NEXUS OF SUSTAINABILITY, INNOVATION AND EXPORT PERFORMANCE: A STUDY OF BOI INDUSTRIAL EXPORTING FIRMS IN SRI LANKA

Karunaratne H.D.M.T.[1] and Dunusinghe P.[2]

Received: February 2025
Revised: May 2025
Accepted: May 2025

Abstract

Increasingly, market mechanism is employed in promoting sustainable development in most of the contexts, including in international trade. Main objective of this study is to examine the relationship between sustainability practices, innovation, and export performance among Sri Lankan industrial exporters operating in Export Processing Zones (EPZ). Employing a mixed-methods approach, data were collected from 80 industrial exporters in four key EPZ zones through structured interviews with a questionnaire while data were analyzed using descriptive and regression techniques. The results revealed a significantly positive relationship between overall sustainability and export performance as well as innovation, with economic sustainability practices demonstrating the most significant influence among each dimension of the sustainability to boost export performance while social sustainability practices enhance innovation at firm level. Findings provide valuable insights for policy makers as well as exporters to boost export performance by understanding the relationship among sustainability, innovation and export performance at firm level.

Keywords: Export Performance, Export Processing Zone, Innovation, Regression Analysis, Sustainability Practices, Sri Lanka.

[1] Research student, MEXT Scholarship Program, GSID, Nagoya University, Japan. *Corresponding author. Email: midorikarunaratne@gmail.com

[2] Professor in Economics, Department of Economics; Head - Department of Information Technology, University of Colombo.

1. Introduction

In today's rapidly changing world, sustainability has risen as a compass that guides the world towards development by balancing economic, environmental as well as social dimensions. Importance of sustainability lies in its multifaceted collision of various dimensions. At its core, sustainability is about ensuring that the actions of people today do not jeopardize the well-being of future generations and that they are socially inclusive. The word 'sustainability' extracted from the Latin word 'sustinere' which means 'to sustain' basically implies maintain, support, endure or uphold (Spindler, 2013). Therefore, the power people hold to continue that over a long period of time is referred to as 'sustain + ability', mainly focusing on the environmental aspects. Its intention is the utilization of natural resources in a way that guarantees their ongoing accessibility for future generations. This approach ensures planet's ecosystems and natural resources are sustained and on the other, it unpacks issues such as pollution, climate change and diversity loss (Rockström et al., 2009). Eventually, the concept of sustainability underwent a revolutionary change, transcending its initial environmental conservation to a broader perspective that includes environmental, economic and social aspects.

In today's economy, sustainability has become intricately linked to exporting firms, influencing consumer behavior, firms' operational strategies and the dynamics of trade which ultimately impact on firm level performance. Integration of sustainability practices into their operations, export firms achieve a competitive edge in the market and expand their market share which boost export performance at firm level. The increasing recognition of sustainability practices integration supports to create loyal customer base due to the genuine commitment for firms at global level and encourage exporting firms to adopt sustainability practices and benefit from such adaptation.

In the realm of developing nations, delving into sustainability, innovation and export performance carries importance for exporters. The relationship among Sustainability, innovation and export performance at firm level is crucial for exporters in developing countries especially in developing countries to encounter challenges such as resource constraints, policy barriers and gain the benefit from such adaptation. Despite the growing interest, empirical evidence on this area is limited specially for Sri Lankan context. Therefore, findings of the study provide valuable insights such as practices like firms that have adopted recycling to reclaim materials or remanufacturing and repacking returned goods especially focus on resource efficiency positively impact on export performance and workplace inclusion policies drive innovation which ultimately increase export performance at firm level Environmental practices such as green certifications and eco-friendly initiatives enhance efficiency and align firms with global standards, collectively improving export outcomes. These insights can help exporters as well as policymakers to develop and promote export performance.

Global concerns on sustainability have influenced firms to adopt some sustainability practices in their operations and benefits from such adaptation. However, knowledge on firms' behavior remain limited at present, especially in the developing country context. Exploring current sustainability practices at firm level is immensely useful in encouraging firms to capture the niche market opportunities

available in the developed world as well as to meet some of the target set forth with respect to international benchmark, such as achieving Net Zero. In Sri Lanka, the government aims at adopting a legislation which make it mandate to achieve Net Zero target by 2050.

Objective of this study is to examine impact of sustainability measures on innovation and export performance of BOI industrial exporters in Sri Lanka. In particular, this study aims at identifying the sustainability practices of exporting firms BOI industrial exporters. Moreover, this study examines innovation and export performance of BOI industrial exporters in Sri Lanka (Porter & van der Linde, 1995; Villena & Souto-Pérez, 2016; Palma et al., 2012).

2. Literature Review

Sustainability is defined as meeting the needs of the present without compromising the ability of future generations to meet their own needs. The term 'sustainability practices' at firm level can be defined as set of actions that adopted by firm into their operations to balance economic, social and environmental dimensions. This concept has been evolved by the triple bottom line concept. Elkington in 1994, proposed the Triple Bottom Line theory which states that sustainability should be assessed based on three dimensions which are environmental, economic and social. It advocates on people, plant and profit (Sala, 2020) . At firm level, economic sustainability focuses on generating profits while ensuring the stability and long-term economic growth of the firm. Social sustainability emphasizes inclusivity, equity, fair labor and working conditions, community engagement and positive contribution to the society. Environmental sustainability concentrated on minimizing the negative impact on environment and responsible use of resources (Pozzobon. E, 2014; Francisco, 2016). Austrian economist, Joseph Schumpeter define 'innovation' in his book called '*Theory of Economic Development*' *(1934)* which involves with the process of either creating new products or improving existing once's using novel production methods. Schumpeter categorized innovation into five key aspects: I. Development of new products, II. application of new production process, III. expansion into untapped markets, IV. discovery of new resource suppliers, V. organizational transformation.
Export performance is a multifaceted phenomenon which addressed by past researchers. Export performance is way of assessing the outcome of firms' activities in international market generally measures through growth of export sales, volume or profitability (Soham, 1996).

