Volume 5, Issue 2, December 2025 - ISSN 2735-5969
http://dx.doi.org/10.21622/IBL.2025.05.2.1665

Interrelations of Logistics Performance and Trade Promotion: A Systematic Review

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Received on: 09 September 2025 **Accepted on: 09 November 2025** **Published on: 25 November 2025**

Abstract

Logistics activities play a critical role in the supply chain system from the sourcing of raw materials through production up to the final product delivery to the end user. This systematic review sought to establish the propensity to use LPI to measure logistics performance and explore the interrelationships between green transportation, logistics eco-innovations, and trade promotion. The Preferred Reporting Items for Systematic Reviews and Meta–Analysis (PRISMA) guided the search. Three databases, Scopus, Web of Science, and Science Direct, were searched, while English peer-reviewed articles published between 2000 and 2025 were considered. Screening, data extraction, and critical appraisal were conducted by two authors independently. The search yielded 21 papers that met the inclusion criteria. The papers used quantitative methods of data analysis with a sample size ranging from 17 to 622 respondents. The results indicated an inclination to use LPI to measure logistics activities, though it was marred by some limitations. The reviewed papers collectively highlighted the benefits of green transportation and logistics eco-innovations in environmental degradation prevention through CO_2 reduction, emission minimization, and pollution reduction. The study is crucial for developing nations through their respective governments, policy makers, and logistics managers to better understand the role of logistics activities, as guided by the LPI, in trade promotion. Though the review provides notable insights in the logistics field, it has some limitations, such as the choice of English language only and the databases considered. The review, in addition, provides recommendations for future studies.

Keywords: *Logistics performance, green transportation, eco-innovations, trade promotion, developing nations.*

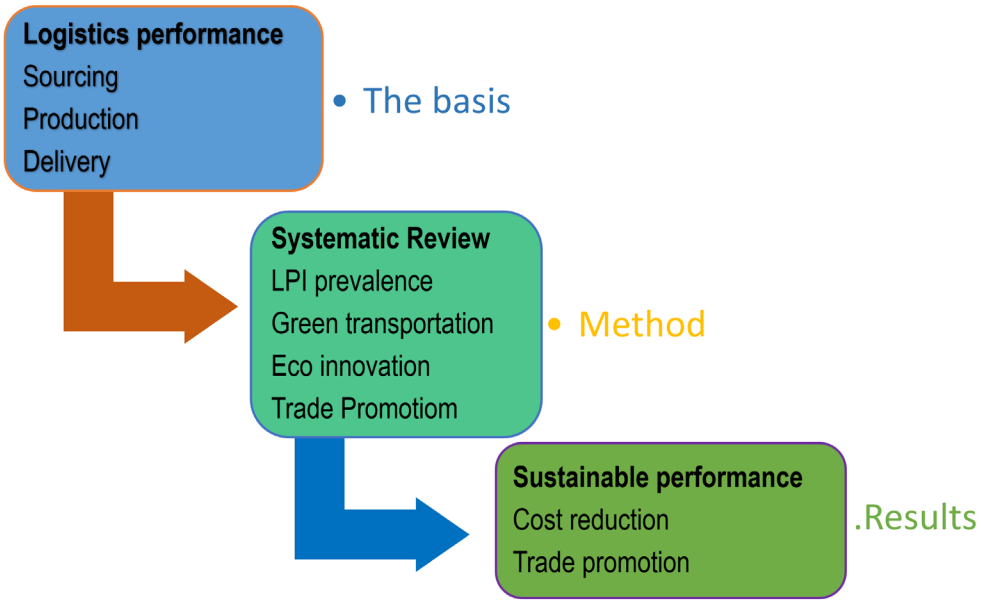

Figure 1: Abstract's graphical illustration

Volume 5, Issue 2, December 2025 - ISSN 2735-5969
http://dx.doi.org/10.21622/IBL.2025.05.2.1665

Introduction

Logistics is a crucial sector that, apart from enhancing the competitiveness of a firm, also promotes the national economic performance and development of a country (Li et al., 2023; Rashidi & Cullinane, 2019). Effective logistics promote economic growth through the production and distribution of goods at reduced costs and enhance customer demand by embracing reliable mechanisms (Domagała et al., 2022; Nikseresht et al., 2024). It also promotes trade through producers' ability to access far-off markets, ability to reduce inventories, gaining foreign direct investment, sustainable competitiveness achievement, and job creation opportunities in the logistics sector (Klymenko & Halse, 2022; Waiyawuththanapoom et al., 2021). Though the logistics industry has contributed immensely to global economic growth, it has brought about significant environmental challenges with the inclusion of noise pollution, emissions of environmental pollutants, traffic congestion, mass landfill through garbage and waste generated in the production process, and daily life as a result of transportation methods. There is a growing worldwide concern regarding our planet's ecological protection due to major pollution incidents emanating from logistics activities.

Innovation is one of the major ways through which environmental protection goals can be achieved (Borrás & Edquist, 2013). Technological innovation provides novel inspirations toward low carbon dioxide emissions and green environment protection (Yi et al., 2020). Other scholars have concurred with this crucial role of technological innovations. For instance, Pan et al. (2019) established a significant relationship between technological innovation and energy efficiency improvement. Similarly, Ibrahiem (2020) indicated that technological innovation improves the quality of the environment to a large extent. Furthermore, Lahouel et al. (2021) demonstrated that science and technology innovation play a crucial role in improving the whole factor green productivity, while information and communication technology facilitates green economy development.

