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Optimizing maritime logistics for sustainable development in Kenya's Blue Economy

Conrad Ochego Mogaka

School of Business and Economics, Mount Kenya University,
General Kago Rd, Thika, Kenya
mogakaconrad@gmail.com

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Abstract: *Purpose*: Kenya's strategic position on Africa's eastern coast makes its blue economy essential for national development. This study analyzes the relationship between sustainable maritime logistics and the potential of the blue economy to promote social equity, environmental sustainability, and economic growth. *Methodology*: A systematic literature review was conducted, synthesizing scholarly research, industry reports, and policy documents on maritime logistics and its contribution to Kenya's blue economy. The analysis focuses on key dimensions such as port infrastructure, regulatory frameworks, and technological innovation. *Results*: The study finds that efficient maritime logistics enhance trade efficiency, reduce transportation costs, and support sustainable practices, thus maximizing the blue economy's potential. However, challenges remain, including limited port capacity, inefficient customs processes, insufficient cold chain infrastructure, and gaps in workforce training. Addressing these issues requires policy reforms and investments in modern infrastructure. *Theoretical Contribution*: This research contributes to the sustainable development theory by positioning maritime logistics as a central element of blue economic resilience and environmental stewardship. It introduces a conceptual model viewing maritime logistics as an enabler of sustainable blue economy growth in Kenya. *Practical Implications*: The study recommends targeted investments in green technologies, improved maritime training, and the formation of multi-stakeholder partnerships to foster collaborative and resilient maritime logistics systems. It also highlights the need for more comprehensive data and encourages future research to include primary data for deeper insights.

Keywords: blue economy, maritime logistics, maritime logistics innovations, maritime transport optimization, regulatory frameworks, and sustainable shipping practices

Corresponding author: *Conrad Ochego Mogaka*
E-mail: mogakaconrad@gmail.com

Sustainable Development Goals (SDGs): SDG 2: Zero Hunger; **SDG 3:** Good Health and Well-being; **SDG 10:** Reduced Inequalities; **SDG 11:** Sustainable Cities and Communities; **SDG 12:** Responsible Consumption and Production

1. Introduction

The current dynamic and highly competitive business world has seen the growing urge for the Blue Economy, which was presented as a global economic framework at the 2012 Rio+20 United Nations Conference on Sustainable Development (Attri, 2018). This was in response to inquiries posed by coastal Least Developed Countries and Small Island Developing States over the inapplicability of the "Green Economy" concept for their ocean-dependent economies (Dissanayake, Withanawasam & Sarjoon, 2021). Thus, the blue economy has emerged as a principal strategy for sustainable development, emphasizing the equitable development and utilization of marine resources to foster economic growth, environmental sustainability, and social welfare (Eikeset *et al.,* 2018). The African Union demonstrates that the BE is a crucial growth engine throughout the African continent via Agenda 2063 (Ufomba, 2020). In 2014, the African Union established the 2050 Africa Integrated Maritime Strategy (AIMS), a framework to maximize Africa's extensive marine and inland water resources for wealth generation and economic advancement. Ocean-based firms generate roughly USD 2.5 trillion annually, accounting for 3% of global GDP and millions of jobs (World Bank, 2017). The worldwide valuation of the Blue Economy is projected to double by 2030 (OECD, 2016) and will serve as a significant catalyst for economic growth.