2.1 Theory

The *theory of product differentiation* is praised for giving consumers more choices even though it can lead to higher production costs for companies in competitive markets. While traditional theories focus on the variety of products created through diversity, they do not fully consider the impacts (Spence, 1976). The usual perspective states product differentiation to distinguish products from competitors. However, companies differentiate their products not to stand out but to improve quality and to introduce new ideas. This dynamic approach to product differentiation drives progress by bringing products and innovations to the market. Real world businesses actively work on differentiating their products and establishing dominance in the

market reflecting the spirit for survival an aspect often overlooked in traditional theories (Wang, 2021). Understanding this aspect of differentiation is essential for grasping its effects on economic growth and societal welfare (Dirisu, Iyiola, & Ibidunni, 2013). Therefore, by differentiating products in international markets, firms can boost the performance of exports at a firm level and also can survive longer in export markets.

Regarding the interconnectedness between exports and innovation as proposed by *Grossman and Helpmans' theory* which suggests that engaging in trade can spark innovation. Firms involved in exporting are motivated to innovate to stay competitive in markets while seizing opportunities (Helpman & Grossman, 1991). Exposure to competition also pushes firms to enhance product quality and efficiency through practices. Furthermore, trade facilitates technology transfer and knowledge exchange across borders as companies engage with partners and adopt the best practices.

Vernon in 1966, introduced the *Product Life Cycle Theory* consisting of many stages; introduction, growth, maturing and decline. He stated that a product's production location and export patterns change across these stages. Hence, export performance was influenced by a country's position in the product life cycle and its ability to innovate and adapt to changing market dynamics. By establishing the relationship between innovation and exports, it can be concluded that innovation can improve export performance at a firm level which has a positive influence.

Firm level sustainability measures involve implementing eco-friendly practices, ethical sourcing and socially responsible initiatives. Mostly, firms align with the triple bottom concept as sustainability measurement (Ullah & Nasim, 2021). Most importantly export firms that are adopting eco-friendly approaches align with international expectations and comply with evolving regulations.

As the manufacturing sector seeks to optimize export performance, it becomes apparent that sustainability leads to innovation and in turn, innovation becomes the catalyst for enhancing competitiveness. Sustainability demonstrates empirically that firms implementing environmental management practices experience tangible improvements in their export performance. Further, its points not only resonate with environmentally conscious consumers but also serves as markets of product quality and corporate responsibility (Galbreath, 2019). Firms that seamlessly integrate sustainability into their business practices drive innovation, positioning themselves as leaders in an increasingly eco-conscious global marketplace. This integration not only aligns with societal expectations but also propels these manufacturing exporters towards greater success on the international stage. By adopting sustainability practices positively influences a firm's ability to enter and succeed in financial markets (Villena & Souto-Pérez, 2016).

When countries focus on their growth of economy and their national income rise, they often direct their focus on research and development (R&D). This investment in R&D helps create products and effective production methods leading to the creation of jobs, advancements in industries and overall economic progress (Zachariadis, 2003). Global trade of goods also plays a crucial role in the relationship between growth and innovation with trade volumes almost doubling over the past fifteen years, especially noticeable in countries like China, India and economies with

lower wages (UNCTAD, 2023). As nations deal with the challenges of globalization and environmental harm, recognizing the connection between sustainability and global trade is essential for promoting development initiatives and fostering a fairer and stabilized worldwide economy. Firms enhance export performance by gaining competitive advantage, differentiating product as per the demand of eco-conscious customers and reputation built through genuine commitment towards sustainability (Elite Pozzobon, 2016).

2.3 Empirics

The adoption of sustainability practices addresses critical global issues such as poverty, environmental degradation, and climate change. At the same time, these practices act as a driving force for innovation, particularly by highlighting the relationship between sustainability, innovation, and export performance. This relationship can be observed in both developing and developed countries, where sustainability practices foster not only environmental benefits but also contribute to economic growth through innovation and exports.

Sustainability practices demonstrate a multifaceted bundle of actions that promote the long-term well-being of both future and present generations, while securing the preservation of social equity as well as environmental integrity (Pozzobon et al., 2016).At macro level, sustainability practices encourage economic growth by nurturing innovation, capture new market opportunities and fostering financial performance as well as evidenced by the positive correlation between sustainability initiatives and profitability (Pham, 2021)In micro level, sustainability practices incorporate the integration of environmental, economic and social considerations into organizational decision-making processes. (Schaltegger, 2011). Firms that prioritize sustainability often focus on product differentiation and innovation to stand out in the market landscape (Hermundsdottir & Aspelund, 2019; Siregar, 2024)

Sustainability has emerged as a significant factor influencing export performance in developing countries, role of sustainability practices in enhancing the competitiveness of firms operating in emerging markets (Golgeci, 2021). Similarly, sustainability initiatives such as eco- labeling and certification schemes can improve the marketability of products from developing countries by signaling adherence to environmental and social standards (Rahman and Khan,2020).

While sustainability practices may enhance the reputation and brand image of firms, it also entails additional costs and resource commitment, which could potentially erode competitiveness factors such as consumer preferences, regulatory requirements and global supply chain dynamics, which can influence the adoption and impact of sustainability initiatives on export performance (Ashraf, Iqba, & Anjum, 2023). Therefore, sustainability practices, innovation and export performance play a significant role in shaping the development of the economy in developing countries exporting firms (Ullah R. , Ahmad, Rehman, & Fawad, 2023). Sustainability practices stimulate innovation by encouraging firms to explore renewable energy sources, eco- friendly materials and green technologies, thereby enhancing their competitive edge in international markets (Govindan, 2020).

