



Impact of National Quality Infrastructure Development on Export Performance in Sri Lanka

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ABSTRACT

This study examines the impact of National Quality Infrastructure (NQI) development on Sri Lanka's export performance from the perspectives of Sri Lankan exporters, addressing a gap in the existing literature. Using a mixed-methods approach, this research integrates secondary data analysis, surveys of export-oriented businesses, and sector-specific case studies. Findings reveal a positive correlation between Quality Infrastructure for Sustainable Development (QI4SD) and export performance in countries such as China, Japan, and South Korea; however, moderate outcomes in Singapore and India suggest additional influencing factors. Survey data indicate that exporters employ Metrology, Standards, Testing, and Quality (MSTQ) frameworks to enhance productivity and product quality. Sector-specific case studies highlight distinct priorities, with edible goods exporters focusing on hygiene and safety standards, and non-edible goods exporters prioritizing efficiency and consistency. Despite MSTQ adoption, exporters encounter persistent challenges such as financial constraints and trade barriers. The study concludes with policy recommendations to improve knowledge dissemination, expand financial support, address import restrictions through collaborative policies, and enhance participation in Free Trade Agreements. These measures are crucial for fostering sustainable growth in Sri Lanka's export sector.

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I. INTRODUCTION

Sri Lanka's export history has undergone significant transformations, shifting from a reliance on traditional products to a diversified export structure. Historically, exports of tea, rubber, and coconut were crucial to the country's Gross National Product (GNP) (Athukorala, 1984; Weerakoon, 1994). However, by the late 1960s, global shifts in demand for these commodities posed challenges to sustainable growth. In response, Sri Lanka initiated comprehensive economic liberalization measures in 1977, positioning itself as a regional pioneer in addressing these challenges (Athukorala & Rajapatirana, 2000). The promotion of non-traditional manufacturing exports, along with trade liberalization and financial restructuring, fueled significant growth until 2000, when these exports represented over 70% of total exports. The subsequent slowdown in export growth highlighted the need to reassess outdated trade analysis methods in light of evolving global production dynamics (Athukorala, 2017). To sustain export diversification amid globalization, it is essential for Sri Lanka to prioritize enhancing market-entry capabilities, fostering innovation, and strengthening emerging sectors (El Araby, 2015; Sri Lanka Export Development Board, 2018). Export growth is essential for driving economic development, generating employment, and fostering innovation in Sri Lanka (Achchuthan, 2013). By diversifying export markets and reducing dependence on specific import sources, Sri Lanka can bolster its economic resilience and adaptability. The contraction in import expenditure between January and August 2022 driven by policy measures, higher import prices, and subdued demand underscores the need for robust export growth. Moreover, financial assistance from international organizations such as the IMF-EFF emphasizes the importance of expanding exports for the country's economic stability and sustainable development (Central Bank of Sri Lanka, 2023). Therefore, prioritizing export growth and market diversification is essential to strengthening Sri Lanka's economy, enhancing global competitiveness, and promoting sustained prosperity. The National Quality Infrastructure (NQI) is expected to exert a significant positive impact on export performance. This expectation is supported by advancements in the global trading system that have facilitated the adoption of effective quality infrastructure frameworks, thereby promoting trade and enhancing economic well-being (El Araby, 2015). South Korea's transformative experience provides compelling evidence of NQI's impact on export

performance. Despite initial quality constraints in the 1960s, South Korea's strategic emphasis on standardization, metrology, and conformity assessment was pivotal in driving economic growth. This strategic focus enabled the successful implementation of NQI, ultimately establishing the country as a global leader by the 1980s (Harmes-Liedtke, 2021; Yoo, 2019). These efforts underscore the critical role of a robust NQI in boosting export performance and supporting active participation in international trade. The literature suggests that the impact of NQI on export performance varies across countries. Challenges such as complex measurement procedures, high compliance costs, and limited access to certification agencies can impede the effectiveness of NQI (Gonçalves & Peuckert, 2011; Tun, 2021). For example, a study of Myanmar's food processing industry found that financial constraints and cost-based competition hindered improvements in product quality and export performance (Tun, 2021). In Sri Lanka, NQI strategies focus on facilitating market entry and ensuring compliance through initiatives such as the development of a legal framework, the implementation of the National Quality Policy (NQP), and a focus on standardization, metrology, conformity assessment, and accreditation (Sri Lanka Export Development Board, 2018; Government of Sri Lanka, 2016). However, the financial capacity and regulatory environment have a significant influence on the export participation of small and medium-sized enterprises (SMEs) (Madushanka & Sachitra, 2021). Furthermore, the literature underscores the importance of individual engagement in quality assurance and control, as well as the role of imports in the production of high-quality export products (Achchuthan, 2013; Lekamge & Ekanayake, 2021). Existing literature extensively examines the factors influencing export performance, with a primary focus on financial constraints and logistical challenges. While some studies explore the role of specific standards or certifications for individual products—such as the impact of HACCP (Hazard Analysis and Critical Control Points) certification on the tea industry—the broader, systemic impact of NQI on export performance remains underexplored. NQI provides a comprehensive framework that integrates Metrology, Standards, Testing, and Quality systems, potentially facilitating alignment with global standards. The present study investigates the research question: What is the impact of National Quality Infrastructure on export performance in Sri Lanka? By analyzing empirical data from the perspectives of Sri Lankan

exporters, the study aims to offer insights and policy recommendations for strengthening the country's export sector. The research design includes an analysis of secondary data from reputable sources such as the World Integrated Trade Solution (WITS) and the Quality Infrastructure for Sustainable Development (QI4SD) Index to examine the relationship between NQI and export performance across Asian countries. Primary data were collected through a structured questionnaire administered to a diverse sample of export-oriented businesses. Additionally, in-depth case studies using purposive sampling provide insights into sector-specific challenges and opportunities encountered by exporters. By integrating survey findings and case study insights, this study aims to offer comprehensive insights and policy recommendations to strengthen NQI's role in enhancing Sri Lanka's export performance and supporting sustainable economic development.