Kenya has recognized fisheries and aquaculture, marine transportation and logistics, culture and tourism, and extractives (oil, gas, minerals, and energy) as crucial sectors of the blue economy. These industries are essential for achieving food security and creating jobs (#OceanAction42017, UN). Since more than 90% of the nation's international trade is facilitated by maritime transport (Africa Marine Cabotage and Blue Economy Conference, 2023), developing a sustainable and efficient marine logistics sector is critically important. Kenya's strategic position on the Eastern coast of the Western Indian Ocean, characterized by a 640 km coastline, an Exclusive Economic Zone (EEZ) encompassing 142,400 km^2, and substantial inland water resources, establishes it as a significant participant in regional and global marine commerce (SDF, 2016). Recent research indicates that the maritime sector in Kenya is expanding. Throughput increased by 11.9% to 1.62 million Twenty-foot Equivalent Units (TEUs). The cargo throughput of Mombasa has increased annually from 33.88 million metric tons in 2022 to 35.98 million metric tons in 2023. Container Freight Stations (CFS) experienced a 55.6% rise in the TEU volumes processed (KNBS Economic Survey, 2024). The overall number of managed vessels at the port was 1,835, representing a 17.6% increase compared to 2021. The detected patterns underscore the growing necessity for efficient maritime logistics systems to facilitate sustainable growth, enhance trade, foster economic rivalry, and provide supportive mechanisms.

2. Literature review

This study examines the components of maritime logistics operations that promote the sustainable growth of Kenya's Blue Economy. This analysis evaluates the principal factors influencing price stability, encompassing the prospects for sectoral growth and associated challenges, the necessity for environmentally sustainable production methods driven by climate change, the potential for job creation, regional integration, the adoption of technology, legislative and regulatory reforms, public-private sector collaborations, and skills development. This project seeks to demonstrate how Kenya may spatially organize its maritime logistics and enhance its policy and planning framework to promote economic development while concurrently safeguarding marine ecosystems. The literature examines the maritime logistics landscape, the function of maritime logistics, sustainability, and the blue economy, along with the relationship between maritime logistics and the sustainable growth of the blue economy.

2.1. Maritime logistics landscape

The evolution and expansion of the worldwide maritime logistics sector are influenced by factors such as e-commerce, technical innovations, and shifting customer preferences (Carpenter, 2023; Dharmadhikari, 2024). 2023 global maritime trade increased by 2.4%, reaching 12.3 billion tons. A 2% increase is anticipated in 2024, with a predicted average annual growth rate of 2.4% from 2024 to 2029 (UNCTAD, 2024; RAcademy, 2025). Technological innovations, environmental dynamics, and evolving customer expectations (Carpenter, 2023) influence the transformation of maritime logistics. The areas under examination include enhancing supply chains, promoting sustainability, and increasing transparency for efficient maritime shipping (Carpenter, 2023). The global Maritime Logistics market is projected to expand from USD 85,454.17 million in 2024 to USD 386,915.2 million by 2031, with a compound annual growth rate (CAGR) of 3.80% (Dharmadhikari, 2024). The accelerated advancement of maritime logistics services is propelled by the demand for raw materials, infrastructure initiatives, and technological innovations (Dharmadhikari, 2024). Geopolitical challenges and climatic hazards persist in hindering the recovery of maritime commerce, inducing uncertainty, disrupting trade routes, and escalating logistical expenses (UNCTAD, 2024; Dharmadhikari, 2024).

The global maritime logistics market primarily comprises the following components: the expansion of e-commerce propels the necessity for expedited and cost-effective delivery solutions, which require streamlined transportation routes and efficient port operations (Dharmadhikari, 2024). Container vessels are a significant component of maritime logistics due to the global need for containerized goods. Most demand is driven by the expansion of e-commerce and the increase in global trade. Ultimately, port services are essential to the economy, enabling cargo transit along the coast, with global commerce volumes rising and demand increasing (Dharmadhikari, 2024). The liquid bulk category, encompassing oil, gas, and LNG, will emerge as the fastest-growing sector within the maritime logistics market, driven by escalating energy consumption and evolving global energy dynamics (Dharmadhikari, 2024). Coastal services, an emerging business, are evolving in response to the increasing need to transport domestic products along the coastline (Dharmadhikari, 2024). Furthermore, geopolitical dynamics induce unpredictability in maritime trade, which modifies planned routes and escalates logistics costs (Dharmadhikari, 2024).