In Sri Lanka, sustainability measures are mostly developed through the concepts of Millenium Development Goals (MDGs) and SDGs. Sri Lanka made significant progress towards achieving MDGs and the key achievements include substantial reduction in the poverty rate (UNDP, 2014; World Bank, 2011), improved healthcare and agricultural programs (ESCAP, 2015; Gunasekera, 2015), achieving a high primary school enrollment rate (Ministry of Education, Sri Lanka, 2010; UNESCO, 2012), significantly reducing the gender gap in education (Perera, 2014; UNICEF, 2014). Sri Lanka has faced multiple challenges, including the 2019 Easter attack, the onset of the COVID-19 pandemic, and the current economic crisis. Despite these setbacks, the country has persistently pursued policy measures at both National and Sub- National levels to fulfill its commitment to the 2030 agenda (Matthias Bruckner, 2018). Although Sri Lanka consistently ranks as a country with high human development, its adjusted Human Development Index is affected by ongoing inequalities.

Sri Lanka is rich in biodiversity, coupled with growing concerns over environmental degradation and climate change has spurred efforts towards sustainable development (Fernando, 2019).Innovation, particularly in sectors such as agriculture, renewable energy and waste management are seen as crucial for addressing these challenges and unlocking economic opportunities for Sri Lanka (Bandara and Tisel 2018). Understanding the role of sustainability initiatives in driving innovation across different sectors is crucial Firms. engaging in product and process innovation more likely to enter new markets and achieve higher export performance. Positive impact of sustainability practices on apparel sector which holds around 40% of the exporting sector, Sri Lanka underscores the benefit from the adaptation.

Sustainability practice adoption has gained increasing relevance in the Sri Lankan export sector, with growing evidence suggesting that integrating sustainability into core business strategies enhances export performance. Broadly, firms that adopt sustainability practices are better positioned to meet global standards, access niche markets, and improve brand image, all of which are critical for maintaining competitiveness in international trade (Fernando, 2019; Perera & Gunasekera, 2014). Environmental practices, such as reducing emissions, waste management, and the use of eco-friendly materials, are particularly important in industries like apparel and agriculture, where global buyers often demand compliance with environmental norms (Gunasekera, 2015; UNDP, 2014). These practices have not only improved firms' market access but also fostered long-term customer relationships and enhanced reputation abroad. However, despite the positive correlation, challenges such as inadequate institutional support, high implementation costs, and limited awareness among SMEs hinder the widespread adoption of such practices (ESCAP, 2015; World Bank, 2011).

Dimension-wise, economic sustainability practices such as efficient resource utilization, cost reduction strategies, and responsible financial management have contributed to improved profitability and price competitiveness of export-oriented firms (ESCAP, 2015). On the social front, practices involving fair labor conditions, community engagement, and employee welfare have been linked to enhanced workforce productivity and compliance with labor standards required by many

foreign buyers (Perera, 2014; UNICEF, 2014). These efforts not only ensure smoother international transactions but also mitigate reputational risks. Environmental sustainability, meanwhile, has emerged as a strategic differentiator, especially in sectors where certifications like ISO 14001 or organic labeling are required. Although the depth of implementation varies across industries and firm sizes, the evidence points to a cumulative positive effect on export performance when sustainability is embedded comprehensively across economic, social, and environmental dimensions. Nonetheless, the literature also stresses that sustained policy support, awareness programs, and financial incentives are essential to deepen the impact of sustainability on Sri Lankan exporters (Fernando, 2019; Gunasekera, 2015).

Significance of sustainability certifications, such as fair trade or organic certifications enhancing the export competitiveness of Sri Lankan products, particularly in the agricultural sector (Nygaard, 2023). These certifications not only signal adherence to ethical and environmental standards but also appeal to niche markets, command premium prices, thereby contributing to improved export revenues. By integrating the sustainability criteria into the supply section, production process and distribution channels, Sri Lankan exporters can enhance product quality, reduce costs, and mitigate risk. This approach helps them gain a competitive edge in international markets (Fernando & Aruppala, 2019). In contrast, there are challenges hindering its effectiveness (Farooq, 2022). But challenges such as limited access to financing, inadequate infrastructure, and regulatory constraints, which hinder the sealing up of sustainable innovations in Sri Lanka (Weerasinghe, 2023).

3. Methodology and Data

This section focuses on the data sources, methods and tools selected for analyzing the research. This study was undertaken to state the analysis and measures of sustainability, innovation and export performance in exporting firms under the Board of Investment (BOI) in the manufacturing sector of Sri Lanka.

Direct interviews were employed to collect primary data along with a structured questionnaire as the research instrument of the study. The structure of the questionnaire adopted by Weerasinghe (2023) which is aligned to Sri Lankan industrial exporting sector and World Bank Enterprise Survey 2021 section H. Scale was adopted by Pozzobon et al. (2010) and Villena-Manzanares & Souto-Pérez (2016). Annual reports of firms and BOI, existing empirical evidence in research articles have gathered as secondary data.

Data collection was done in accordance with the calculations that made before hand by the industrial categories and location-based categorization. There are 18 subcategories under industrial exporting firms of BOI and it rearranged into 5 categories as follows.