II. ANALYTICAL FRAMEWORK

The continuous advancement of the global trading system has fostered the development of effective Quality Infrastructure (QI) systems that facilitate trade while safeguarding human, animal, and environmental well-being. "Quality Infrastructure" encompasses key components, including metrology, standardization, testing, quality management, conformity assessment, certification, and accreditation, collectively referred to as Metrology, Standards, Testing, and Quality (MSTQ) (El Araby, 2015). These MSTQ practices are supported by international agreements, such as the WTO's Technical Barriers to Trade Agreement, and global organizations, including the ISO, IEC, BIPM, OIML, ILAC, and IAF (United Nations, 2016). Adopting international norms for metrology, accreditation, standardization, and certification is vital for expanding regional and global trade, as these standards facilitate market access and enhance competitiveness for exporting countries (United States, 2005). Thus, adherence to these standards is crucial for sustaining trade growth and maintaining cross-border quality. Developing countries face significant challenges in integrating into international value chains, primarily due to difficulties in complying with quality standards and trade regulations. Effective communication of quality attributes, particularly those not immediately observable to customers, is crucial for these nations, where information disparities are more pronounced compared to developed economies (Hudson & Jones, 2003). A well-

functioning QI system mitigates information asymmetry among economic actors, enables precise resource allocation, and enhances market efficiency (Gonçalves & Peuckert, 2011). Therefore, establishing robust QI systems is essential for developing countries to promote prosperity, health, and overall economic stability (United Nations, 2016). In this context, the development of a National Quality Infrastructure (NQI) becomes paramount. NQI refers to the institutional framework responsible for establishing and implementing standards, encompassing metrology, conformity assessment, and accreditation (Tippmann, 2013). Metrology provides the scientific foundation for standardization and conformity assessment, while standardization defines quality requirements, and conformity assessment ensures adherence to these standards through testing and inspection (Yoo, 2019). A robust NQI enables countries to meet international quality standards, facilitating market access and fostering fair competition. Therefore, an effective NQI is crucial for economies to demonstrate compliance with recognized standards, both domestically and internationally (Mavroeidis & Tarnawska, 2015). Sri Lanka's NQI strategy aims to enhance the compliance and market-entry capabilities of small and medium-sized enterprises (SMEs), emerging exporters, and established export industries by providing trade information, promotional support, and quality compliance services. The legal framework of the NQI, established through parliamentary acts and overseen by regulatory bodies, ensures consumer and environmental protection. However, a comprehensive legal restructuring is required to create a cohesive framework that integrates all NQI institutions and authorities (Sri Lanka Export Development Board, 2018). This restructuring is critical for improving the efficiency and effectiveness of the NQI, fostering greater competitiveness in global markets. The NQP, introduced in 1995 and subsequently revised, has facilitated sectoral improvements, including the expansion of conformity assessment services and laboratory accreditation. The NQP aims to promote a quality-driven culture across policies, entrepreneurship, research, and environmental protection (Government of Sri Lanka, 2016). While provisions for a central coordinating body, the National Quality Council, have been incorporated into the NQP, its implementation remains pending (Sri Lanka Export Development Board, 2018). Despite this delay, NQI institutions in Sri Lanka continue to focus on standardization, metrology, conformity assessment, and accreditation, thereby supporting consumer

protection, product safety, and environmental standards (Sri, 2018; Government, 2016). SME export participation in Sri Lanka is significantly influenced by financial resources and government policies. Madushanka and Sachitra (2021) highlight that accessible financing and effective financial management are crucial for SME export activities, emphasizing the need for government support, including low-interest loans and streamlined export procedures. Policy initiatives that address tax barriers, ensure exchange rate stability, and revise tariff structures are also essential in fostering a conducive export environment. For example, the tea industry faces challenges due to financial constraints that limit the adoption of international quality standards such as HACCP. These challenges are compounded by factors such as outdated information, high certification costs, and limited technical capacity (Simi, 2006). Importing key inputs, such as raw materials, components, and machinery, is a crucial factor in facilitating technology adoption, producing high-quality export products, and enhancing productivity (Achchuthan, 2013). This interdependence between imports and exports underscores the importance of a robust import infrastructure to sustain export sector growth and competitiveness. Quality assurance and control are essential for export-oriented industries, as demonstrated by Sri Lanka's apparel sector. Specifically, the industry's transformation from a low-cost production base to a globally recognized hub underscores the benefits of proactive quality management, including addressing worker absenteeism and maintaining awareness of prevailing standards (Lekamge & Ekanayake, 2021). Furthermore, the implementation of standards such as ISO 14001:2015, supported by management commitment and operational control, not only enhances resource efficiency but also ensures the production of high-quality exports (Weerasinghe & Jayasooriya, 2020). While numerous studies have identified common factors influencing export performance, there is limited research examining the specific impact of NQI on Sri Lanka's exports. This study aims to assess the influence of NQI on the country's export performance, focusing on the perspectives of Sri Lankan exporters regarding the development and implementation of MSTQ practices, institutions, and policies. The findings will provide insights into how NQI contributes to product quality improvements, enhances global competitiveness, and supports export growth. Through empirical analysis, this study seeks to offer policy recommendations that will strengthen Sri Lanka's

export sector and promote sustainable economic development.

