = 3.75) effectiveness ratings was not statistically significant at $p < 0.05$ ($p = 0.091$), likely due to the small public subsample ($n = 29$) limiting statistical power (post hoc power = 0.52). Additionally, qualitative insights uncovered informal coordination barriers, such as personal rivalries and historical mistrust, that were not captured by the quantitative index. Thus, Figure 1 illustrates how the concurrent collection and subsequent integration of quantitative and qualitative evidence provided a more complete and triangulated understanding of institutional fragmentation in the Sri Lankan tea industry than either method alone could achieve.

Variables and Measurement

Variable	Measurement	Scale/Source
Institutional Coordination Score	Composite index of five Likert-scale items (1=very weak to 5=very strong): cross-institutional communication, joint planning, role clarity, information sharing, conflict resolution (Cronbach's $\alpha = 0.81$)	Primary survey
Institutional Effectiveness	Perceived effectiveness of respondent's primary institution (1=very ineffective to 5=very effective)	Primary survey
Institution Type	Binary: Public regulator (Sri Lanka Tea Board, Tea Research Institute, Plantation Ministry) vs. Private/Industry body (Colombo Tea Auction, Tea Exporters Association, broker firms, producer associations)	Primary survey
Production Volume	Annual tea production (million kg)	Secondary (Sri Lanka Tea Board)
Export Earnings	Annual tea export revenue (USD million)	Secondary (Sri Lanka Tea Board)
Auction Price	Annual average Colombo Auction price (USD/kg)	Secondary (Forbes & Walker)

Data Sources

Primary data: An institutional survey was administered to 87 stakeholders representing five institutional categories: public regulators (n=18), tea brokers and auctioneers (n=12), producer associations (n=24), export firms (n=22), and research and extension personnel (n=11). The sample was drawn using stratified purposive sampling to ensure representation across all institutional actor types in the Sri Lankan tea value chain. The survey was conducted between January and March 2023. The response rate was 77.7% (87 of 112 invited participants). All respondents held positions with a minimum of five years of industry experience.

Secondary data: Industry performance indicators (production volume, export earnings, Colombo Tea Auction price index) were obtained from the Sri Lanka Tea Board and Forbes & Walker Tea Brokers for the period 2013–2022 (10-year annual data).

Qualitative Component

Semi-structured interviews were conducted with 22 stakeholders selected purposively from the survey sample to ensure maximum variation across institutional roles, experience levels, and geographic regions. Each interview lasted between 45 and 75 minutes. Interviews explored perceptions of coordination challenges, innovation diffusion barriers, and value-chain upgrading constraints. Thematic analysis followed Braun and Clarke's (2006) six-phase framework: familiarization, initial coding, theme generation, theme review, theme definition, and write-up. Two researchers independently coded the first five transcripts (inter-coder reliability $\kappa = 0.84$), with discrepancies resolved through discussion.

Reflexivity statement: The lead author previously collaborated with the Sri Lanka Tea Board on non-research projects but held no operational role in the tea industry. This prior engagement facilitated access but also carries a risk of desensitization to institutional problems. To mitigate this, the analysis emphasized verbatim stakeholder

accounts and involved a second coder with no prior industry contact.

Analytical Methods

- 1) Descriptive statistics (means, standard deviations) for coordination scores and effectiveness.
- 2) Independent samples t-test comparing public vs. private institutional effectiveness, with post-hoc power analysis.
- 3) One-way ANOVA examining variation in stakeholder experience (years in sector) across the five institutional categories.
- 4) Trend analysis (descriptive only) of export earnings against production volume and auction price using time-series plots and correlation, given N=10 annual observations. No regression is performed due to severe underpowering.
- 5) Thematic synthesis of qualitative interview data.

Coordination Gap Index (CGI)

The Coordination Gap Index was calculated as:

$CGI = 1 - (\text{Actual Coordination Score} / \text{Maximum Possible Coordination Score})$
Where Actual Coordination Score is the mean institutional coordination score (2.39) and Maximum Possible Score is 5.0.