Table 1:Iindustrial Classification of BOI-Registered Firms in Sri Lanka

1. Plastic and Rubber	1. Plastic and articles thereof
	2. Rubber Products
2. Food, Beverages and Tobacco	3. Food and Beverages
	4. Tobacco
3. Textiles, Textile articles, Garments and Leather	5. Garments
	6. Textiles
	7. Leather, travel goods and foot wear
	8. Other made-up articles
4. Machinery and compliance, Printing, transport Equipment	9. Machinery and mechanical appliance
	10. Printing industry products
	11. Transport equipment
5. Other	12. Base materials and articles
	13. Ceramic Products
	14. Petroleum
	15. Chemical Product
	16. Gem diamonds and Jewelries
	17. Other industrial exports
	18. Wood and paper products

Source: Board of Investment (BOI) Sri Lanka Database.

The target population consists of 445 registered industrial exporters from Katunayake, Biyagama, Horana and Seethawaka BOI zones because 75% of industrial exporting firms are located in these EPZ zones. According to the calculations, 80 firms were selected using stratified random sampling and simple random sampling techniques. The Board of Investment provided a list of industrial exporting firms registered under the BOI. Stratified random sampling was first applied to the population, and then firms were selected from the list using simple random sampling based on the calculated sample size

Sustainability practices and innovation are the independent variables and export performance is the dependent variable of the study. The conceptual framework consists of two analysis methods: (1) the direct impact of sustainability practices on the export performance of industrial exporters in Sri Lanka and (2) the determinants of innovation of industrial exporters in Sri Lanka. Sustainability practices are divided into three dimensions by aligning to triple bottom line. The argument behind the conceptual framework is sustainability practices influence innovation and innovation influences export performance at firm level. Since sustainability determinant part of innovation, data analysis performed two analyses to measure the association between sustainability, innovation and export performance.

Data analysis consists of descriptive as well as inferential analysis. Descriptive analysis is used to summarize and describe the basic characteristics of the data. Inferential analysis mainly breaks down to two parts which first part consists of examine how sustainability practices impact on Innovation by employing logistic regression analysis and second part consists with how sustainability practices impact on export performance by employing multiple regression analysis; providing dimension wise models as well as overall models. This Study constructed composite indices to measure the Likert scale used for sustainability practices. Through expert

survey, sustainability practices were weighted based on their perceived importance within each dimension.

Economic Specification

In this study, the impact of sustainability on innovation is analyzed by employing the logit model due to dependent variable binary nature. Innovation is a binary variable denoted as 0 for "no" and 1 for "yes". Sustainability is a qualitative variable thus converted to an index through the standard procedures. Regression analysis is used for the analysis of the direct impact of sustainability practices on export performance of the BOI firms.

In this study there are several logit models were constructed where dependent variable is Innovation and independent variables are firm wise overall sustainability index, economic sustainability index, social sustainability index and environmental sustainability index, research and development, size of the firm and age of the firm. In constructing sustainability indices, the OECD's *Handbook on Constructing Composite Indicators: Methodology and User Guide* (2005) served as a foundational resource and Innovation was measured in accordance with Section H of the World Bank Enterprise Survey 2021, which categorizes innovation into process and production innovation, both assessed using a standardized scale. Innovation variable is encoded: if firm has done either process or product innovation as 1 and if has not done either product and process innovation as 0 which is a binary variable. Firm size was coded as if firm size is 300-400 employees it coded as 1 and 0 otherwise. Age of the firm encoded as 1 if firm age is 30-50 years and 0 otherwise. Overall sustainability Index is a composite index and research and development is encoded as where 1 is firm has spending on R&D and 0 otherwise.

Model states as follows:

$$log\frac{p_i}{1-p_i} = \alpha_0 + \theta Z_i + X_i\beta + u_i$$

where the log-odds corresponding to pi (y taking 1=innovative firm, 0 otherwise) is modeled as a linear combination of the covariates plus a possible intercept term: Z_i is the sustainability index, X_i is a matrix consisting some firm level variables such as sectoral dummies, β is a coefficient vector related to other variables, and u_i is the standard disturbance term which is independently and identically distributed.

Multiple Linear Regression with dummy variables is a method used to examine how sustainability practices determine export performance. The main idea of this approach is to understand the association between sustainability practices and export performance at level.

Multiple Regression Equation as follows:

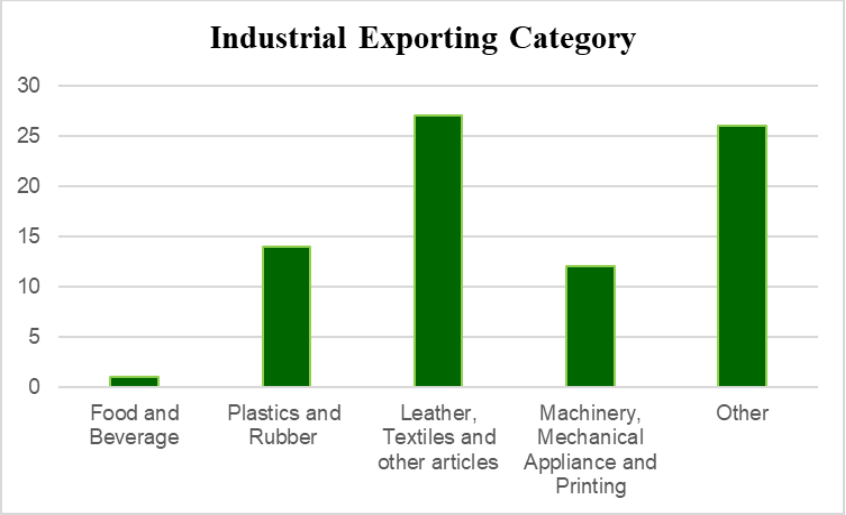
$$y_i = \alpha_0 + \theta Z_i + \beta X_i + u_i$$

Where, y_i is the growth of exports during the years 2017-2019, Z_i is the sustainability index, X_i is a matrix consisting of firm level variables such as sectoral dummies, β is a coefficient vector related to other variables, and u_i is the standard disturbance term which is independently and identically distributed.