III. METHODOLOGY

This study adopts a mixed-methods research design, integrating both quantitative and qualitative approaches to evaluate the impact of NQI development on export performance in Sri Lanka. The research combines secondary data analysis with primary data collection to provide a comprehensive assessment of NQI's influence on exports. To begin, secondary data were analyzed to understand the overall impact of NQI development on export performance across Asian countries, including Sri Lanka. Secondary data were sourced from credible platforms, such as the World Integrated Trade Solution (WITS) and the Quality Infrastructure for Sustainable Development (QI4SD) Index. The QI4SD Index offers insights into the NQI of various Asian countries, while the WITS database provides export values. The analysis focused on export data for the year 2020, constrained by the availability of relevant data. In addition to secondary data, primary data were collected through two methods. First, a structured survey was distributed remotely to a diverse sample of export businesses in Sri Lanka. The survey aimed to capture exporters' perceptions and experiences regarding the impact of NQI development on export performance. The survey was conducted via Google Forms, targeting exporters in sectors such as apparel, tea, spices, rubber, food and beverage, and other miscellaneous exports. The email addresses for survey distribution were sourced from the exporter directory of the Sri Lanka Export Development Board. Over 150 exporters were contacted, and 47 voluntary responses were received within 14 days. The survey consisted of 10 questions, nine of which were close-ended, and one open-ended. The survey focused on various aspects of NQI, including the application of MSTQ standards, exporters' satisfaction levels, and expectations regarding NQI's role in enhancing export performance. Secondly, in-depth case studies were conducted to explore how NQI development influences export performance in specific sectors. The case studies followed Yin's (2018) methodological approach, utilizing purposive sampling. Key industry representatives from both established and emerging export sectors in Sri Lanka were interviewed, including executives from the coconut, jackfruit, rubber, tea, handloom, frozen food, and apparel industries. Six participants were interviewed via Zoom between May 22 and June 7, 2023, with each session lasting

between 30 and 60 minutes. The participants included the General Manager of Business Development, Director of Operations, Managing Director, Manager of Quality Assurance, and Chief Executive Officer/Director. The interviews were audio-recorded and transcribed for subsequent analysis. The data collected through both quantitative and qualitative methods were subjected to rigorous analysis. Descriptive statistical methods were employed to analyze the quantitative data obtained from the survey, while descriptive statistical analysis was applied to the qualitative data derived from the case studies. The findings from both data sources were compared and synthesized to derive meaningful insights into the relationship between NQI development and export performance. This analysis provides valuable information for policymakers, industry practitioners, and stakeholders involved in enhancing export performance through NQI development.

IV. RESULTS

This section provides a detailed analysis of secondary data and survey findings, supplemented with case studies, to examine the relationship between NQI development and export performance. The analysis emphasizes the correlation between QI4SD index scores and export outcomes across selected Asian countries. Additionally, perspectives from Sri Lankan exporters and SMEs offer valuable insights into the perceived impact of NQI improvements on national export performance.

A. Analysis of Secondary Data

Table 1. Comparison of QI4SD Index Scores and Export Values of Selected Asian Countries

Country	QI4SD Index	Export Value (USD) (Million)
China	83.0	2,499,207
Japan	76.5	705,671
South Korea	73.0	542,172
India	66.6	323,251
Singapore	58.6	390,332
Russia	57.5	426,720
Indonesia	56.0	167,683
Thailand	52.4	233,674
Malaysia	49.2	240,212
Cambodia	49.2	14,825
Pakistan	39.5	23,749
Vietnam	37.4	264,610
Philippines	34.9	70,927
Sri Lanka	34.5	11,974
Mongolia	29.1	7,620
Afghanistan	21.6	870
Nepal	20.7	960

Sources: QI4SD Index (n.d.); World Bank (n.d.)

The integration of export values with QI4SD index scores reveals a complex relationship between the development of a country's quality infrastructure (QI) and its export performance. High QI4SD scores, observed in China, Japan, and South Korea, are associated with strong export values, indicating that well-developed QI systems play a crucial role in supporting higher export performance.

However, in countries such as Singapore and India, relatively high QI4SD scores do not correlate with export values as substantial as those in China, Japan, or South Korea. This discrepancy suggests that factors beyond QI4SD, such as regional trade conditions, industry-specific strengths, or economic policies, may also shape export outcomes alongside QI development. While further research is needed to explore these factors in greater depth, these cases imply that high QI4SD scores alone may not fully account for the variability in export performance across nations.

In countries with moderate QI4SD scores, such as Thailand, Malaysia, Indonesia, and Cambodia, export values exhibit considerable variation. These discrepancies highlight both the ongoing development of their QI systems and the complex interplay of factors influencing export performance. Conversely, countries with lower QI4SD scores, including Sri Lanka, Afghanistan, Nepal, and Mongolia, demonstrate limited export performance, underscoring the challenges posed by weaker QI systems and other socio-economic constraints.