To measure a country's logistics performance, the World Bank, in conjunction with Finland's Turku Institute of Economics, devised the national Logistics Performance Index (LPI) in 2007. This became the initial step toward comprehensively evaluating the development level of logistics performance in different countries. LPI is a derivative of a standardized questionnaire that takes online surveys and then makes use of principal component analysis to compose the data into a single index. The values range between 1 and 5, with one as an indicator of low logistics performance and 5 indicating high performance. The results are released every two years, with the first release in 2007 (Arvis et al., 2018). The six components of customs, infrastructure, services, timeliness, tracking and tracing, and international shipments inform the LPI.

LPI, as an interactive benchmarking tool, identifies eminent opportunities and challenges associated with logistics performance. Arvis et al. (2018), in pursuit of exploring the state of logistics performance in different nations, established that while low-income nations concentrated on logistics infrastructure and facilitation of transport, countries in the middle-income earners' band focused on efforts toward improvement of logistics skills, services, and trade regulations. On the other hand, high-income nations were more focused on the state of green logistics and information systems. Green logistics impacts a country's trade performance through cost reduction, timeliness, consistency, and customer service, all of which influence the overall global export competitiveness (Yingfei et al., 2022). Therefore, the LPI is not without limitations, and while some scholars appreciated the use of LPI as a unifying factor in measuring the effectiveness of the logistics sector at the international level, they argued that it was not generally suitable to measure domestic or in-country performance (Nayak et al., 2024; Nguyen & Le, 2024). Against this backdrop, to fill the mentioned gaps, this study sought to conduct a systematic review on the role of logistics performance in trade promotion while guided by the following specific objectives:

1. To determine the propensity to use the logistic performance index as a measure of logistics performance
2. To establish the implications of green logistics on trade promotion
3. To explore logistics eco-innovation adoption and its association with trade promotion.

Literature Review

Logistics is one of the key areas that supports the direct establishment of customer relationships and enhances organizations' long-lasting competitive advantage (Ali et al., 2022). Erturgut (2016) regarded logistics performance as the high-quality implementation of logistics activities when delivering products from the source to the end consumer with prompt consideration of logistics principles as well as customer satisfaction. How efficiently logistics activities are adopted significantly influences an organization's capability to satisfy customer requirements at the minimal cost possible (Marchesini & Alcântara, 2016). Fahimnia et al. (2011) noted that it is imperative to monitor logistics performance across the entire supply chain, right from the raw materials' supply up to the end user or the

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individual consumer. The impetus to reduce costs while increasing logistics performance is directly associated with an improvement in both local and international trade (Carlucci et al., 2018).

Arshed et al. (2022) noted that the association between logistics and trade promotion is one of the most researched topical issues in the recent past. This has led to a skewed interest in logistics performance measurement in different organizations. As argued by Waśniewski (2021), adequacy in the performance measurement system is paramount to all logistics organizations. The establishment and construction of logistical performance must therefore directly communicate with the proposed objective achievement of a firm. Different approaches have been used to measure logistics performance. For instance, Mentzer and Konrad (1991) used the logistics activities' concept of transportation, inventory management, warehousing, and order processing, among other logistics management subcategories, to determine logistics performance. Logistics effectiveness, superiority, or differentiation and efficiency concepts have also been used in numerous studies as measures of logistics performance (Bobbitt, 2004; Fugate et al., 2010). The introduction of LPI in 2007 became the initial step toward comprehensively evaluating the logistics performance of different countries. Although without limitations, LPI has been used as a yardstick in measuring logistics performance, and different scholarly works have evaluated its association with various factors such as economic growth, green transportation, innovation, and trade, among others.

The green supply chain has increasingly become a hot topic in the management science field, with green logistics as its subcategory. According to Wu and Dunn (1995), green logistics is an overall environmentally friendly logistics system comprising green transportation, green warehousing, reverse logistics, and waste recycling. The main drive toward green logistics adoption is the achievement of a sustainable balance in the relationship between economic, environmental, and social gains (Dekker et al., 2012). The three categories are anchored on the Bottom Line sustainability framework (TBL), which challenges industries to include the security of people and planet protection in their pursuit of economic achievements (Griggs et al., 2013). Several studies have linked TBL with green transportation and firm performance. For example, Lai and Wong (2012) established a significant positive relationship between green logistics management and environmental quality improvement and business performance at the manufacturing level. Regulatory pressures also promoted green logistics and had a positive effect on environmental profitability. D'Aleo and Sergi (2017) also emphasized the competitive edge enjoyed by companies that embrace effective green logistics. These include an increment in the market value of products and cash flow optimization with the inclusion of current and other expenses reduction.

A firm's green logistics services, coupled with efficient procedures, enhance its competitive advantage and increase its performance (Campos & Hardwick, 2006). According to Wong and Tang (2018), in the green logistics realm, efficient supply chain management has a significant positive relationship with a firm's performance since a green supply chain results in enhanced organizational performance, which in turn promotes profitability and market share. This improves the environmental sustainability and financial performance of a firm.

In as much as the logistics sector is considered the global economy's backbone through its crucial role of connecting suppliers with consumers worldwide, the sector is marred by side effects that, if unchecked, would be detrimental to the present and future generations, environmentally speaking. Logistics activities have resulted in elevated fossil fuel combustion and direct release of greenhouse gases (GHG) into the atmosphere, which has a damaging effect on the health and environment in the long run (Magazzino & Schneider, 2020). In 2014, for example, it was noted that the logistics sector was named a major contributor to environmental degradation, accounting for 22% of carbon dioxide (CO_2) emissions worldwide. OECD (2017) emphasized the need to embrace green supply chain failure, to which transport emissions of CO_2 are projected to rise by 60% by 2050, while global freight alone will take a lion's share of 160%. Therefore, how do firms strike a balance between conducting logistics activities and taking care of the environment? Innovation has been singled out as one of the surest ways of safeguarding the environment (Borrás & Edquist, 2013).