4. Estimation and Discussion

This section presents the fundamental characteristics derived from the sample obtained by this study.

Figure 1: Distribution of BOI registered firms by industrial exporting category



Source: Created by the author

Composition of the industrial exporting categories evident that 'Leather, textiles and other articles' category stands out with highest number of firms totaling 27 firms which accounted as 33.75% of the sample while Food and Beverage, Plastic and Rubber, Printing and Machinery and Other categories recorded as one, fourteen, twelve and twenty-six firms respectively. This illustrates the fact that apparel industry of Sri Lanka holds significant position, approximately 46.6% from total exports Sri Lanka which reflect in the sample composition. Distribution of the BOI registered firms, the largest portion recorded in Katunayake BOI zone which accounted as 39% while Biyagama, Horana and Seethawaka BOI zones recorded 30%, 21% and 10% respectively. For sustainability, author has constructed composite indices for each dimension as well as overall sustainability. For interpretation, author has set the rage as follows.

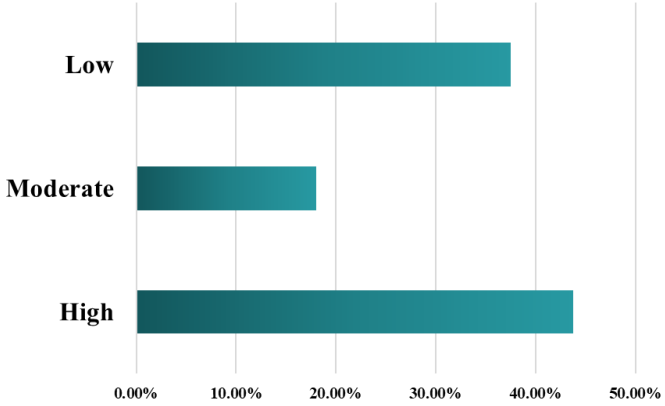
***T*able 2: Classification of Sustainability Levels Based on Composite Index Scores**

Range	Level of Sustainability
0-0.39	Low sustainability
0.4-0.6	Moderately sustainable
0.6>=	Highly sustainable

Source: Author's Compilation.

According to the results, all the firms have adopted sustainability practices up to certain extent at firm level

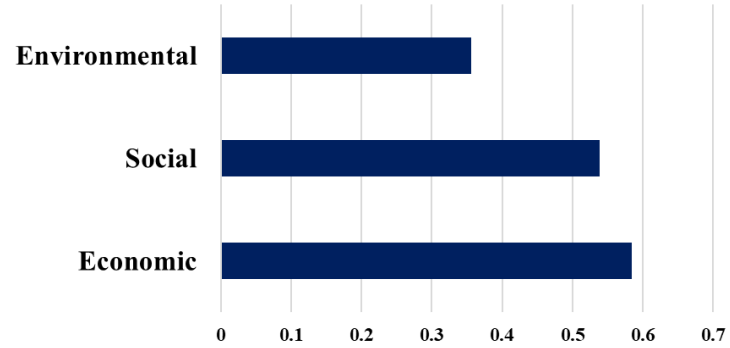
Figure 2: Overall Sustainability Adoption Rate 2017-19



Source: Created by the author

Among all industrial firms, 43.8% of industrial firms reported a high rate of overall sustainability. But 37.5% of industrial firms have low rate of overall sustainability in Sri Lanka.

Figure 3: Dimension Wise Sustainability Index 2017-19



Source: Created by the author

Figure 3 demonstrates that dimension wise sustainability in average of industrial exporting firms in Sri Lanka. It demonstrates that economic, social and environmental sustainability in average recorded as 0.584, 0.538 and 0.356 respectively. Economic and social sustainability depict moderate level which implies stability in financial performance and social responsibility up to certain level. But environmental sustainability is low which highlight significant gap of environmental sustainability practice adoption in industrial exporting firms of Sri Lanka.

As per the results of cross tabulations describe that both firm size and specific industrial category have a notable interconnection with sustainability practices at firm level in the context of Sri Lanka. Larger firms specially those who have employees

more than 300 have a tendency to integrate sustainability practices when compared to the small sized firms. Industries including leather and textile demonstrate a higher tendency to integrate sustainability practices to the firm.

Descriptives illustrate that 81% of the firms have done and 75% of industrial firms have done research and development according to the results of the study. Export performance descriptives reveal that most of the industrial exporting firms indicating moderate export performance which accounted as 61.3% while only 22.5% of firms that have performed high export performance. As per the cross-tabulation results, only 12.5% of the firms that have performed high sustainability adoption while achieving high export performance.

We employ multiple regression technique to analyze the impact of sustainability practices on export performance at firm level. This analysis consists with dimension wise models as well as overall model. As mentioned earlier, four indices were constructed for sustainability; economic sustainability, social sustainability, environmental sustainability and overall sustainability. Overall sustainability index is the independent variable while industrial category and research and development are the control variables of the model.

Export growth is the dependent variable, log export growth has taken to more normalize the data. The variable 'industrial category' which is control variable, breaks down to five categories which are 'Food and beverages', 'Plastic and Rubber', 'Textiles, Garments and leather', 'Machinery, Mechanical appliances and printing' and 'Other'. Therefore, model has performed four dummy variables by taking food and beverage as the reference category for the model. Multiple regression results of overall model as follows.