These findings emphasize the need for country-specific research to investigate how targeted improvements in NQI can enhance export performance, particularly in nations with underdeveloped QI systems. Tailored NQI interventions could help address export limitations by strengthening quality standards and improving competitiveness in international markets.

B. Survey Results

A descriptive statistical analysis was performed to evaluate the impact of MSTQ improvements on business performance. This analysis provides a comprehensive overview of perspectives from diverse business profiles, as summarized in Table 2 and illustrated in Figure 1.

Table 2. Business Profile Characteristics in the Survey Questionnaire

Category	Number of Businesses	Percentage (%)
>10 years	28	59.60
5–10 years	11	23.40
<5 years	8	17.00
Large-scale	18	38.30
Small-scale	12	25.50
Medium-scale	10	21.30
Micro-scale	7	14.90
Locally owned	40	85.10
MNC	5	10.60
Proprietorships	1	2.10
Joint ventures	1	2.10

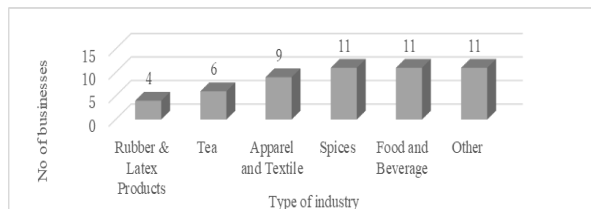


Figure 1. Distribution of Businesses by Export Sector Based on Survey Responses

Note: Some businesses operate in multiple export sectors concurrently. The data presented reflect the number of businesses within each sector independently, without adjustments for overlapping sector participation.

Impact of MSTQ Improvements on Business Outcomes:

Survey responses from 47 participants revealed that 87.2% reported improvements in their MSTQ practices, indicating a proactive approach to enhancing quality standards. Conversely, 12.8% of respondents reported a lack of substantial advancements in MSTQ practices.

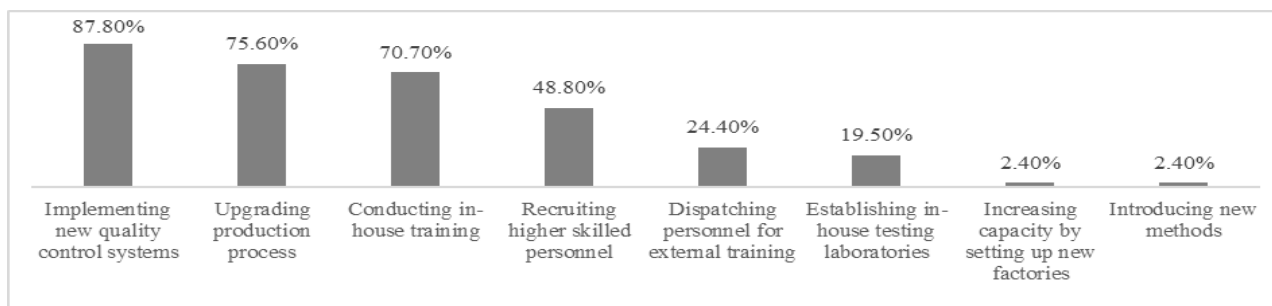


Figure 2. Strategies Implemented for MSTQ Enhancement

Strategies Implemented

Among respondents reporting MSTQ improvements, 90.2% prioritized quality enhancement, 68.3% emphasized upgrading standards, 53.7% achieved improvements in testing facilities, and 31.7% focused on calibrating metrology tools. As illustrated in Figure 2, key strategies included the adoption of advanced quality control systems, process upgrades, and in-house training initiatives, reflecting a strong

commitment to quality advancement and workforce development. The recruitment of skilled personnel also emerged as a pivotal measure for sustaining high-quality standards. Conversely, less commonly reported strategies—such as external training, establishing in-house testing laboratories, and capacity expansion—demonstrate varying levels of engagement with MSTQ enhancement strategies across organizations.

Outcomes and Impacts

The analysis of the questionnaire responses underscores the significant outcomes of MSTQ enhancements. Key business benefits included substantial reductions in waste (92.7%), productivity gains (70.7%), improved product quality (73.2%), and the introduction of new product variations (43.9%). These findings highlight the efficacy of the implemented strategies, emphasizing the critical role of MSTQ in driving organizational success.

Furthermore, MSTQ improvements have profoundly influenced export performance. Of the 41 surveyed companies that implemented MSTQ enhancements, 95.1% reported positive impacts on export activities. Notably, these enhancements facilitated the introduction of new, higher-value products (69.2%), increased export volumes of existing products (61.5%), and enabled entry into new, higher profit-margin markets (43.6%). Additionally, respondents reported reductions in order lead times (2.6%), expansion of market

portfolios (2.6%), and increased secured orders (2.6%), attributable to elevated quality standards. These results underscore the multidimensional impact of MSTQ enhancements, solidifying their role as a cornerstone of competitive advantage in international markets.

Challenges and Constraints

Despite these benefits, 4.9% of respondents reported no discernible effects from MSTQ improvements. Additionally, four participants cited challenges, including reduced profit margins

due to the high costs associated with maintaining MSTQ standards. Furthermore, four respondents emphasized that MSTQ should not be viewed as the sole determinant of market access. These concerns, alongside the limited adoption of certain strategies, underscore the complexities inherent in implementing MSTQ improvements.