Innovation can generally be termed as "the implementation of a new or significantly improved product (goods/service) or process, a new marketing method, or a new organizational measure in practice, in the work organization or in external relations" (Manual, 2005). Consequently, eco-innovation entails the production, assimilation, and adoption of novel products, services, and processes, which results in the reduction of environmental risks such as pollution and degradation (Kemp & Pearson, 2007). Therefore, in relation to the sustainability of logistics activities, the role of eco-innovation in reducing climate change and curbing environmental pollution cannot be ignored (Greenland et al., 2023). Although there is evidence of significant commitment toward greening through innovation adoption in developing nations, the process is, however, faced by unlimited challenges (Nguyen & Dekhili, 2019; Van Loi et al., 2020). The challenges

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arise from factors such as striking a balance between business growth and the ability to reduce the negative impacts associated with logistics, distribution, and manufacturing operations, in addition to the pollution concerns created by the mushrooming industrialization and urbanization (Li & Qamruzzaman, 2023; Van Loi et al., 2020). The benefits of innovation in the logistics sector outweigh the challenges, with various scholars establishing a significant positive relationship between innovation and sustainable development, corporate performance, competitive advantage, and business growth, among others (Ayinaddis, 2023; Le et al., 2022; Tseng et al., 2022). Different theories that guide firms in the adoption, implementation, and evaluation of innovative technologies have been established. This review will be grounded on the diffusion of innovation theory (DOI), which seeks to establish how firms adopt eco-innovation by considering the following perspectives: innovation's advantages, ease of use, compatibility, trialability, and observability (Rogers, 2003). Extant research has established a few studies examining eco-innovation adoption in developing countries, particularly linking LPI and DOI, hence this review.

Methods

To gather, analyze, and synthesize related studies in the field of logistics performance and trade promotion, this paper adopted the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA). Page et al. (2021) noted that the use of the PRISMA approach guarantees a comprehensive and unbiased analysis of the reviewed literature. Three databases of Scopus, Web of Science, and Science Direct were searched. The key words included in the search were 'logistics performance', 'logistics efficiency', 'logistics capacity', 'trade promotion', 'business promotion', 'trade support' and 'developing countries." The search strategy adopted Boolean operators of 'AND, OR" in combining the key terms as follows: (*logistics performance OR logistics efficiency OR logistics capacity) AND (trade promotion OR business promotion OR trade support) AND (developing countries OR emerging nations).* This ensured a comprehensive exploration of the related literature. Open-access peer-reviewed journal papers published between 2000 and 2025 were considered for review. The review considered English-only papers within the scope of developing nations that used quantitative data analysis techniques. According to Halog and Anieke (2021), although research in environmental sustainability has gained impetus in the recent past, it is generally a new concept, and slow growth has been evidenced in developing nations apart from China, hence the choice of developing countries and the short time range. The systematic identification and screening process yielded 21 papers that were considered eligible for analysis. The search flow diagram is shown in Fig. 2.

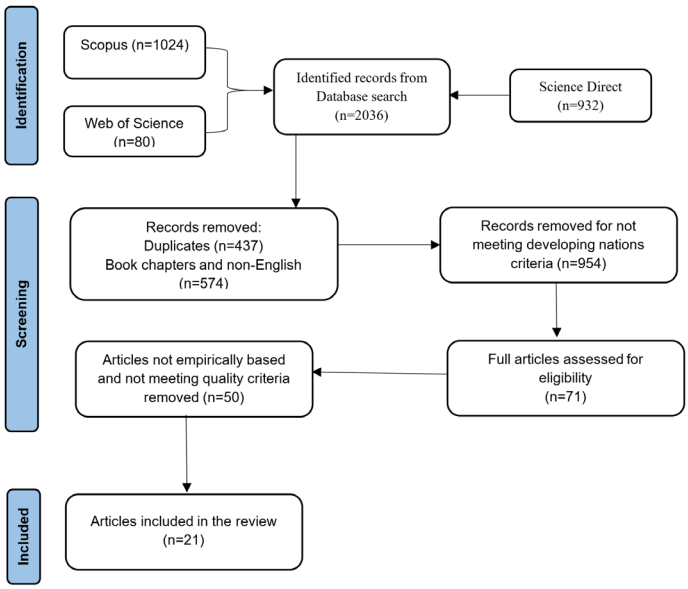

Figure 2: PRISMA flow diagram

Results

The review narrowed down to 21 peer-reviewed papers that covered cross-cutting topical issues related to logistics performance, green logistics, logistics eco-innovation, and trade promotion. The study area was developing nations as categorized by the World Economic Situation Report (WBG, 2022). Out of the 21 reviewed papers, seven were specifically from China, five from Asian countries 5, Thailand 1, three from Africa 3, three from emerging nations 2, Bangladesh 1, Vietnam 1, and 1 from India. The results section is divided into three categories with seven papers in each category. Category one dealt with papers covering the propensity to use LPI as a measure of logistics performance (Table 1), category two looked at the association between green transportation and trade promotion (Table 2), while the last category dealt with reviewing the interrelations between logistics eco-innovation and trade promotion (Table 3). The papers used quantitative methods of data analysis with a sample size ranging from 17 to 622 respondents. The data collection methods used comprise online surveys, interviews, focus groups, and secondary data from different accredited sources. The wide range of data collection methods, varying sample sizes, and wide geographical scope enriched the understanding of topical issues in relation to logistics performance and trade promotion in developing nations.