Table 3: Results of Logistic Regression Overall Model

Dependent Variable: Innovation 2017-2019			
Variable	Model (1)	Model (2)	Model (3)
Overall sustainability index	3.159572**	9.442853**	17.72423**
	(1.609233)	(3.570827)	(6.770023)
Research and Development		5.814980**	8.143473**
		(1.504462)	(2.565512)
Age			-0.444844
			(1.03767)
Size			-3.135902
			(1.861539)
Constant	0.019668	-5.732003	-7.877521
	(0.744837)	(2.136085)	(2.946412)
No of Observation	80	80	80
R2	0.053229	0.585544	0.647446
F-test value- LR statistic	4.109908	45.21128	49.99090

Note: *, **, and *** indicate the estimated coefficients are statistically significant at 10%, 5%, and 1% respectively and Standard errors are reported in parentheses.
Source: Author's compilation based on E-Views Version 12

Model one was estimated by introducing overall sustainability and model two and three were included in addition to the variable of interest other variable in explaining export performance. It is evident that throughout model one to model three, overall sustainability index remains positive and statistically significant in consistent manner while Research and development also indicating same results with regard to the models.

The sustainability index coefficient shows how export growth changes, for every 0.1 increment in the Sustainability Index assuming all other factors remain constant. As per the results of multiple regression model, there is a positive significant impact of overall sustainability index and research and development on export performance.

For dimension wise model, economic, social and environmental sustainability indices are independent variables while export growth is the dependent variable which reflect the export performance. Research and development and industrial category are control variables of the model. Dimension wise results as follows.

Table 4: Results of Logistic Regression Sub-Indices Model

Dependent Variable: Innovation 2017-2019

Variable	Model (1)	Model (2)	Model (3)
Economic sustainability index	13.82290**		
	(5.280715)		
Environment sustainability index		3.218843	
		(2.777449)	
Social sustainability index			11.73250**
			(4.749358)
Research and Development	8.023963	4.294110	7.206082**
	(2.557680)	(0.989315)	(2.312635)
Age	0.981901	0.989602	-0.236648
	(1.066858)	(0.906686)	(1.102475)
Size	4.120437	-0.987319	2.193344
	(2.207575)	(0.948585)	(1.63839)
Constant	-11.31012	-2.014407	-7.915282
	(4.282932)	(1.375928)	(3.069999)
No of Observation	80	80	80
R2	0.652830	0.487381	0.41591

Note: *, **, and *** indicate the estimated coefficients are statistically significant at 10%, 5%, and 1% respectively and Standard errors are reported in parentheses.

Source: Author's compilation based on E-Views Version 12

Above model demonstrate the dimension wise models which illustrate the impact of economic, social and environmental dimensions on export performance at firm level. As per the results of dimension wise models, economic sustainability has a positive significant impact on export performance at firm level under 95% of confidence interval.

Under second analysis, examines the how sustainability practices determine the innovation at firm level. Logit model has employed since dependent variable has

a binary nature. This analysis also consists dimension wise models as well as overall model. Dependent variable is innovation which is binary; have done or not have done innovation. Age, size and research and development are control variables of the model while overall sustainability index is the independent variable in the overall model. Results of the overall model as follows.

Table 5: Results of Multiple Regression Overall Model

Dependent Variable: Logarithm of Export Growth during 2017-2019			
Variable	Model (1)	Model (2)	Model (3)
Overall sustainability index	0.5640*	0.5821**	0.5377**
	(0.2445)	(0.2363)	(0.2296)
Research and Development		0.2630**	0.2888**
		(0.1021)	(0.1027)
Leather, Textiles, and other articles			0.1800
			(0.2811)
Mechanical Appliance and Printing			0.3830
			(0.2882)
Plastic and Rubber			0.4293
			(0.2893)
Other			0.0696
			(0.2785)
Constant	-2.3072	-2.513494	1.8841
	(0.1287)	(0.147859)	(0.2953)
No of Observation	80	80	80
R^2	0.0518	0.1157	0.1893
F-test value	5.3183	6.1686	4.0744

Note: *, **, and *** indicate the estimated coefficients are statistically significant at 10%, 5%, and 1% respectively and Standard errors are reported in parentheses.
Source: Author's compilation based on E-Views Version 12

Notably, both the Overall Sustainability Index and R&D investment are identified as significant factors influencing innovation. A rise of one unit in the Overall Sustainability Index is linked to an increase in the chances of innovation with an estimate of 17.72423 indicating that companies with strong sustainability efforts are more likely to engage in innovative practices. importance of technology advancement and innovation focused approaches for driving innovation.

Table 6: Results of Multiple Regression Sub-Indices Model

Dependent Variable: Logarithm of Export Growth during 2017-2019			
Variable	Model (1)	Model (2)	Model (3)
Economic sustainability index	0.4114**		
	(0.1721)		
Environment sustainability index		0.4317	
		(0.2447)	
Social sustainability index			0.3040
			(0.1839)
Research and Development	0.2888**	0.3051**	0.2811**

	(0.1026)	(0.1045)	(0.1048)
Leather, Textiles, and other articles	0.1701	0.1488	0.1867
	(0.2805)	(0.2852)	(0.2868)
Mechanical Appliance and Printing	0.3720	0.3860	0.3976
	(0.2879)	(0.2927)	(0.2934)
Plastic and Rubber	0.4239	0.4262	0.4440
	(0.2889)	(0.2938)	(0.2945)
Other	0.0521	0.0505	0.0979
	(0.2782)	(0.2830)	(0.2839)
Constant	1.9197	2.0010	1.9745
	(0.2888)	(0.2894)	(0.2972)
No of Observation	80	80	80
R2	0.1916	0.1640	0.1598
F-test value	4.1221	3.5835	3.0515

Note: *, **, and *** indicate the estimated coefficients are statistically significant at 10%, 5%, and 1% respectively and Standard errors are reported in parentheses.
Source: Author's compilation based on E-Views Version 12

Under dimension wise models, three different models were created to study how sustainability factors, company characteristics (age and size) and Research and Development (R&D) influence innovation within companies.
As per the results, it can be concluded with evidence that social sustainability and economic sustainability both indices have positive significant impact on innovation at firm level.