Recommendations and Accessibility

The survey revealed considerable dissatisfaction with MSTQ accessibility in Sri Lanka. Only 39% of respondents expressed satisfaction, while 61%

indicated substantial barriers to access. Respondents proposed several measures to address these issues, including:

- Increasing awareness (nine participants)
- Strengthening government support (three participants)
- Conducting research on MSTQ requirements and gaps (one participant)

Table 3. Descriptive Statistics of Selected Companies in the Export Industry

Study No.	01	02	03	04	05	06
Company Name	Planet's Pick	Clinco Rubber Moulding	Blue Field Tea	FMCG: name not disclosed	Aitken Spence	Kandygs Handlooms
Year Estd.	2015	2019	1921	1979	1977	1971
Workforce	50	20	300	600	2,500	110
Products	Coconut /Jackfruit	Rubber products	Conventional/ organic tea	Frozen food	Apparel products	Handloom products
Certificates	ISO 22000, HACCP, GMP, Organic (EU, USDA, JAS), Non-GMO CDA, FAD, BRC	ISO 9000, BSCI	ISO 22000, HACCP, SLS, Organic (EU, USDA, JAS, NOP) Lion logo	ISO 22000:2018, HACCP, GMP	International certifications related to ethical practices, strict safety protocols	Eco certificates, international standard color tests
Annual Export	LKR 35M	> LKR 50M	USD 36M	LKR 70M	USD 25M	USD 75K
Markets	US, Europe, UK	US, Europe, UK, Japan	Japan, Russia, Australia	Australia, NZ, US	US, Europe, UK	Europe, Asia, Australia
MSTQ Strategies	PQPI, OC, INN Testing Lab Installed	PQPI, OC, INN Improved Documentation	PQPI, OC, INN Gov. Testing	PQPI, OC, INN Private Testing	PQPI, OC, INN, ERP, Digitalization	PQPI, OC, INN, Quality Circles
Resources	TKH (OFE), PU, SF - labs /improvements	TKH (Consultant) PU, SF - except for Intermix m/c	TKH (Supplier's Input), PU, SF	TKH (OFE), PU, SF	TKH (OFE), PU, SF Loans	TKH (OFE), PU, SF for new m/c
Obstacles	None	Lack of testing facilities, no support for value addition	High costs, unstable market regulations	None	High tariffs	None
Overcome Obstacles	Teamwork, skilled staff recruitment	Request for gov. lab support	Own funds for improvements	Compliance with boarder regulations	Expect bilateral negotiations	Recruit skilled/qualified team
Gov. Support	None	MSS 2019	None	None	None	None
Recommendations	Financial grant/loans for SMEs	Support for in-house lab, recognition and assistance for value-addition, upgrade CABs for international recognition	Transparent pricing, restructure import bans	Equal opportunities and facilitate participation in international events. Provide up-to-date, practical information.	Develop banking to support exporters, maximize FTAs	Financial support for eco-friendly, export-driven businesses

Note:

PQPI = Product Quality and Process Improvement,
 OC = Obtained Certifications,
 INN = Innovations,
 TKH = Technical Know-How,
 OFE = Own Factory Expertise,

PU = Personnel Upgrading
 SF = Self-Funding
 Gov. = Government
 m/c = Machine
 CAB = Certification Accreditation Body.
 MSS = Market Support Scheme

These findings underline the need for comprehensive policy interventions, targeted awareness programs, advanced training initiatives,

and technological upgrades to strengthen MSTQ practices. Respondents also emphasized disparities between Sri Lanka and other Asian countries, underscoring the critical need for strategic alignment and policy coherence to enhance MSTQ accessibility and its associated benefits.

C. Case Studies

Table 3 presents profiles of participating export companies, detailing their MSTQ strategies, implementation mechanisms, resource acquisition methods, challenges encountered, suggested solutions, and the impact of government policies.

V. DISCUSSION

This study employed a three-step methodological approach: secondary data analysis, descriptive statistical evaluation of survey responses, and in-depth case studies. The secondary data analysis revealed a significant positive correlation between QI4SD and export performance in China, Japan, and South Korea, highlighting the critical role of NQI in driving economic success. South Korea's economic transformation exemplifies this relationship; strategic NQI implementation, which overcame early challenges in the 1960s, contributed to substantial growth and global competitiveness by the 1980s (Harmes-Liedtke, 2021; Yoo, 2019). However, the cases of Singapore and India demonstrate that high QI4SD scores do not always correlate with robust export performance, suggesting that other factors also influence outcomes. This discrepancy prompted further exploration into the specific impacts of NQI enhancement. The survey provided valuable insights, emphasizing the importance of case studies in understanding the complex relationship between NQI and export performance.

A. Discussion of Primary Data

Survey and case study findings reveal significant trends in the implementation of MSTQ strategies across various export sectors. The survey data show that 90.2% of participants are focused on quality enhancement, 68.3% on standards upgrading, 53.7% on testing facilities, and 31.7% on metrology improvement. These findings are corroborated by case studies, which offer deeper insights into the practical applications of MSTQ. A cross-case analysis identifies recurring themes such as product quality improvements, process enhancements, certification acquisition, innovation, testing practices, and resource allocation, shedding light on both success factors and challenges encountered.