Volume 5, Issue 2, December 2025 - ISSN 2735-5969
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Propensity to use the logistic performance index as a measure of logistics performance

Most of the reviewed journal articles jointly underscored the widespread propensity to use LPI as a measure of logistics performance in different countries. They illuminated the six subcategories of LPI of customs, infrastructure, ease of shipment, logistics services, tracking and tracing, and timeliness, whereby in some studies all six subcategories were included, while others included some of them, and the majority used the aggregate value (Chang et al., 2020; Halaszovich & Kinra, 2020; Koh et al., 2018).

Of the six subcategories, infrastructure scored the highest in spurring logistics activities across borders (Chang et al., 2020; Halaszovich & Kinra, 2020). Better infrastructure corresponded to lower transportation costs, improved efficiency, and positive economic consequences (Chang et al., 2020). While reviews called for infrastructure upgradation to trigger economic growth, they also advocated for investment in national road infrastructure to overcome national transportation system obstacles that limit international business activities (Ding et al., 2022; Halaszovich & Kinra, 2020).

In the relationship between LPI and transportation costs, findings were collectively in agreement that higher logistics aggregate value meant lower logistics transportation costs and higher export levels (Chang et al., 2020; Panichakarn & Pochan, 2023). This means that logistics efficiency informed by the chosen mode of transportation had a direct positive effect on transportation costs, which translated into improved local and international trade (Chang et al., 2020; Ding et al., 2022; Panichakarn & Pochan, 2023). Ding et al. (2022), for example, used China's LPI to explore the interrelations between logistics performance and export competitiveness. Results established that when the efficiency of logistics and transport was high, transportation costs expressed per unit distance were low, and with a decrease in logistics and transportation costs, demand for domestic products by foreign markets increased, as did the export value, which was expressed in terms of domestic prices. Ding et al. (2022) further noted that the reduction of transportation costs by approximately 50% had a fivefold increment in the number of transactions made.

LPI also considered corruption an ethical issue. Koh et al. (2018) assessed the relationship between corruption, trade facilitation, and LPI in Asian countries. The findings indicated that corruption significantly impacted the composite LPI and each of the six dimensions of LPI. This concurred with other studies that argued that while corruption is regarded as a "grease the wheel" factor to facilitate trade and efficiency by circumventing bureaucratic legal frameworks, corruption can be regarded as "sand in the wheels" since the grease money leads to an increase in the cost of trade, leading to an eventual burden on the populace (Koh et al., 2018; Nayak et al., 2024).

The nexus between LPI and policy and governance was also underscored. Reviews established that policy design and government effectiveness impacted logistics activities (Nayak et al., 2024; Nguyen & Le, 2024). Governance inefficiencies create room for unethical issues such as corruption that negatively impact logistics activities. Effective governance in cross-border operations creates transparency of regulatory authorities, which impacts law enforcement, leading to increased international trade activities (Koh et al., 2018; Nguyen & Le, 2024). It was further established that an inefficient legal framework impacted financial crises by decoupling logistics activities. Countries facing political constraints had extended financial crises in terms of debts and weak currencies, which led to a low-value LPI and consequently poor logistics activities.

However, some studies argued that, as much as they appreciated the use of LPI as a unifying factor in measuring the effectiveness of the logistics sector, it was not without notable limitations and hence did not utilize it (Nayak et al., 2024; Nguyen & Le, 2024). They pointed out that LPI was unifying at the international level but was not generally suitable to measure domestic or in-country performance. They therefore went a step further to devise the in-country (ILPI), which is based on the perceptions of international freight forwarders and other across-border logistics professionals, and the national LPI (NLPI), which is based on feedback from domestic logistics freight forwarders. Nayak et al. (2024), through an extensive literature search and empirical analysis, identified six dimensions of the ILP index in their order of importance from the most significant to the least significant: quality of infrastructure, economic, telecommunication infrastructure, physical infrastructure, social, and environmental dimensions. Nguyen and Le (2024) borrowed from Ekici et al. (2019) in the construction of an NLPI and used the five dimensions of infrastructure, market size, innovation, education and training, and technology readiness. Their argument was that the unifying factors proposed in the LPI may not necessarily cut across both developed and developing nations since the primary area of focus may differ.

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Table 1: Propensity to use the logistic performance index as a measure of logistics performance

Title	Authors/publication year	Country (s)	Sample size	Yr range	Methods Used	LPI Measure
Impacts of regional integration and maritime transport on trade: with special reference to RCEP	(Chang et al., 2020)	Singapore, Malaysia, Indonesia, etc.	16 countries	2007, 2010, and 2015	Gravity Model	Linear shipping connectivity Logistics performance index Trade performance
The double-edged resource-based view of logistics performance and governance in Asian countries	(Koh et al., 2018)	Afghanistan, Nepal, Indonesia, Mongolia, etc.	26 countries	2007- 2014	Static Linear Panel Model	Corruption LPI Governance
The impact of distance, national transportation systems, and logistics performance on FDI and international trade patterns: Results from the Asian global value chains	(Halaszovich & Kinra, 2020)	Cambodia, Laos, etc.	22 countries	2007, 2010, 2012	Gravity Model	Distance The national transportation system LPI FDI Trade–Imports and exports
Does Cross-Border Logistics Performance Contribute to Export Competitiveness? Evidence from China Based on the Iceberg Transport Cost Model	(Ding et al., 2022)	China	10 countries	2012-2018	Iceberg transport cost model	LPI Logistics efficiency Costs Export level Export competitiveness
Financial crises and national logistics performance: Evidence from emerging and developing countries	(Nguyen & Le, 2024)	Emerging nations	100	2007- 2017	Dynamic Panel Data Model	Financial crises—banking, currency, and debt crises National LPI Infrastructure, market size, education, and training
Development of an in-country logistics performance index for emerging economies: a case study of Indian states	(Nayak et al., 2024)	India	21 Indian states	2012-2018	Quintile and Principal Component Analysis	In country LPI Physical infrastructure Quality Telecommunication Social index Economy
Analysis of the efficiency of land transport connectivity for international trade between Thailand and China	(Panichakarn & Pochan, 2023)	Thailand China Vietnam Laos	126 informants		Time-cost-distance Analysis	LPI – time, cost, distance Trade efficiency