5. Conclusion

This study investigates the interplay among sustainability, innovation and export performance at firm level in Sri Lankan industrial exporting firms specially registered under BOI and operating in Katunayake, Biyagama, Seethawaka and Horana because 70% of the industrial exporting firms are located in these for BOI zones. This research addressing the existing gap of understanding the impact of sustainability practices on Innovation and Export Performance especially in Sri Lanakan context.

Descriptive analysis illustrates that the composition of the industrial exporting categories evident that 'Leather, textiles and other articles' category stands out with highest number of firms totaling 27 firms which accounted as 33.75% while distribution of the BOI registered firms, the largest portion recorded in Katunayake BOI zone. According to the results, most of the firms have adopted sustainability practices up to certain extent. As per the results of cross tabulations that describe both firm size and specific industrial category have a notable interconnection with sustainability practices at firm level in the context of Sri Lanka. Larger firms have a tendency to integrate sustainability practices and leather and textile category demonstrates a higher tendency to integrate sustainability practices to the firm.
According to the results of inferential analysis, there is a positive impact of overall sustainability practices as well as social sustainability practices in dimension wise on innovation at firm level which proves the existing argument of literature. Multiple regression results provide the evidence as positive significant impact of overall sustainability practices and economic sustainability practices in dimension wise on

export performance at firm level in Sri Lanka which contribute as new finding to existing literature for Sri Lankan context.

Findings of inferential analysis reveals that economic sustainability, especially recycling and reclaim materials and resource efficiency have most substantial impact on export performance. In the context of social sustainability, workplace policies play a pivotal role for drive innovation. To address this, study recommends financial incentives such as tax breaks for firms investigating in accessible workplace as well as public awareness campaigns to foster 'green thinking culture. For environmental sustainability, study claims that green certifications like ISO14001 and consumer reward programs to promote eco-friendly packaging as well as waste reduction. It enhances operational efficiency and align to the international sustainability framework and standards thus improve the export performance.

Lastly, policy implications emphasize a multifaceted approach to incorporate sustainability practices into firm level industrial exporting sector of Sri Lanka. This research suggests for policy makers to support sustainability adoption through financial incentives such as low interest loans and grants for green infrastructure and recycling technologies. Moreover, by building a national brand identity that demonstrate commitment to sustainability, Sri Lanka as a developing country can attract environment conscious audience and also investors. Therefore, implementing sustainability practices in holistic manner policymakers can promote a supportive eco-system that enhances export performance of Sri Lanka not only at firm level but also as a country and be a leading country in sustainable manufacturing.

References

Achinivu, G. K. (2017). Product life cycle theory and its application in business research: A systematic review approach. *Entrepreneurship and the Knowledge Economy*, 282.

Amrutha, V. N., & Geetha, S. N. (2020). A systematic review on green human resource management: Implications for social sustainability. *Journal of Cleaner Production*, 119131.

Anderson, P., & Tushman, M. L. (2018). Technological discontinuities and dominant designs: A cyclical model of technological change. In *Organizational Innovation* (pp. 373–402). Routledge.

Anil, N. K., Shoham, A., & Pfajfar, G. (2016). How export barriers, motives, and advantages impact export performance in developing countries. *International Journal of Export Marketing*, 117–141.

Archibugi, D. D., & Filippetti, A. (2009). The technological capabilities of nations: The state of the art of synthetic indicators. *Technological Forecasting and Social Change*, 917–931.

Ashraf, H. A., Iqba, J., & Anjum, W. (2023). Greening the bottom line: Investigating the influence of green management innovation on firm financial performance in the Pakistani manufacturing sector. *Global Economics Review*, 291–306.

Ashraf, M. A. (2019). Transition from millennium development goals (MDGs) to sustainable development goals (SDGs): Blueprint of Bangladesh for

implementing the sustainable development goals (SDGs) 2030. *Medicine Today*, 31, 46–59.

Barbieri, N., Consoli, D., Napolitano, L., Pugliese, E., & Sbardella, A. (2023). Regional technological capabilities and green opportunities in Europe. *The Journal of Technology Transfer*, 749–778.

Biely, K., Passel, V., & Steven, J. (2022). Market power and sustainability: A new research agenda. *Discover Sustainability*.

Boso, N. S.-M. (2013). Firm innovativeness and export performance: Environmental, networking, and structural contingencies. *Journal of International Marketing*, 62–87.

Department of Census and Statistics, S. L. (2024, January). Sustainable development goals in Sri Lanka. pp. 1–2.

D'Souza, C., Apaolaza, V., Hartmann, P., & Brouwer, A. R. (2019). Marketing for sustainability: Travellers' intentions to stay in green hotels. *Journal of Vacation Marketing*, 27, 187–202.

Dissanayake, S. P., Gunaratne, L. H., Sivanathewerl, T., & Ginigaddara, G. A. (2021). Impact of adoption of sustainable agricultural practices on household food security in small-scale paddy-cattle farming systems in Anuradhapura District, Sri Lanka.

Evans, N. B., Short, S., & Rana, P. (2014). A literature and practice review to develop sustainable business model archetypes. *Journal of Cleaner Production*, 65, 42–56.

Farooq, S. (2022). Effect of financial crisis on sustainability of industrial sector in Sri Lanka. *Journal of Research in Social Development and Sustainability*, 33–44.

Fernando, M., & Aruppala, D. (2019). Role of green supply chain management on project success of Sri Lankan construction companies.