B. Cross-Case Comparison of MSTQ Strategies and Implementation Mechanisms

Product quality emerged as a strategic priority across all six case studies, with industry-specific strategies tailored to each sector. Survey data support this finding, with 90.2% of respondents reporting quality improvements over the past five years. Among the edible exports (Cases 01 and 03), significant investments were made in advanced packaging solutions. For instance, Case 01, which exports coconut water and spice-infused foods, utilizes microwavable pouches and corrosion-resistant packaging sourced from Thailand to preserve flavor, ensure safety, and extend shelf life. Similarly, Case 03 employs eco-friendly, recyclable materials for tea packaging, highlighting both consumer safety and sustainability. In contrast, non-edible sectors, such as rubber and apparel (Cases 02, 05, and 06), adopted distinct strategies—focusing on product innovation, continuous R&D, and advanced dyeing processes. These varying approaches underscore the importance of industry-specific adaptations to maintain competitive quality standards.

Process improvement was another central focus, with 68.3% of participants engaging in process upgrades, 87.8% implementing new quality control systems, and 75.6% pursuing production improvements. In the edible goods sector, food safety and hygiene were prioritized, alongside the integration of energy-efficient technologies such as infrared (IR) sterilization, which helped preserve physico-chemical properties, nutritional values, and sensory qualities (Aboud et al., 2019). For example, Case 01 implemented IR treatments, automated stainless-steel machinery, and epoxy-coated flooring, effectively minimizing contamination risks. This led to British Retail Consortium (BRC) certification, facilitating entry into the European market, where sustainability and product safety are critical for consumer trust and regulatory approval. In contrast, Case 04 employed systematic risk assessments and used blast freezers operating at temperatures between -27°C and -40°C to rapidly freeze composite food items, reducing the formation of large ice crystals and thereby preserving texture, flavor, and nutritional value, while expanding market access to Australia and New Zealand. In the non-edible sector, distinct strategies were employed: Case 02 standardized operations, Case 05 adopted technology platforms and digitalization for enhanced efficiency, and Case 06 implemented quality circles to ensure product consistency. These sector-specific strategies underscore the

diverse applications of MSTQ principles in the pursuit of quality and efficiency. Across all six cases, these strategies resulted in increased productivity (70.7%), waste reduction (92.7%), and improved product quality (73.2%), as indicated by the survey findings.

Certification acquisition was a key theme across all case studies, demonstrating a strong commitment to quality and adherence to industry standards. The edible goods sector, in particular, focused on obtaining food safety certifications such as ISO 22000, HACCP, and organic certifications, which facilitated enhanced market access and profitability. In contrast, non-edible sectors emphasized social responsibility standards, such as the Business Social Compliance Initiative (BSCI), as seen in Case 02. This highlights the importance of certifications across sectors, not only for market recognition but also for enhancing exporter credibility. As noted by Hudson and Jones (2003), developing countries face significant challenges in integrating into international value chains, primarily due to difficulties in meeting quality standards and trade regulations. In this context, effective communication of quality attributes—particularly those not immediately observable to customers—becomes crucial. In such cases, certification serves as an essential tool for ensuring compliance and building trust.

Innovation was a critical driver of quality improvement and competitiveness across all case studies. Case Study 01 emphasized product customization for European buyers, while Case Study 02 developed portable rubber ramps as a user-friendly alternative to traditional steel or concrete solutions for elderly and disabled individuals. These ramps, designed to address mobility needs, facilitate independent living, particularly for wheelchair users, and align with the growing demand for accessible solutions, expanding into European, U.S., and Australian markets. Case Study 03 adopted eco-friendly packaging, catering to environmentally conscious consumers. In Case Study 04, popular food items were transformed into frozen products to extend shelf life and facilitate international market entry. Case Study 05 focused on continuous innovation to align with evolving fashion trends, while Case Study 06 pioneered sustainable textile production, utilizing 100% bamboo yarn, advancements in cotton, linen, and bamboo fabrics, and natural dyes. Bamboo, a rapidly renewable fiber, supported sustainable practices, as it was processed into yarn and handwoven into soft fabrics with a sheen and smoothness comparable

to silk and cashmere, providing economic opportunities for low-income families. Bamboo fabrics require less dye than cotton due to superior absorption properties, leading to more efficient dyeing processes, vibrant colors, and enhanced drape. Additionally, bamboo fibers exhibit high moisture absorption, deep color retention, and inherent antimicrobial and UV-shielding properties, reducing the need for petrochemical treatments. These attributes have made bamboo fabrics increasingly attractive in the textile market (Chaudhary, 2019). Survey results indicated that 43.9% of respondents reported successful product innovations, underscoring the significant role of innovation in driving export growth.

Testing was a key strategy across all six case studies, with varying approaches to its application. Case Study 01 prioritized in-house laboratory testing for R&D, reducing outsourcing costs. Case Study 02, lacking internal testing facilities, faced increased expenses and delays. Case Study 03 combined in-house testing with government services, while Case Study 04 relied exclusively on private laboratories to avoid delays. Case Study 05 used its in-house lab for both testing and R&D, and Case Study 06 focused on in-house assessments for color fastness and sewing quality. These cases highlight the efficiency of in-house laboratories in reducing costs and improving competitiveness, while reliance on external facilities often leads to delays and higher expenses. Survey results indicated that 19.5% of respondents viewed in-house laboratories as a critical investment for MSTQ implementation, emphasizing the need for accessible, cost-effective testing to enhance global competitiveness.

Survey and case study findings indicate that the development of NQI, through the implementation of MSTQ and efficient resource utilization, positively impacts export performance. However, challenges persist, particularly affecting profitability, sustainability, and competitiveness in sectors outside Case Studies 01, 04, and 06, which reported fewer issues.