Green logistics and trade promotion

Reviewed studies on green logistics and trade promotion collectively emphasized the sustainability aspects of the TBL framework, which measures an organization's success in three key areas: environmental, economic, and social sustainability (Tornatzky, 1990) (Fig. 3). Most of the reviews leaned more on the environmental sustainability aspect of the logistics firms. The findings collectively indicated that logistics activities had an impact on environmental degradation through emissions, ecological hazards, and waste generation (Liu et al., 2018; Sheikh et al., 2023; Yang et al., 2024). There is a need for the integration of sustainability strategies to reduce the carbon footprint and minimize pollution. This requires the adoption of eco-friendly logistics practices to improve logistics performance and protect the environment.

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Liu et al. (2018), for example, appreciated the crucial role played by green supply chain management in environmental sustainability. The scholars modeled the interrelationships between logistics performance and environmental degradation. Using data from 42 Asian countries between 2007 and 2016, the findings indicated a positive nexus between logistics performance and environmental degradation. Some subcategories of LPI, for example, international shipment decreased CO_2 emissions, while logistics activity timeliness intensified CO_2 emissions. The study called for concerted efforts to encourage green logistics in the sampled nations to ensure environmental protection.

Similarly, Lu et al. (2019) attempted to construct an environmental LPI (ELPI) to assess green transportation and logistics performance. The findings established a strong correlation between ELPI and LPI. Generally, countries with high values of LPI had high values of ELPI. High ELPI values implied a reduction in CO_2 emissions and fossil fuel consumption, resulting in greener transportation, high trade volumes, economic growth, and trade promotion (Liu et al., 2018; Sheikh et al., 2023; Subramanian et al., 2014). Sheikh et al. (2023) further noted that with maritime logistics accounting for approximately 90% of international trade in volume, there was a need to observe cost efficiency, fuel and emission efficiency in order to achieve environmental sustainability whilst improving the port's overall competitiveness and functionality of maritime logistics.

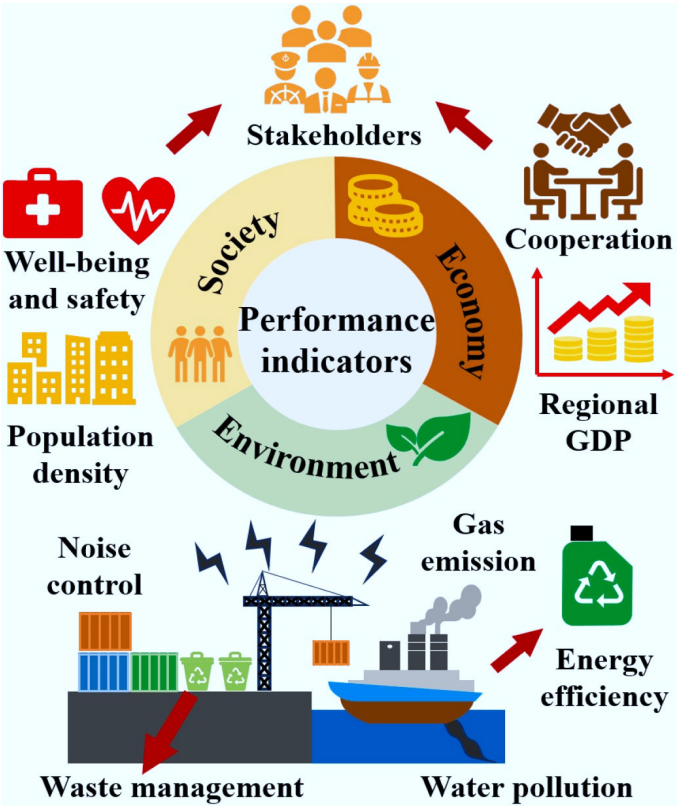

Figure 3: Concept of the TBL Framework
Source: Zhang et al. (2024)

Regarding social sustainability, there was a consensus on the role of the government in promoting green transportation and overall business sustainability (Yang et al., 2024; Yingfei et al., 2022). Reviews acknowledge the impact of logistics activities on environmental degradation. However, the question that begs is "What is the government's role in curbing the vice?" Different strategies have been fronted with the inclusion of government tax policies and adoption of electric commercial vehicles (ECVs), among others. Most economists have advocated for policies such as a carbon tax and Cap-and-trade (C&T) to curb carbon emissions. The carbon tax policy is a fee levied by the government for each ton of carbon emitted, which encourages companies to reduce emissions when the cost of reduction outweighs the cost of tax payment. C&T, on the other hand, involves the establishment of an initial maximum level of carbon emission, which is referred to as the carbon emission quota.

Reviews recommended for the government role in implementing the two strategies, whose uptake currently is slow, and the inclusion of purchase subsidies and the availability of charging ports for ECVs (Subramanian et al., 2014; Yang et al., 2024; Yingfei et al., 2022). Yang et al. (2024), while using 52 restaurant owners in Shenzhen, China, investigated the influence of government policies on the adoption of EVCs, noted that the adoption is crippled by challenges such as high initial purchase costs, extended charging periods, degradation of the battery, and limited range. The study advocated for the government to combine C&T mechanisms with purchase subsidies to encourage ECV adoption and reduce emissions.