The evolving African maritime logistics sector is influenced by external technological advancements and sustainability factors reshaping resilient supply networks (Nganda, 2024). Maritime logistics is expanding due to critical infrastructure expenditures and rising trade volumes (Dharmadhikari, 2024). The African marine logistics market's key characteristics include the high demand for iron ore, coal, and grains (UNCTAD, 2024). Africa's geographical position is crucial for shipping operations in the region (RoK, 2022). Advancement in technology: The emergence of technology-driven logistics enterprises enhances the linkage between truck owners, drivers, and firms, necessitating cargo transportation (IFC, 2020). Furthermore, the European port network, characterized by advanced infrastructure and a strategic position along several international trade routes, significantly contributes to the region's remarkable growth rate in the maritime logistics sector (Dharmadhikari, 2024).

Kenya has emerged as a significant hub in East Africa, assuming an expanding position in the global logistics sector (Karma, 2024). The marine sector in Kenya encompasses coastal and inland water transport, logistics and supply chains, and shipbuilding (RoK, 2022), as well as significant commercial and tanker routes connecting Africa to Europe, the Far East, and the Americas (RoK, 2022), which traverse the Kenyan coastline. The port of Mombasa is the most significant and principal entry point to the Eastern and Central Africa region, catering to a population of about 300 million in 2022. The remaining elements are significant in the Kenyan maritime logistics sector: over 90% of Kenya's international trade, over US$3 billion, is conducted via maritime transport, with the nation's coastline situated along significant maritime economic corridors. Kenya faces issues like the lack of salary requirements for seafarers, a scarcity of vessel employment opportunities, and limited participation of women in maritime operations. The government has acknowledged the Blue Economy sector as a crucial pillar in supporting the nation's economy. Kenya has ratified multiple international treaties governing the maritime transport sector. The United Nations Convention on the Law of the Sea (UNCLOS) and treaties established by the International Maritime Organization (IMO) are included.

2.2. Role of maritime logistics

Maritime logistics constitutes a critical component of international trade and the global supply chain, encompassing the planning, execution, and management of products transit via maritime routes (Hadiningrat, Wiradanti & Umar, 2024; Lau, Chen, Poo, Ng, & Ying, 2024; Caliskan & Ozturkoglu, 2016). It is engineered to convey substantial quantities of products efficiently and cost-effectively across extensive distances (Delfin-Ortega, 2025). More than 90% of worldwide trade occurs through sea shipping, underscoring the significance of maritime logistics in the global supply chain of goods (Song, Chhetri & Lee, 2023; Abeyratne, 2024). The primary activities in shipping logistics encompass transportation arrangement, port operation management, customs clearance, freight forwarding, inventory management, cargo handling, supply chain coordination, risk management, and environmental compliance (Cariou, 2020).

Ports play a crucial role in maritime logistics by serving as gateways for global trade, facilitating cargo transportation to and from boats and onward to final destinations (Cariou, 2020; Abeyratne, 2024). The company possesses the requisite infrastructure to manage the flow of thousands of products, facilitating customs clearance, inspections, and documentation (Windward, 2024). Additionally, ports offer warehousing, packaging, and consolidation services, connecting maritime routes with terrestrial transportation networks to enable the seamless transfer of commodities across borders (Singh, Dwivedi & Pratap, 2023). These methods greatly enhance supply chain resilience within the maritime business, as effective logistics in a maritime supply chain substantially alleviates disturbances (Zhou, Guo, Chen & Jiang, 2025).

Integrating maritime logistics with a comprehensive supply chain management system enables organizations to monitor shipments in real-time and enhance decision-making (Xiao *et al.,* 2024). Enhanced visibility facilitates supply chain risk management, allowing organizations to anticipate risks and proactively mitigate them, such as adverse weather events or geopolitical conflicts, thereby ensuring the uninterrupted operation of their supply chains (Amin, Hasyim, Sun'an, Hilman & Fahmiasari, 2024). Marine logistics, in comparison to alternative transportation modalities, facilitates the movement of substantial quantities of products, accessing global ports and alleviating congestion on maritime routes. Consequently, it produces precise schedules and consistent journey durations (Ahmadinejad & Langerood, 2024). Lau, Chen, Poo, Ng, & Ying (2024) assert that ocean transport is a compelling business model due to its capacity to offer reduced shipping prices per unit and facilitate the consolidation of large cargoes to save transport expenses.