Empirical evidence highlights the substantial financial burdens faced by small and medium enterprises (SMEs) in meeting international quality standards, as corroborated by findings in the existing literature. For instance, Case Study 01 underscores the significant costs associated with obtaining BRC certification to access European markets in the edible export sector. Similarly, Case Study 03 illustrates the challenges exporters encounter when implementing costly recommendations from conformity assessment

bodies under stringent deadlines. These observations align with prior research, such as Simi (2006), which identifies financial constraints and high certification costs as major barriers for the Sri Lankan tea industry in adopting HACCP standards, thereby limiting market access. Likewise, Tun (2021) emphasizes that compliance costs in Myanmar impede the effectiveness of NQI, adversely affecting product quality and export performance. Case Study 02 highlights how the absence of in-house laboratory facilities exacerbates costs and delays, compelling SMEs to rely on external testing for quality assurance. Similarly, Case Studies 05 and 06 reveal the financial strains associated with process upgrades and product standardization. Notably, Case Study 05 underscores the critical need for export-oriented development banking services, as commercial banks often lack the expertise and resources required to support export-driven growth. Among the cases examined, only Case Study 02 reports positive outcomes, attributed to financial support provided through the Sri Lanka Export Development Board's (SLEDB) Market Support Scheme, which alleviated machinery costs. These findings emphasize the inadequacy of existing government support and the pressing need for increased resource allocation. This conclusion aligns with Madushanka and Sachitra (2021), who advocate for enhanced funding mechanisms, accessible financing options, and supportive policies such as low-interest loans, exchange rate stability, and streamlined export regulations. Despite these interventions, SMEs continue to face barriers to product development and innovation, underscoring the need for targeted financial assistance. Such assistance should include accurate data collection, comprehensive financial assessments, and evaluations of growth potential. Addressing challenges related to certifications, process improvements, and value addition requires substantial investment, highlighting the importance of sustained support. Collaboration among stakeholders—including the Ministry of Finance, Ministry of Trade, SLEDB, banks, business development organizations, international donors, and private investors—is essential for providing holistic assistance to SMEs. Overcoming financial barriers through targeted government interventions is critical to strengthening NQI, improving export performance, and fostering broader economic development.

Survey and case study findings underscore the urgent need for improved knowledge dissemination and tailored support for exporters. Exporters primarily acquire knowledge through

international exhibitions, self-study via online platforms, and paid expert consultations. However, evidence from Case Studies 02 and 04 reveals significant shortcomings in government-provided information, which is often outdated and impractical. This aligns with Simi (2006), which highlights similar issues in the tea industry's adoption of HACCP standards, hindered by financial constraints and obsolete guidance. While international exhibitions provide critical access to advanced knowledge, high participation costs and limited government sponsorships restrict accessibility. Case Study 04 illustrates inadequate support in identifying emerging trade sectors. Despite these barriers, the company independently adopted blast-freezing technology learned at an exhibition, unlocking new export opportunities. Moreover, Case Study 02 indicates that local SMEs are often underrepresented in assistance programs, with Case Study 04 showing that sponsorships disproportionately favor established exporters over emerging sectors. To address these inequities, grant selection processes should be refined to ensure broader and more equitable participation. While sponsoring all SMEs may not be feasible, inclusive knowledge dissemination programs are vital. Collaborative technical training initiatives involving government officials and international experts can facilitate the transfer of emerging technologies, best practices, and market intelligence. Hybrid training sessions in accessible languages can further enable nationwide participation. Additionally, fostering partnerships between industry professionals and policymakers can enhance SME support. These measures are essential to empower exporters, strengthen SME competitiveness, and drive success in global markets.

The analysis highlights the challenges posed by import bans on essential items and chemicals, particularly within industries like tea farming. Sri Lanka's economic constraints have prompted the Central Bank of Sri Lanka (2023) to recommend export market diversification and reduced reliance on specific import sources as strategies to enhance economic resilience. However, the imposition of import restrictions has yielded mixed outcomes. Essential inputs such as raw materials, components, and machinery are crucial for maintaining high-quality export production, increasing productivity, facilitating technological adoption, and promoting export growth (Achchuthan, 2013). For example, Case Study 03, focusing on tea exports to Japan, Russia, and Australia, revealed that fertilizer import bans degraded soil fertility, leading to reduced yields, compromised product quality, and lower profits

compared to previous years. This underscores the interdependence of imports and exports and the necessity of a robust import system to sustain export performance. Similarly, Case Study 01 demonstrates how access to high-quality imports supports export standards. The company transitioned from inadequate locally sourced packaging to advanced microwavable pouches and corrosion-resistant materials imported from Thailand, significantly enhancing product quality and shelf life. These findings emphasize the pivotal role of essential imports in driving technological advancements, maintaining export standards, and strengthening NQI, collectively boosting export sector growth. To mitigate the adverse effects of import restrictions, collaboration among stakeholders is vital. Government agencies, including the Department of Import-Export Control and the Department of Commerce, should work with industry representatives to identify viable alternatives and develop substitutes for restricted items. This study contributes to the literature by identifying industry-specific challenges arising from import restrictions and advocating for a multi-sectoral approach. Reassessing the costs and benefits of import bans is essential for creating sustainable solutions, requiring coordinated efforts across government, industry, and other stakeholders to drive long-term economic growth.