Government policies also play a crucial role in the allocation of resources for infrastructural development (Liu et al., 2018). This entails transportation networking to sustain imports and exports, and a telecommunication network system necessary for information exchange among others. Bold quality infrastructure bolsters communication among supply chain participants, leading to financial performance and enhancement of international trade (Van Vo & Nguyen, 2023; Yingfei et al., 2022). On the economic sustainability, the achievement of both environmental and social sustainability leads to economic sustainability of cost savings, increased market share, and profit growth (Chien & Shih, 2007). Yingfei et al. (2022), for instance, adopted a cross-sectional survey to investigate the relationships between green logistics performance and business performance in China. The results established a positive relationship between infrastructure and green logistics performance, which had a beneficial effect on the environment, services trade, and firm performance.

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Table 2: Green logistics and trade promotion

Title	Authors/publication year	Country (s)	Sample size	Anchoring Theories	Subject unit	Green transportation and trade promotion
A comprehensive performance measurement model for maritime logistics: a sustainability and policy approach	(Sheikh et al., 2023)	Bangladesh	76	TBL	Academicians Logistics managers	Port performance Shipping connectivity Hinterland logistics Sustainability and resilience
Effectiveness of policies for electric commercial vehicle adoption and emission reduction in the logistics industry	(Yang et al., 2024)	China	52	Time Windows Model	Restaurant owners	Government policies Carbon tax policy Cap and trade mechanism Adoption of electric commercial vehicles
Green logistics performance and infrastructure on service trade and environment-Measuring firm's performance and service quality	(Yingfei et al., 2022)	China	335	Logistics theory New trade theory	Economists Financial analysts Accountants	Green logistics performance Infrastructure Service trade and the environment Firms' performance Service quality
Green Transportation and Logistics Performance: An Improved Composite Index	(Lu et al., 2019)	Sub-Saharan Africa Asia	112 countries	-		LPI Green transportation CO_2 emissions Oil consumption Environmental LPI
The relationship between the environment and logistics performance: Evidence from Asian countries	(Liu et al., 2018)	Asian countries	42 countries	Green supply chain framework		Logistics performance Environmental degradation LPI CO_2 emissions Trade openness
Integration of logistics and cloud computing service providers: Cost and green benefits in the Chinese context	(Subramanian et al., 2014)	China	236	Diffusion of the Innovation theory	Small- and medium-sized logistics providers	Perceived green benefits Cost benefits of the integration Cloud computing
Greening the Vietnamese supply chain: The influence of green logistics knowledge and intellectual capital	(Van Vo & Nguyen, 2023)	Vietnam	142	Absorptive capacity theory RBV	Business managers	Green logistics performance Environmental performance Green intellectual capital Green knowledge exploitation

Logistics eco-innovation and trade promotion

With the prevailing worldwide environmental degradation due to various human activities, many countries have embraced innovation as a strategy toward environmental protection by devising ways of reducing emissions while retaining a competitive edge. This section sought to establish the level of eco-innovation embracement in the logistics sector and how the embracement relates to trade promotion in developing nations. The diffusion of innovation theory (DOI), which seeks to establish how firms adopt innovation (Rogers, 2003), guided this section. The diffusion process in the model explains the preceding steps for an innovation to be incepted,

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for example, through cost-benefit analysis, which helps in decision-making on whether to adopt an innovation (Atkin et al., 2018). The reviewed studies were grouped into three broad thematic areas: digitalization—the conversion of information into a digital format that can be computer processed; technological innovation—new technologies introduction or improvement of the existing ones; and smart logistics—the application of both digital technologies and data analytics to enhance logistics performance (Ridwan et al., 2024; Setthachotsombut et al., 2024; Wang et al., 2024).

Digitalization: There was a consensus on the crucial role played by the digitalization of trade in border control measures, efficiency, and trade management processes (Ridwan et al., 2024; Zhao et al., 2023). Digitalization reduces trade costs, fortifying the resilience of international supply chains. In addition, digitalization enables businesses to access a greater number of international connected suppliers and consumers using online platforms. Wang et al. (2024), for example, established the effect of the application of digital technology on the green products export of a firm while using data from Chinese listed firms. The scholars underscored the role of artificial intelligence and the digital economy in economic growth gains and sustainable development. A significant positive relationship between digital technology application and green product export was established.

Organizations with advanced ICT digital platforms such as ERP, AI, and cold services incorporated in their logistics systems enhance communication between actors in the sector (Coll & Straube, 2025). With digital connectivity and internet service utilization, exporting firms gain through time and cost reduction aspects related to border procedures as well as documentation. There was also a notable improvement in the quality of trade, transport infrastructure, logistical services, and the overall performance of the logistics firm. Ridwan et al. (2024), for instance, in an attempt to establish the relationship between financial development and trade performance as drivers toward Vision 2063 attainment in Africa, incorporated digitalization and transport services in the model. A positive interrelation between trade performance and digitalization, market size, and trade openness was noted.

Technological innovation (TI): Technological innovation has led to the efficiency and improvement of activities in the logistics sector (Du & Li, 2022). Through TI, firms are able to manufacture and export high-tech, eco-friendly products, thereby increasing their market share, profitability, and economic growth (Liu et al., 2024; Ridwan et al., 2024; Zhao et al., 2023). Zhao et al. (2023) investigated the impact of the logistics industry on global value chain promotion in China, including the role of technological innovation. Technological innovation, human capital, and logistics infrastructure positively influenced the global value chain. The paper recommends that the overall improvement of logistics systems would ultimately lead to an optimized value chain that would ensure smooth circulation both at home and abroad.