Fernando, R. G. (2022). Sustainable machining: Environmental performance analysis of turning. *International Journal of Sustainable Engineering*, 15–34. https://doi.org/10.1080/19397038.2021.1995524

Freeman, R., & Phillips, R. (2002). Stakeholder theory: A libertarian defense. *Business Ethics Quarterly*, 12, 331–349.

Fukuda-Parr, S. (2016). From the Millennium Development Goals to the Sustainable Development Goals: Shifts in purpose, concept, and politics of global goal setting for development. *Gender and Development*, 24, 43–52.

Fukuyama, F., & Marwah, S. (2000). Dimensions of development. *Journal of Democracy*, 11, 80.

Gössling, S. (2019). Tourism, information technologies and sustainability: An exploratory review. *Marketing for Sustainable Tourism*, 156–173.

Gaglio, C. (2017). Trade liberalization and export performance: A literature review. *Revue d'économie politique*, 1, 25–46.

Galbreath, J. (2019). Drivers of green innovations: The impact of export intensity, women leaders, and absorptive capacity. *Journal of Business Ethics*, 47–61. Retrieved from http://www.jstor.org/stable/45181118

Goodland, R. (1995). The concept of environmental sustainability. *Annual Review of Ecology and Systematics*, 1–24.

Govindan, K. A. (2020). Supply chain sustainability and performance of firms: A meta-analysis of the literature. *Transportation Research Part E: Logistics and Transportation Review*, 101923.

Grossman, G. M. (1990). Trade, innovation, and growth. *The American Economic Review*, 80(2), 86–91.

Helpman, E., & Grossman, G. (1991). Trade, knowledge spillovers, and growth. *European Economic Review*, 35, 517–526.

Hermundsdottir, F., & Aspelund, A. (2021). Sustainability innovations and firm competitiveness: A review. *Journal of Cleaner Production*, 124715.

Hidalgo, C. A., Klinger, B., Barabási, A. L., & Hausmann, R. (2007). The product space conditions the development of nations. *Science*, 317(5837), 482–487.

Hoekman, B., & Sabel, C. (2021). Plurilateral cooperation as an alternative to trade agreements: Innovating one domain at a time. *Global Policy*, 12, 49–60.

Hueting, R. (2010). Why environmental sustainability can most probably not be attained with growing production. *Journal of Cleaner Production*, 18(6), 525–530.

Hultman, M., Robson, M. J., & Katsikeas, C. S. (2009). Export product strategy fit and performance: An empirical investigation. *Journal of International Marketing*, 1–23.

Idowu, S. O. (2021). World Business Council for Sustainable Development; Encyclopedia of Corporate Social Responsibility. Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-28036-8_196

Jarmai, K. (2020). Learning from sustainability-oriented innovation. In *Responsible Innovation: Business Opportunities and Strategies for Implementation* (pp. 19–35).

Jayarathne, P., & Sachitra, V. A. (2021). Sustainable practices through competitive capabilities in the apparel industry: Sri Lankan experience.

Klewitz, J., & Hansen, E. G. (2014). Sustainability-oriented innovation of SMEs: A systematic review. *Journal of Cleaner Production*, 65, 57–75.

Kularatne, T., Wilson, C. A., Hoang, V., & Lee, B. (2019). Do environmentally sustainable practices make hotels more efficient? A study of major hotels in Sri Lanka. *Tourism Management*, 213–225.

Kumar, S. A. (2016). Millennium development goals (MDGs) to sustainable development goals (SDGs): Addressing unfinished agenda and strengthening sustainable development and partnership. *Indian Journal of Community Medicine*, 41, 1–4.

Leal Filho, W., Fritzen, B., Ruiz Vargas, V., Paço, A. Z., Q., D. F., & Wu, Y. J. (2022). Social innovation for sustainable development: Assessing current trends. *International Journal of Sustainable Development & World Ecology*, 311–322.

Leonidou, L. C. (1995). Empirical research on export barriers: Review, assessment, and synthesis. *Journal of International Marketing*, 29–43.

Lopes, J. M., Pacheco, S., Monteiro, R., Santos, E., & Carolina, T. (2022). Drivers of sustainable innovation strategies for increased competition among companies. *Sustainability*, 14.

Lozano, R. (2015). A holistic perspective on corporate sustainability drivers. *Corporate Social Responsibility and Environmental Management*, 22, 32–44.

Lyon, T. A. (2007). Corporate social responsibility and the environment: A theoretical perspective. *Review of Environmental Economics and Policy*, 240–260.

Man, M. M. (2010). The relationship between distinctive capabilities, innovativeness strategy types and the export performance of small and medium-size enterprises (SMEs) of the Malaysian manufacturing sector. *International Journal of Management and Innovation*, 15.

Managi, S., & Kumar, S. (2013). Green innovation and sustainable development in the manufacturing sector. *Global Environmental Change*, 205–215.

Nascimento, F. B., & Andre, B. (2023). The role of sustainability in export firms' performance: Insights from small and medium enterprises. *Journal of International Business and Sustainability*, 67–80.

Niebel, T., & Schlemmer, J. (2016). Sustainability strategies for the firm. *Global Economics Review*, 48, 94–106.

Osman, S. (2015). Driving forces of sustainability in SMEs and the challenges of sustainable development in Sri Lanka. *Environmental Management Review*, 12, 2015.

Saha, P., & Bhuiyan, M. (2023). Environmental sustainability practices for manufacturing SMEs: A case study. *Journal of Sustainability Management*, 45, 1425–1435.

Tamura, K., & Ueda, Y. (2020). The role of innovation in export competitiveness of firms. *International Journal of Innovation and Technology*, 11, 101–112.