2.3. Sustainability and the Blue Economy

The Blue Economy concept promotes economic activities associated with aquatic environments, oceans, and coastlines to attain environmental sustainability (Lee *et al.,* 2020). The objective is to preserve marine ecosystem integrity while promoting economic expansion (Khan & Emon, 2024). Silver & Gray (2015) assert that the blue economy is accountable for the sustainable use of ocean resources to foster economic growth and provide employment while safeguarding the integrity of ocean ecosystems. Marine transportation, shipbuilding and repair, ecological services, renewable energy, coastal and oceanic tourism, non-living resources, and living resources are encompassed (Sarker, Hussain, Assaduzzaman & Failler, 2019). Pace, Saritas, and Deidun (2023) identify ocean governance and marine policy, ecological services, climate change adaptation, and sustainable business models as crucial areas of blue economy study.

Sustainable aquaculture practices represent a technological advancement that contributes to preserving marine biodiversity while meeting the rising worldwide demand for seafood (Mustafa, Estim, Shapawi, Shaleh & Sidik, 2021). Shipbuilders are adopting sophisticated technologies to enhance energy efficiency and provide greener fuels by 2024 (Mba, 2024). Innovations that markedly decrease emissions and enhance fuel efficiency (Qayed, 2023) must be used in the maritime transportation sector to attain sustainable growth. Research by Renaldo *et al.* (2024) acknowledged the significance of advancing offshore renewable energy sources as a crucial approach for sustainable development and diminishing reliance on fossil fuels.

2.4. Maritime logistics and sustainable growth of the Blue Economy

Roy (2019) characterizes the Blue Economy as a paradigm for economic development that underscores the necessity of adopting sustainable practices in using oceanic resources to advance remedies for ocean health. Maritime logistics are crucial to the Blue Economy, particularly for island states and underdeveloped countries with coastlines and maritime territory (Khan & Emon, 2024). Diverse themes drive the Blue Economy's sustainable development through maritime logistics. Maritime movement is a significant catalyst for transformation in coastal and marine ecosystems (Bulleri & Chapman, 2010). Ninety percent of trade occurs over sea routes, making maritime and multimodal transport advancements essential (Valentine, Benamara & Hoffmann, 2013). This is bolstered by the recent advancements in AI and the digitalization of smart ports, which can facilitate the implementation of necessary modifications to improve commerce and the efficiency of the logistics department (Nikčević & Škurić, 2021). Governance and economic policies are influenced by the potential and problems presented by the Blue Economy, especially concerning the alleviation of port congestion and the necessity for enhanced turnaround (Clemente *et al.,* 2023).

Sibali and Jainuddin (2024) assert that global connectivity must be enhanced and seaborne trade boosted via strategic investments in marine logistics. Investment for that expansion should adhere to Ocean Principles (Whisnant & Vandeweerd, 2019). Consequently, integrated marine spatial planning and integrated ocean governance are essential for the sustainable utilization of oceanic areas (Frazão Santos *et al.,* 2020). Engagement of stakeholders in the decision-making process is essential for the sustainability of the Blue Economy (Das *et al.,* 2024). This is essential for enhancing sustainability in the Blue Economy and depends on the capacity to create and utilize technology (Khan & Emon, 2024). The administration of ecological compensation and regulatory systems facilitates the equilibrium and advancement of economic development and environmental considerations (Wu *et al.,* 2020).

Maritime logistics connectivity is very pertinent to the sustainable growth of the Blue Economy. It underscores the prudent utilization of marine resources to stimulate economic development while safeguarding the integrity of ocean ecosystems (Elston, Pinto & Nogueira, 2024). This is crucial for developing island nations with coastal and marine areas. Maritime logistics connectivity significantly influences the Blue Economy (Nikčević & Škurić, 2021). Mogila, Ciolek, Toroj, and Zaucha (2024) emphasize shipping as the conveyance of ointments, goods, and raw materials across maritime routes. It is essential to render these processes efficient and sustainable.