The analysis of Case Study 05 highlights the significant challenges posed by high tariff barriers, which restrict the company's ability to expand into new markets. Consequently, the company has concentrated its exports in the United States, Europe, and the United Kingdom, emphasizing the need for proactive bilateral trade negotiations and agreements to unlock access to additional markets. Such agreements can reduce trade costs, enhance competitiveness, and foster knowledge exchange, promoting best practices and innovation through global collaborations. For FTAs to be successfully implemented in Sri Lanka, the involvement of key stakeholders is vital. These include the Ministry of Trade, Ministry of Foreign Affairs, Department of Commerce, and relevant industry associations. International trade and economic experts should also be engaged during negotiations and implementation to ensure FTAs align with national economic goals, address sector-specific challenges, and boost export performance. The Vietnam-EU FTA demonstrates the potential benefits of well-structured agreements. Duong (2016) highlights that the agreement attracted foreign investment by positioning Vietnam as a cost-effective destination with competitive labor costs. It facilitated technology transfer, knowledge

sharing, and expertise development from European companies to Vietnamese firms, enhancing technical capabilities. Furthermore, it strengthened intellectual property protections, improved labor quality, and prompted economic policy reforms, driving modernization in Vietnam. These findings demonstrate how well-designed FTAs can advance NQI, improve trade conditions, and enhance export competitiveness in countries like Sri Lanka. To fully realize these benefits, targeted government support is essential to address challenges, including tariff barriers and capacity constraints, and to promote sustainable growth in the export sector. A strategic approach to FTA development can serve as a catalyst for economic growth, fostering innovation and positioning Sri Lanka as a competitive player in global markets.

In conclusion, this study makes a significant contribution to the existing literature on export performance by emphasizing the critical role of NQI development, particularly through the implementation of MSTQ principles, certification acquisition, innovation, and process improvements. It provides new insights drawn from the practical experiences and perspectives of exporters in Sri Lanka, where the impact of NQI on export performance has been less explored in prior research. While studies such as Simi (2006) and Tun (2021) highlight financial and infrastructural barriers to meeting quality standards, this research extends these findings by presenting industry-specific strategies and case study evidence from diverse sectors. Additionally, it offers practical insights into how SMEs can overcome financial constraints and leverage targeted government support to enhance competitiveness, in line with Madushanka and Sachitra's (2021) recommendations on addressing financial barriers faced by SMEs. This study also extends previous research by emphasizing the interdependence of imports and exports in maintaining high-quality standards, thereby adding depth to discussions on the adverse impacts of import restrictions on export performance. In contrast to studies focusing solely on mutual benefits, this research explores the role of FTAs in enhancing NQI, supported by empirical evidence. By addressing gaps in knowledge dissemination, equitable grant allocation, and policy alignment, this study provides actionable recommendations for strengthening Sri Lanka's export sector. It broadens the scope of existing research and offers a comprehensive approach to advancing NQI's role in fostering sustainable export growth.

VI. CONCLUSION

This study underscores the transformative impact of advancements in MSTQ on export performance, emphasizing their role in enhancing productivity, reducing waste, improving product quality, and fostering innovation. Survey findings reveal that 95.1% of respondents identified MSTQ improvements as critical to export success. However, challenges such as high maintenance costs and limited accessibility—indicated by only 39% of respondents expressing satisfaction—highlight the necessity of adopting an integrated approach that combines MSTQ development with other critical enablers to achieve sustainable export growth. Case study findings further substantiate these insights, demonstrating how strategic MSTQ implementation enhances process efficiency, certification attainment, and resource optimization, directly contributing to export competitiveness. Nonetheless, persistent barriers such as profitability constraints, limited sustainability, and sector-specific competitiveness challenges remain significant obstacles across industries.

Addressing these challenges requires targeted government interventions. Policies that prioritize accessible MSTQ infrastructure, foster collaboration between government and industry stakeholders, and ensure adequate resource allocation are essential to overcoming these barriers. By addressing these structural impediments, Sri Lanka can strengthen the functionality of its NQI, enhance its global market positioning, and promote sustainable economic growth.

Policy Recommendations:

1. **Expand Financial Assistance Programs for SMEs:** Introduce tailored financial support mechanisms, including the establishment of development banking systems, to alleviate financial constraints, foster innovation, and enhance international competitiveness.
2. **Enhance Knowledge Dissemination and Technical Training:** Develop comprehensive training programs that leverage international expertise to facilitate knowledge transfer of advanced tools, technologies, and market intelligence, empowering exporters to compete effectively in global markets.
3. **Promote Collaborative Solutions to Import Restrictions:** Strengthen partnerships

between government entities and industry stakeholders to address import restrictions, focusing on identifying alternative inputs and substitutes to mitigate adverse impacts on affected sectors.

4. **Expand Free Trade Agreements (FTAs):** Proactively negotiate bilateral and multilateral FTAs to diversify market access, reduce trade barriers, and improve supply chain efficiency, thereby enhancing global competitiveness.

By implementing these targeted measures, Sri Lanka can strengthen its NQI, address sector-specific challenges, and provide comprehensive support to exporters. This coordinated approach will establish a foundation for sustained export growth and economic resilience in an increasingly competitive global trade environment.

This study contributes to academic discourse by empirically linking advancements in MSTQ to export performance, emphasizing the strategic importance of quality infrastructure in fostering competitiveness and market success. It offers valuable insights into the challenges and opportunities faced by exporters in developing economies and provides practical policy recommendations to strengthen NQI systems. By positioning MSTQ improvements as a strategic tool to overcome structural barriers, this study expands the existing literature and highlights their role in promoting sustained export-driven economic growth.

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