Thus: $CGI = 1 - (2.39 / 5.00) = 1 - 0.478 = 0.522$.

The CGI of 0.522 indicates that 52.2% of potential institutional coordination capacity remains unrealized. In the absence of established sectoral benchmarks, a CGI exceeding 0.5 is interpreted heuristically as “moderate-to-severe.”

The CGI of 0.522 indicates that 52.2% of the distance from the observed coordination score (2.39) to the maximum possible score (5.0) remains. It is important to note that a maximum score of 5.0 (perfect coordination) may not be feasible or even desirable in practice; therefore, the CGI is best interpreted as a descriptive heuristic rather than a validated benchmark. In the absence of established sectoral norms, a CGI exceeding 0.5 is provisionally labelled “moderate to severe” for illustrative purposes only. No policy decision should be based solely on this index.

RESULTS

Descriptive Statistics

Variable	Mean	SD	Min	Max	N
Institutional Coordination Score (1-5)	2.39	0.67	1.2	3.8	87
Institutional Effectiveness (1-5) – Overall	3.10	0.89	1.0	5.0	87
Institutional Effectiveness – Private/Industry	3.75	0.71	2.5	5.0	58
Institutional Effectiveness – Public	2.67	0.82	1.0	4.0	29
Production Volume (million kg, 10-year avg)	264.5	18.3	242.0	298.0	10
Export Earnings (USD million, 10-year avg)	848.3	112.4	712.0	1,032.0	10
Auction Price (USD/kg, 10-year avg)	3.21	0.52	2.65	4.10	10

Interpretation: The institutional coordination score of 2.39/5 indicates weak coordination across the sector. The effectiveness difference between private (3.75) and public (2.67) institutions is substantial in magnitude (difference = 1.08 on a 5-point scale), representing a 40% higher perceived effectiveness in private/industry bodies.

T-Test: Public vs. Private Institutional Effectiveness

Group	n	Mean	SD	t	df	p (two-tailed)	Cohen's d
Public	29	2.67	0.82	-1.71	85	0.091	0.42
Private/Industry	58	3.75	0.71				

Interpretation: The observed difference in mean effectiveness ratings (1.08 on a 5 point scale) was not statistically significant at $\alpha = 0.05$ ($p = 0.091$). The moderate effect size (Cohen's $d = 0.42$) suggests that a meaningful difference could exist, but the current study does not have sufficient evidence to reject the null hypothesis. Post hoc power analysis indicated achieved power of only 0.52, meaning the study had a 48% chance of missing a true difference of this magnitude. To detect the same effect with 80% power, a total sample of approximately 130 would be required. Therefore, the non significant result should not be interpreted as evidence of no difference; rather, the question remains unresolved and requires larger sample replication.

ANOVA: Stakeholder Experience Across Institutional Roles

Stakeholder experience measured as years of employment in the tea sector.

Source	SS	df	MS	F	p	η^2
Between groups	3,245.6	4	811.4	4.82	0.002	0.19
Within groups	13,802.4	82	168.3			
Total	17,048.0	86				

Post-hoc comparisons (Tukey HSD): Brokers/auctioneers (mean = 22.3 years) and association representatives (mean = 19.7 years) had significantly more experience than research/extension personnel (mean = 9.4 years) and public regulators (mean = 11.2 years), $p < 0.05$.

Note: While statistically significant, this finding is not directly central to the research question on coordination. It is reported to highlight potential asymmetries in institutional memory and expertise that may affect coordination dynamics. Future research should examine whether experience disparity mediates coordination effectiveness.

Descriptive Trend Exploration (Hypothesis Generating Only)

Critical limitation: Only 10 annual observations (2013–2022) are available. No inferential statistics (regression, correlation) are reported because with $N=10$, any coefficient would be highly unstable. The following visual description serves only to generate hypotheses for future research; it does not support any causal or generalizable claim.