Furthermore, the Blue Economy pertains to utilizing oceans and seas as essential resources for economic growth and environmental sustainability (Roy, 2019). Furthermore, as 90% of trade is conducted via maritime channels, there is substantial advocacy for enhancing maritime and multimodal transport networks (Lau *et al.,* 2024). The primary objective of this comprehensive improvement of ports, logistics, and maritime safety is to substantially contribute to the blue economy and local, national, and regional GDP (Nyokabi & Mbirithi, 2024). Consequently, ports serve as essential venues for esting, refining, and scaling new technologies and promoting sustainable growth within the broader maritime economy (Faran & Ejaz, 2022).

Talley (2017) emphasizes that vessels account for about 90 percent of world trade by volume and over 70 percent by value. Maritime logistics linkage significantly influences a nation's societal identity (Lau *et al.,* 2024). Identifying factors is a crucial catalyst for transformation in coastal and marine ecosystems (Karubaba, 2024). Efficient logistics substantially enhance route optimization, reduce emissions, and, most critically, diminish environmental impact on shipping (Lo, 2022). Logistics is essential for protecting the marine environment, facilitating transportation responsibly and sustainably (Muñoz-Villamizar *et al.,* 2021). This involves the execution of efficient waste disposal methods and the proactive prevention of oil spills. Sustainability in the blue economy must be aligned with environmental stewardship and the enhancement of employment opportunities related to shipping and global logistics (Wang, Yuen, Wong & Li, 2020).

Sustainable maritime transport offers numerous benefits to the Blue Economy (Nikčević & Škurić, 2021). The decarbonization of shipping and the greening of ports are essential in combating climate change and global warming (Alamoush, Ölçer & Ballini 2020). This objective can be achieved by utilizing renewable energy sources and mitigating the carbon footprint linked to marine transportation. Implementing sustainable maritime transport may foster economic growth, promote social inclusion, and enhance livelihoods, all while safeguarding the environment (Elston, Pinto & Nogueira, 2024). This

fosters innovation in the smart shipping, ports, transportation, and international connection sectors. A viable avenue for commercial resources derived from maritime settings is the Blue Economy. This approach aims to restore degraded ecosystems and utilizes innovative technologies that enable effective and sustainable management of marine resources (Spalding, 2016).

Implementing sustainable fisheries and environmental aquaculture generates employment and stimulates economic growth in local communities (2024, Yulisti, Hidayat, Firdausy, Mu'awanah, Kurniasari & Nurjati). Fifth, it is imperative to advocate for the decarbonization of shipping, as greenhouse gas emissions from the global maritime fleet are increasing (Grzelakowski, Herdzik & Skiba, 2022). Ports and maritime operators are essential to the blue economy and a sustainable future (Alamoush, Ölçer & Ballini, 2022). The sustainability of maritime transport within the framework of trade is crucial. Approximately 90% of global commerce commodities are conveyed via maritime transport (Rojon, Lazarou, Rehmatulla & Smith, 2021). The initiative advocates for ship recycling and technology advancements to enhance green infrastructure in coastal areas. It aids in preserving biodiversity and landscapes, which is advantageous for tourism and coastal economies (Bhattacharya & Sachdev, 2024).

3. Methodology

A systematic literature review was conducted to consolidate scholarly studies, industry reports, and policy papers concerning marine logistics and its impact on economic growth, environmental sustainability, and social equity in Kenya. It examines fundamental aspects of maritime logistics, including port physical infrastructure, regulatory frameworks, and technological advancements, to investigate their impact on the sustainable development of the blue economy.