TI has also introduced innovative cities that play a key role in ecological protection worldwide (Fig. 4). Their focus is on improving energy efficiency, reducing pollutants, and improving environmental quality (Du & Li, 2022). Du and Li (2022) established the relationships between innovative city building and green logistics efficiency promotion in China. Their findings established a significant relationship between innovative cities and green logistics efficiency. The implementation of the innovative cities pilot policy was also deemed key in driving green logistics efficiency.

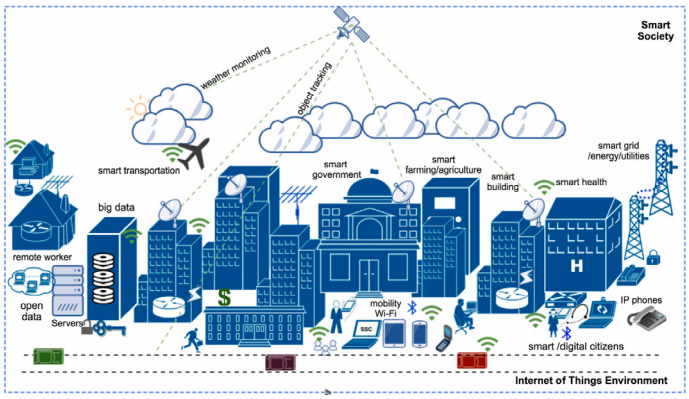

Figure 4: Illustrative figure of a model smart city
Source: Inuwa and Das (2024)

Smart Logistics Policy (SLP): Smart logistics emerged as a result of the need to optimize logistics activities of the flow of goods, resources, and communication along the supply chain with the help of digital technologies (Liu et al., 2024; Uckelmann, 2008). Government policies play a crucial role in the development of smart logistics. With government support, there is the formulation and implementation of policies that foster smart logistics. The policies aim at embracing technological opportunities, reducing pollutants, and improving the overall competitiveness of the firm. The reviews collectively underscored the role of SLP in influencing production, improving transportation, distribution, and smart warehousing (Liu et al., 2024; Setthachotsombut et al., 2024; Wang et al., 2024). The end results of the reduction of errors, complexity, cost, labor, and enhanced operational efficiency lead to a positive firm's competitiveness (Du & Li, 2022; Setthachotsombut et al., 2024).

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http://dx.doi.org/10.21622/IBL.2025.05.2.1665

Table 3: Logistics eco-innovation and trade promotion

Title	Authors/publication year	Country (s)	Sample size	Yr range	Adoption barriers	Logistics innovation and trade promotion
Investigating the asymmetric effects of financial development on trade performance in Africa: Can digitalization, transport services, and regulatory quality drive the vision of 2063?	(Ridwan et al., 2024)	South Africa Egypt Morocco Nigeria Algeria		1996-2022	Cyber insecurity Fraud Financial theft	Financial development Digitalization Transport service Regulatory quality Trade performance
Effect of the logistics industry on the promotion of China's position in the global value chain: An international trade perspective	(Zhao et al., 2023)	Asian countries		1995-2018		Human capital Technological innovation Logistics infrastructure National economic development Global value chain
The implications of smart logistics policy on corporate performance: Evidence from listed companies in China	(Liu et al., 2024)	China		2012-2017	Financial constraints Stakeholder conflicting interests	Smart logistics policy Firm performance
Digitalization of interorganizational communication in the East African food industry	(Coll & Straube, 2025)	Ethiopia Rwanda Tanzania	17		Lack of technical know-how Cost implication Face-to-face culture	Logistics network structure Communication digitalization International trade
Logistics business management of a provider in Thailand with smart logistics	(Setthachotsombut et al., 2024)	Thailand	400		Obsolete legal structure Resistance to change Financial constraint	Smart logistics (SL) business management People management SL Rooms and working space SL Administration and management of SL Innovation dynamics Trade performance
Does innovative city building promote green logistics efficiency? Evidence from a quasi-natural experiment with 285 cities	(Du & Li, 2022)	China	285	2005-2019	Lack of policy alignment Lack of government support	Green logistics efficiency Policy implementation Green technology innovation
Going "green trade": Assessing the impact of digital technology application on green product exports.	(Wang et al., 2024)	China	622		Financial constraints Technical barriers Green trade restrictions	Digital technology application Green product export Environmental regulation Technology effect Market expansion

Volume 5, Issue 2, December 2025 - ISSN 2735-5969
http://dx.doi.org/10.21622/IBL.2025.05.2.1665

Discussion

The search established considerable ease in obtaining published articles from China compared to any other developing nation. This observation concurs with that of Halog and Anieke (2021) that although research in environmental sustainability has gained impetus in the recent past, slow growth has been evidenced in developing nations apart from China. Out of the 21 reviewed papers, seven were specifically from China, five from Asian countries 5, Thailand 1, three from Africa 3, three from emerging nations 2, Bangladesh 1, Vietnam 1, and one from India. It can therefore be deduced that, in terms of literature, as compared to Asian countries, Africa is lagging behind, and this calls for concerted efforts toward research improvement. The slow growth in Africa, which is attributed to both infrastructural and social challenges such as bottlenecked port operations, poor road quality, political and security instability, and inadequate rail facilities, among others, also calls for action by the concerned leaders and policy makers (Adewole & Struthers, 2018).