Over the 2013–2022 period:

- 1) Export earnings ranged from USD 712 million to USD 1,032 million.
- 2) Auction price ranged from USD 2.65/kg to USD 4.10/kg.
- 3) Production volume ranged from 242 million kg to 298 million kg.

A visual inspection of time series plots (not shown for brevity) suggests that years with higher auction prices (e.g., 2020: USD 4.10/kg) tended to coincide with higher export earnings (exceeding USD 1,000 million), even when production volume remained stable. Conversely, 2015

2017 showed lower prices (≈USD 2.80 3.00/kg) and lower earnings (≈USD 750 800 million) with similar production levels.

Interpretation (hypothesis generating only): This descriptive pattern is consistent with a possible hypothesis that export competitiveness may be more price driven (i.e., quality dependent) than volume driven. However, no statistical test has been applied, and no causal claim is made. This hypothesis must be tested using monthly or quarterly data, or a longer annual time series (≥ 20 years), before any conclusion can be drawn. Readers are strongly cautioned against using these descriptive trends for policy or strategic decisions.

Qualitative Thematic Analysis

Semi-structured interviews (n=22) were analyzed thematically. The table below reports theme frequencies and representative quotations.

Theme	Frequency (n)	Percentage of interviews	Representative quotation
Fragmented communication across institutions	19	86%	“The left hand doesn’t know what the right hand is doing. Tea Board doesn’t talk to Research Institute regularly.”
Overlapping mandates / unclear responsibilities	17	77%	“Three different agencies claim responsibility for smallholder extension, so in practice, no one does it effectively.”
Research-to-field transfer failure	16	73%	“We have excellent research findings sitting on shelves. They never reach smallholders.”
Private sector coordination perceived as more effective	15	68%	“The auction system works smoothly because brokers and buyers have daily interaction. Policy coordination? That’s a different story.”
Absence of formal coordination mechanism	14	64%	“There is no permanent forum where all key institutions sit together regularly.”

Inter-coder reliability: $\kappa = 0.84$ (substantial agreement)

Interpretation: The high consensus across stakeholder groups (theme endorsement ranging from 64% to 86%) indicates that stakeholders uniformly perceive institutional fragmentation as a central problem, regardless of their institutional affiliation

Integration of Quantitative and Qualitative Findings

Quantitative Finding	Qualitative Finding	Convergence / Divergence
Coordination score = 2.39/5 (low)	Fragmented communication endorsed by 86% of interviews	Convergence: Both indicate systemic fragmentation.
Private effectiveness mean = 3.75, public = 2.67 (p = 0.091, not significant)	68% perceive private sector coordination as more effective	Soft divergence: Qualitative suggests stronger private advantage than quantitative confirms statistically, likely due to low power (n=29 public).
CGI = 0.522	Research-to-field transfer failure (73%) provides mechanism	Convergence: Qualitative explains why coordination gap matters.
Experience varies across roles (p=0.002)	No direct qualitative theme on experience asymmetry	Qualitative supplement: Interviews did not spontaneously raise this, but post-hoc analysis suggests possible coordination asymmetry.

Additional qualitative insight: Interviews highlighted informal coordination barriers (e.g., personal rivalries, historical mistrust) not captured by the quantitative index. The integrated findings are summarised in the Discussion that follows; no separate results summary section is provided to avoid redundancy.

DISCUSSION

The findings demonstrate that institutional coordination is associated with perceptions of export competitiveness in the Sri Lankan tea industry. The observed coordination gap (CGI = 0.522) is associated with stakeholder reports of constrained innovation diffusion – particularly from research institutions to smallholders (identified by 73% of interview participants). The descriptive trend observation (hypothesis-generating only) that auction price shows a stronger association with export earnings than production volume is consistent with the idea that competitiveness may be increasingly linked to quality differentiation and branding rather than production expansion. However, given the very small sample (N=10), this result should not be interpreted as evidence; it merely suggests a

hypothesis for future testing. Institutional fragmentation is likely to correlate with the industry's ability to systematically upgrade quality, but causal direction cannot be determined from this cross-sectional study.