4. Results

The results of this study are summarized in Table 1, which identifies and categorizes the principal factors affecting maritime logistics and their impact on the sustainable development of Kenya's blue economy. The analysis reveals that robust port infrastructure, supportive regulatory frameworks, and ongoing technological innovation are essential for efficient maritime logistics. Conversely, the sector faces significant barriers, including limited port capacity, procedural inefficiencies in customs, insufficient cold chain logistics, and a shortage of skilled maritime professionals. These challenges hinder the optimal integration of maritime logistics with the broader blue economy objectives. The table further demonstrates that addressing these barriers can lead to tangible benefits, such as increased trade volumes, lower transportation costs, and adopting more sustainable operational practices. Overall, the results underscore the need for targeted investments, policy reforms, and capacity-building initiatives to unlock the full potential of Kenya's maritime sector in driving sustainable economic growth.

Table 1: Results

Category	Findings
Africa's maritime logistics	Africa's geographical location is strategic for shipping. Demand is rising for iron ore, coal, and grains. Growth of technology-driven logistics. Infrastructure investments and rising trade volumes are key growth drivers. Kenya is committed to UNCLOS and IMO conventions. Kenya's strategic role: Mombasa Port is a key gateway for 300 million people in East and Central Africa.
Challenges and risks	Geopolitical tensions and climatic hazards disrupt maritime commerce. Higher logistics costs due to route disruptions.
Drivers of Transformation	Demand for sustainability and efficient supply chains. Digitalization and automation are improving logistics. Geopolitical and climate risks are affecting trade routes and increasing costs. Growth in e-commerce and technology. Rising consumer expectations. Sustainable shipping investments.
Growth of maritime logistics	Expected growth of 2% in 2024 and an annual growth rate of 2.4% through 2029. Global maritime trade grew by 2.4% in 2023, reaching 12.3 billion tons. The market is projected to reach USD 386,915.2 million (2024-2031) with a CAGR of 3.80%.
Kenya's maritime sector	90% of Kenya's international trade (worth $3B) is by sea. Key challenges: seafarers' wage standards, employment opportunities, and gender inclusion. The Port of Mombasa serves 300 million people and is a key gateway to Eastern and Central Africa. The Blue Economy is a government priority.
Maritime logistics & sustainable growth	Decarbonization and green ports are crucial for climate change mitigation. Investment in port equipment, IT, and infrastructure enhances efficiency. Investments in maritime infrastructure, digital tech, and ocean governance are needed for long-term sustainability. Port and logistics expansion contributes to GDP growth. Smart shipping & eco-friendly ports leading to sustainable industry growth. Smart shipping and technology-driven solutions support sustainability.
Market segments	Coastal shipping is emerging due to increased domestic transportation demand. Container shipping is expanding due to increased demand for international trade. Liquid bulk shipping (oil, LNG) is the fastest-growing sector. Port services are crucial due to increasing global trade volumes. Regional transportation solutions supporting coastal shipping expansion.
Role of maritime logistics	Key functions include port operations, customs clearance, cargo handling, and risk management. More than 90% of global trade depends on maritime logistics. Real-time tracking and digital integration enhance shipment monitoring. Supports global supply chains by enabling large-scale transportation.
Sustainability and blue economy	Adoption of energy-efficient ships and sustainable fuel alternatives. Maritime decarbonization and sustainable aquaculture are key to economic and biodiversity balance. Ports evolving into green hubs of smart systems & cleaner energy. Sustainable shipping practices include eco-friendly shipbuilding, emission reductions, and offshore renewable energy. The Blue Economy promotes economic growth while ensuring ocean sustainability.
Future trends	Adoption of eco-friendly aquaculture and waste management strategies. Digitalization of logistics and real-time tracking improve efficiency. Investment in marine spatial planning and governance is essential.

5. Suggested research agenda

The study asserts that efficient maritime logistics is essential for developing a sustainable blue economy. This report delineates the challenges that hinder poor countries from using blue economies. This study investigates elements that hinder or facilitate sustainable marine development. This document offers a comprehensive framework to examine the intricate connections between maritime logistics and the blue economy. This methodology applies to other emerging nations encountering analogous difficulties, offering comparative analysis and insights across countries.