The review established a notable inclination to use LPI as a measure of logistics activities in various firms and countries. Different studies have established the interrelationships between myriad dimensions in the logistics sector, such as liner shipping connectivity, trade performance, full container load, corruption, governance, foreign direct investment, financial crises, and LPI. However, it was noted that logistics performance in most of the developing countries is still lacking. For instance, a comparison of performance from the 2023 World Bank's LPI ratings for the top 20 countries in the developed nations, Asia, and Africa was carried out. While developed nations had an average score of 3.96, Asia scored 3.27, while Africa scored 2.72. This thus calls for the need to improve logistics activities in developing nations, especially in Africa.

While LPI is a benchmarking tool in measuring logistics performance, some reviews noted its notable limitations, and scholars argued that it might not adequately fit to measure national or in-country logistics performance. They argued that while it was paramount to have a unifying logistics index at the international level, for effective policies and reforms at the national level, it was advisable to use performance indicators that were more relevant to an individual nation instead of generalization. This concurs with some studies that established that while low-income nations concentrated on logistics infrastructure and facilitation of transport, countries in the middle-income earners' band focused on efforts toward improvement of logistics skills, services, and trade regulations. On the other hand, high-income nations were more focused on the state of green logistics and information systems.

It was also established that since the unifying LPI is based on web surveys and qualitative information derived from both logistics and freight forwarding experts, there was a risk of bias because of their subjective norms. Respondents' attitudes and cognitive ability could affect the qualitative data negatively. Therefore, considering these limitations, some scholars failed to use the World Bank's devised LPI and suggested other models that could be utilized in measuring LPI for specific nations through the use of established indicators that were specific to a given nation, while utilizing secondary data.

On the link between green transportation and trade promotion, the reviewed articles first noted the environmental degradation effect of logistics activities and then collectively underscored the need to regulate logistics activities to protect today's and future generations. Green logistics was connected to the reduction of CO_2 emissions, greenhouse gases, and pollution, which had an ultimate positive effect on both local and international trade. How do firms achieve green logistics? The reviews fronted various strategies, which included the implementation of environmental policies such as tax levies and carbon prices, and purchase subsidies for electric vehicles. However, vices such as corruption were mentioned as one of the social evils that derail logistics activities, leading to higher trade costs and eventual cost increases of the end products. This lowers the competitiveness of the logistics firms. As much as the reviews called on firms to take individual responsibility in promoting environmental protection, there were calls for government facilitation through offering purchase subsidies and developing policies that favor logistics firms.

Embracement of logistics eco-innovation and its role in trade promotion was also evidenced in the reviewed articles. Innovative strategies used by different companies in different nations included digitalization, implementation of smart logistics policy, and adoption of innovative cities. Innovative cities are directly correlated with green logistics through the prevention of pollution, reduction of emissions, and sustainable business performance. While innovative technology adoption presented notable advantages, it was marred by a couple of adoption challenges: while most of the reviews listed financial constraints, others included cybersecurity threats, lack of government support in policy alignment, resistance to change due to rigid organizational culture, and lack of technical know-how. This, therefore, calls for concerted efforts by different key actors in the logistics industry to encourage and adopt technological innovations.

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Limitations

The systematic review has some limitations, even though it provides notable insights regarding logistics performance and trade promotion. First, the search criteria used three databases of Scopus, Web of Science, and Science Direct. Though the search was rigorous, there might be chances of excluding some relevant studies due to variations in terminology and indexing methods. In addition, the search could have missed other valuable papers not published within the scope of the three databases. Second, the review relied on English-language peer-reviewed articles published between 2000 and 2025. Language and publication bias in terms of time frame may have been experienced. Third, the reviewed papers were drawn from different countries, used different sample sizes, different data collection methods, and diverse use of data analysis methods such as gravity models, linear panel models, and transport ice berg models, among others. While these added to the robustness of the study, they, however, curtailed the generalizability capacity of the findings. Lastly, although different countries were included in the review, the study did not include cross-country comparative frameworks. However, these limitations present solid ground for continued research in the field of logistics performance and trade promotion.

Conclusion

There is an extensive propensity to adopt and use LPI as a measure of logistics performance by different scholars in developing nations. However, it was noted that the World Bank's LPI had some limitations that curtailed some scholars from adopting it and thus devised and proposed other LPIs meant for specific reasons, e.g., specific regions. An intricate interplay between green transportation and trade promotion was also evidenced. The reviewed articles were anchored on different theories related to green transportation studies, such as the Resource-Based View, New Trade Theory, and Green Supply Chain framework. However, the review used the TBL framework to broadly categorize green transportation and firm performance into three categories: economic, environmental, and social sustainability. The role of green transportation in CO_2 reduction, production of green products, reduction of greenhouse gas (GHG) emissions, governance, policy framework formulation, firm performance, and firms' competitive advantage were all enshrined in the three subcategories of the TBL framework.

Innovation also played a crucial role in environmental protection, especially through pollution and emissions prevention. Digitalization, adoption of smart logistics policies, and promotion of innovative cities were some ways through which this was achieved. The diffusion of innovation theory, which aids in decision-making on whether to adopt a technology innovation, best guided this section. Through a five-step process of knowledge, persuasion, decision, implementation, and confirmation, an organization is able to decide whether to accept or reject an innovation. This was evidenced in the reviews through an analysis of barriers to innovation adoption, such as financial constraints and lack of policy frameworks in favor of technology and an eventual analysis of the benefits derived from the adopted technologies, such as the positive impact on the environment and the firm's performance through cost reduction, labor reduction, minimization of errors and overall operational efficiency improvement. However, the study suggests that future work should develop validated, country-level LPI variants that capture green innovation impact on trade in low-income regions.

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