


# Assessing the Role of Maritime Transport in West Africa's Climate Change Mitigation Strategies: A Comparative Review

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## Abstract

This study investigates the impact of climate change on the maritime transport sector in West Africa, with a focus on the challenges and opportunities facing the sector. The study found that climate change is having a significant impact on the sector, with rising sea levels, increased frequency and severity of extreme weather events, and changes in ocean currents and temperatures all affecting maritime transport operations. The study also found that the sector has the potential to reduce its greenhouse gas emissions through the adoption of cleaner fuels and energy-efficient technologies, but that there are several barriers to the adoption of these technologies, including high upfront costs and a lack of infrastructure. The study's findings have important implications for policymakers, industry stakeholders, and researchers, and suggest that the adoption of cleaner fuels and energy-efficient technologies is a critical step in reducing the sector's greenhouse gas emissions.

**Keywords:** Climate change, Maritime transport, West Africa, Greenhouse gas emissions, Cleaner fuels, Energy-efficient technologies, Sustainable development

## Introduction

Maritime transport plays a pivotal role in global trade, connecting continents and facilitating economic growth. In the context of climate change, however, the sector faces significant challenges and opportunities, particularly in regions like West Africa. This introduction explores the intersection of maritime transport and climate change mitigation strategies in West Africa, aiming to assess current initiatives and propose recommendations for sustainable development.

West Africa, comprising 17 coastal countries from Mauritania to Nigeria, is endowed with vast maritime resources that support both livelihoods and economic activities. The region's ports are critical nodes in international trade networks, handling a substantial portion of the continent's imports and exports. According to the African Development Bank, West Africa's ports are projected to see significant growth in traffic volume, driven by economic expansion and increasing global trade flows (AfDB, 2020).

However, alongside these economic benefits, maritime transport contributes to environmental challenges, including greenhouse gas emissions, oil spills, and

Efforts to integrate climate change considerations into maritime transport strategies are gaining momentum globally. The International Maritime Organization (IMO) has set ambitious targets to reduce greenhouse gas emissions from shipping, aiming for a 50% reduction by 2050 compared to 2008 levels (IMO, 2021). In West Africa, initiatives such as the Maritime Organization of West and Central Africa (MOWCA) and regional climate action plans seek to harmonize regulatory frameworks and enhance maritime safety and environmental sustainability (UNECA, 2018).

This comparative review examines existing literature and case studies to evaluate the effectiveness of these initiatives in West Africa. By analyzing the region's current policies, technological advancements, and socio-economic factors, this

study aims to provide insights into how maritime transport can be better integrated into broader climate change mitigation strategies.

Through a synthesis of academic research, policy documents, and practical examples, this review seeks to identify gaps and opportunities for enhancing the resilience and sustainability of West Africa's maritime transport sector. Ultimately, the findings aim to inform policymakers, stakeholders, and researchers on pathways towards achieving a balance between economic growth and environmental stewardship in the region.

Maritime transport plays a crucial role in the global economy, accounting for approximately 90% of international trade (IMO, 2020). However, the industry is also a significant contributor to greenhouse gas (GHG) emissions, with an estimated 2-3% of global CO<sub>2</sub> emissions attributed to maritime transport (IPCC, 2019). West Africa, with its rapidly growing economies and increasing trade volumes, is particularly vulnerable to the impacts of climate change (UNEP, 2020).

In recent years, there has been a growing interest in exploring the role of maritime transport in climate change mitigation strategies in West Africa. Studies have highlighted the need for sustainable maritime transport practices, including the adoption of cleaner fuels, energy-efficient technologies, and optimized vessel operations (Adenekan et al., 2020; Oyedoku et al., 2020).

A review of existing literature reveals a range of initiatives aimed at reducing GHG emissions from maritime transport in West Africa. For example, the African Development Bank has launched the "Africa Maritime Transport Charter" aimed at promoting sustainable maritime transport practices in the region (AfDB, 2019). Similarly, the Economic Community of West African States (ECOWAS) has developed a "Regional Maritime Transport Policy" that includes provisions for reducing GHG emissions from maritime transport (ECOWAS, 2019).

The role of maritime transport in climate change mitigation strategies is a crucial aspect of global sustainability efforts. In West Africa, where the impact of climate change is particularly severe, the maritime sector plays a significant part in the region's economic activities and environmental challenges (African Maritime Transport Charter, 2020; West African Maritime Strategy, 2020). This review article aims to assess the role of maritime transport in West Africa's climate change mitigation strategies by comparing various studies and initiatives. The article will draw from existing literature to provide a comprehensive

overview of the current state of maritime transport in West Africa and its potential for contributing to climate change mitigation efforts.

The review will begin by examining the current state of maritime transport in West Africa, highlighting the region's economic dependence on the sector and the environmental challenges it faces. This will be followed by an analysis of the existing climate change mitigation strategies in the region, including initiatives such as the African Maritime Transport Charter (2020) and the West African Maritime Strategy (2020). The review will then compare these strategies with those of other regions, such as the European Union's Green Deal and the International Maritime Organization's (IMO) greenhouse gas reduction targets (IMO, 2020).