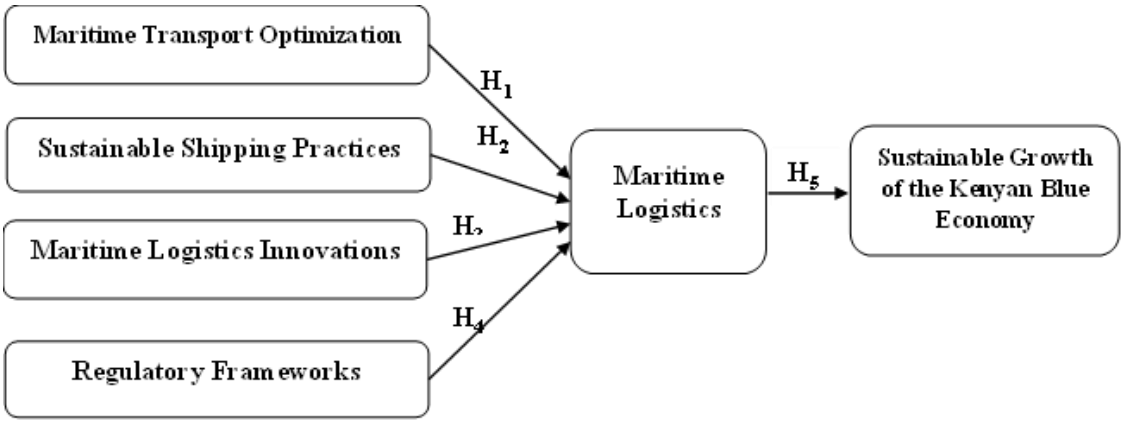
Subsequent research must concentrate on formulating reliable methodologies for assessing the impacts of the port's infrastructure, human capital, and advancements in maritime logistics. This will substantiate potential policy measures and resource distribution grounded in empirical research. Instruments, including stock assessments, quota systems, and community-based management strategies, are essential for fisheries management; nevertheless, more enhancements are necessary to cultivate more effective and sustainable practices. The document must encompass an assessment of value-added seafood enhancement and a study on market accessibility. The environmental implications must be meticulously evaluated throughout marine activities, including shipping, fishing, and port operations. This will facilitate the development of strategies to alleviate environmental risks.

Furthermore, future research will examine the impacts of automation, artificial intelligence, and blockchain technology on enhancing efficiency and sustainability in maritime logistics. Insights from maritime development programs in other East African countries could provide significant lessons for Kenya. The blue economy can be enhanced by exchanging best practices and regional collaboration.

Certain research studies have examined the sustainability of the blue economy and its diverse elements of maritime logistics. This research investigates the interaction of these elements and their influence on maritime logistics, hence impacting the sustainability of the blue economy. Theoretical and pragmatic viewpoints on maritime logistics have been examined to enhance understanding of their role in promoting the growth and sustainability of the blue economy.

This study presents a conceptual framework (Figure 1) illustrating the primary components of maritime logistics and their association with the sustainable growth of the blue economy. Furthermore, it enriches the pertinent literature through the provided conceptual framework, which augments the comprehension of marine logistics capabilities. Consequently, the empirical examination of this idea may yield significant implications for the development and sustenance of blue economies. Consequently, the findings in this paper will assist scholars, practitioners across many sectors, and researchers to comprehend the theoretical and practical dimensions of marine logistics as a catalyst for blue growth and the advancement of the blue economy, thereby enhancing global well-being.

Figure 1: Proposed conceptual framework



The conceptual framework in Figure 1 has been hypothesized as follows;

H_1: Transport optimization has a statistically significant effect on maritime logistics.
H_2: Sustainable shipping practices have a statistically significant effect on maritime logistics.
H_3: Maritime logistics innovations have a statistically significant effect on maritime logistics.
H_4: Regulatory frameworks have a statistically significant effect on maritime logistics.

H_5: Maritime logistics has a statistically significant effect on the sustainable growth of the Kenyan blue economy.