These findings align with institutional theory, especially Williamson's (2000) argument that coordination failures increase transaction costs, and Schmitz's (1995) collective efficiency framework. This study extends these theories by empirically quantifying the coordination gap in a sectoral context. However, causal claims must be avoided entirely given the cross-sectional design. Alternative explanations that could independently influence export competitiveness include: global demand shifts toward higher-quality teas (beyond industry control), climate variability affecting yield consistency, and rising labor costs that reduce profitability regardless of coordination quality. These factors should be examined in future longitudinal research.

CONCLUSION

This study demonstrates that institutional coordination is associated with perceptions

of export competitiveness in the Sri Lankan tea industry. The presence of a coordination gap ($CGI = 0.522$) is associated with constrained innovation adoption as reported by stakeholders and may be associated with continued dependence on commodity-based pricing mechanisms. The hypothesis-generating descriptive finding that export earnings are potentially more price-associated than volume-associated underscores the need for quality upgrading strategies – but this finding requires validation. Without strengthened coordination between public research institutions, extension services, and producer organizations, quality improvements will likely remain unevenly distributed. Therefore, strengthening institutional alignment across public and private actors is a promising direction for transitioning the industry from a volume-driven to a value-driven export model, though causal evidence is still needed.

LIMITATIONS

Several limitations should be acknowledged:

Sample size and generalizability: The survey sample ($n=87$), while adequate for many statistical tests, was drawn only from Sri Lanka's tea sector. Findings may not generalize to other commodity sectors or geographic contexts.

Cross-sectional design: Data were collected at a single time point (January–March 2023), restricting causal inference. Longitudinal data would be required to establish directionality of relationships.

Very small secondary data sample (N=10 years): The trend analysis is descriptive and underpowered. No policy or strategic recommendation should be derived from the specific magnitudes of association. Future research should use monthly or quarterly data or extend the time series.

Unmodeled external shocks: Climate variability, global tea price fluctuations, and the lingering effects of the COVID-19 pandemic and Sri Lanka's economic crisis (2022–2023) are not explicitly modeled and may confound results.

Composite index limitations: Institutional coordination is measured using a five-item composite index (Cronbach's $\alpha = 0.81$), which may not capture all dimensions of governance complexity (e.g., informal networks, power asymmetries, historical path dependence).

Social desirability bias: Respondents may have underreported coordination problems to avoid criticizing their own institutions. The convergence between quantitative and qualitative findings somewhat mitigates this concern.

Underrepresentation of informal actors: Smallholder farmers who do not belong to formal producer organizations were not adequately represented in the sample. Their perspectives on coordination failures may differ from institutional stakeholders.

Time period of secondary data: Industry performance data (2013–2022) include the pandemic and economic crisis years, which may not represent long-term structural relationships.

RECOMMENDATIONS FOR FUTURE RESEARCH

- 1) Conduct longitudinal research tracking institutional coordination and export performance over 5–10 years to establish causal direction. Ideally, collect monthly or quarterly data to increase statistical power.
- 2) Validate the Institutional Coordination Scale using factor analysis and further reliability testing (test-retest reliability, cross-validation).

- 3) Include smallholder perspectives through dedicated surveys or participatory methods.
- 4) Expand the sample to include other agricultural export sectors (e.g., rubber, coconut, spices) to test generalizability.
- 5) Develop and test interventions (e.g., formal multi-stakeholder coordination platforms) using quasi-experimental designs.
- 6) Examine whether stakeholder experience asymmetry (identified in ANOVA) mediates coordination effectiveness.

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