6. Limitations and gaps

There are gaps and a lack of research on Kenya's maritime logistics and sustainable blue economy. A marine fishing and shipping limitation deficiency exists in Kenya's emerging marine fisheries training programs. Current port infrastructure must evolve concurrently with the volume of goods to be managed. Furthermore, there is a deficiency of trained trainers and maritime experts. A significant obstacle is the insufficiency and high cost of training facilities, tools, and equipment. Seafarers in Kenya receive training; nonetheless, many are deficient in the abilities required to operate container, bulk, and tanker vessels. Kenya lacks a national shipping carrier, hindering its ability to capitalize on transshipment prospects fully. Port inefficiency includes prolonged container dwell periods, delays in vessel traffic clearances, and extended documentation procedures.

Notwithstanding billion-dollar improvements, port operations continue to exhibit inefficiency. Furthermore, there are limited competitive port choices in the vicinity. The Mombasa port tariff for shipping lines, currently encompassing 36 charge categories, has rendered the lack of a pricing framework detrimental.

The available research has numerous limitations. There are discrepancies in the data about the fisheries' contribution to Kenya's GDP, with several sources presenting contradictory amounts. Furthermore, inadequate regulation and enforcement of environmental legislation exacerbate pollution, resource overexploitation, and unsustainable livelihoods. Furthermore, it is essential to convey to communities the significance of participating in the seafood business, ensuring they possess the necessary information and resources to initiate their involvement. Monitoring shipping services and taxes is quite crucial. It is essential to fortify governance frameworks and facilitate cross-jurisdictional collaboration to enhance the integration of water resources management across governmental tiers. The identified shortcomings and restrictions necessitate additional research to guide policy and advance sustainable maritime logistics and the blue economy in Kenya.

7. Conclusion

This study identified significant gaps and problems hindering the integration of Kenya's maritime logistics sector with the blue economy. The studies emphasize a complex interconnection between governance challenges, skill deficiencies, infrastructure inadequacies, and operational inefficiencies. The study highlights a widening disparity between the demand and supply of port infrastructure and marine professionals; as cargo volume rises, strategic investment is essential to enhance port infrastructure and human resources, including refurbishing key training facilities and capacity development for marine professionals. The lack of a national shipping carrier and ongoing inefficiencies at the port, such as prolonged stay periods and complex taxes, hinder Kenya's shipping industry from capitalizing on transshipment opportunities and competing successfully in the area. The research demonstrates the necessity for improved governance structures, legislation, and enforcement measures to address pollution and over-extraction. This study emphasizes the necessity for more comprehensive data, economic analysis, and rigorous policy evaluation to support evidence-based solutions in future research initiatives. This strategy is essential to realize the transformative potential of Kenya's maritime sector and facilitate a sustainable blue economy.

8. Recommendations

According to the report, the Kenyan government must significantly invest in enhancing the ports' capacity, equipment, and logistics. This exercise must be more thorough, encompassing a master plan to project freight growth while integrating climate resilience. Road and rail infrastructures linking ports to inland destinations can enable rapid and unobstructed freight movement. The current skills deficit requires resolution, which a national maritime training policy can achieve. The establishment a nd enhancement of maritime training institutions are essential, as is the provision of affordable yet high-quality training and the recruitment of proficient trainers. Curricula suitable for the industry must

encompass competencies associated with container, bulk, and tanker vessels, in addition to port operations and management. They must be supported by scholarship opportunities and financial help to engage young Kenyans in the maritime sector.

The viability of a national marine carrier requires assessment. Identifying the most efficient and sustainable solution necessitates that all stakeholders in the pursuit evaluate alternatives, including public-private partnerships, through a cost-benefit analysis. The project can substantially enhance Kenya's international shipping and transshipment capabilities. The Kenya Ports Authority possesses the capacity to enhance customs logistics, minimize container dwell time, and streamline ship traffic documentation processing. Optimal strategies from leading portsand investment in digital port administration technologies. Enhancing the intricate tariff framework and augmenting transparency will foster competitiveness. The government must enhance maritime rules, prioritizing environmental protection, resource management, and safety. Effective law enforcement must address pollution, overfishing, and other unsustainable behaviors. An efficient marine governance framework necessitates collaboration across agencies.

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Conflicts of interest

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