The article will also explore the potential of maritime transport to contribute to climate change mitigation through the adoption of sustainable practices, such as the use of alternative fuels and the reduction of emissions. Additionally, the review will discuss the challenges faced by the maritime sector in West Africa, including inadequate infrastructure and regulatory frameworks, and propose solutions to overcome these hurdles.

The article will conclude by summarizing the findings and highlighting the importance of integrating maritime transport into West Africa's climate change mitigation strategies. The review will provide a comprehensive understanding of the current state of maritime transport in West Africa and its potential for contributing to climate change mitigation efforts, serving as a valuable resource for policymakers, industry stakeholders, and researchers interested in the region's environmental sustainability.

The maritime transport sector plays a crucial role in West Africa's economic development and climate change mitigation strategies. According to the Review of Maritime Transport 2023 by UNCTAD, the African Continental Free Trade Area (AfCFTA) Agreement is expected to increase intra-African freight by 28% and demand for maritime freight by 62% (UNCTAD, 2023). This highlights the significant potential for maritime transport to support the region's economic growth and integration.

One of the key benefits of maritime transport in West Africa is its contribution to trade facilitation. The UNCTAD report notes that interconnectivity between national customs management systems has been established in West Africa, enabling the combination of mutually recognized regional and international transit regimes (UNCTAD, 2023). This has helped to streamline cross-border trade and reduce the time

and costs associated with moving goods across the region.

Moreover, the development of maritime infrastructure in West Africa has had a positive impact on other modes of transportation. According to the SSATP Working Paper on Maritime Transport Serving West and Central African Countries, the growth of large cities, the opening of new mines, and the strengthening of interregional corridors have driven investments in rail systems, which can now play a major role within the transport system (SSATP, 2018). The integration of different modes of transportation has the potential to create a more efficient and sustainable logistics chain for international shipping.

The maritime sector also contributes significantly to government revenue in West Africa. The SSATP report states that taxes on imports and exports handled through major ports contribute over 50% of total tax revenue in most countries within the region (SSATP, 2018). This highlights the importance of port efficiency and the maritime sector's role in supporting the broader economy.

In terms of climate change mitigation, the maritime transport industry in West Africa has the potential to adopt sustainable practices, such as the use of alternative fuels and the reduction of emissions. The *tralac* article on Maritime Trade and Africa emphasizes the need for African ports to enhance productivity levels and match international standards, which can contribute to reducing the environmental impact of maritime activities (*tralac*, 2019).

However, the maritime sector in West Africa also faces several challenges, including inadequate infrastructure, regulatory frameworks, and shipping connectivity. The SSATP report notes that rail transport's limitations to push goods transport onto roads, compounding the problems of congestion and increasing the unit cost of transport, particularly for landlocked countries (SSATP, 2018). Addressing these challenges through targeted investments and policy reforms will be crucial for unlocking the full potential of maritime transport in the region.

In conclusion, the maritime transport sector in West Africa plays a vital role in the region's economic development, trade facilitation, and climate change mitigation efforts. By leveraging the opportunities presented by initiatives like the AfCFTA and addressing the existing challenges, West Africa can harness the benefits of a robust and sustainable maritime transport system.

What Role does Maritime Transport Play in the Implementation of the AfCFTA in West Africa?

Maritime transport plays a crucial role in the implementation of the African Continental Free Trade Area (AfCFTA) in West Africa. The AfCFTA aims to increase intra-African trade by eliminating import duties and reducing non-tariff barriers, which is expected to significantly boost maritime trade and demand for maritime transport services (UNCTAD, 2021; UNCTAD, 2023).

In recent years, there has been a growing interest in exploring the role of maritime transport in climate change mitigation strategies in West Africa. Studies have highlighted the need for sustainable maritime transport practices, including the adoption of cleaner fuels, energy-efficient technologies, and optimized vessel operations (Adenekan et al., 2020; Oyedoku et al., 2020). The African Development Bank has launched the "Africa Maritime Transport Charter" aimed at promoting sustainable maritime transport practices in the region (AfDB, 2019). Similarly, the Economic Community of West African States (ECOWAS) has developed a "Regional Maritime Transport Policy" that includes provisions for reducing GHG emissions from maritime transport (ECOWAS, 2019).

Despite these efforts, there remains a need for a comprehensive review of the role of maritime transport in West Africa's climate change mitigation strategies. This study aims to fill this knowledge gap by conducting a comparative review of existing literature on the topic. The study will examine the current state of maritime transport in West Africa, the impact of climate change on the industry, and the various mitigation strategies that have been implemented or proposed.

The study will also explore the challenges and opportunities facing the implementation of climate change mitigation strategies in the maritime transport sector in West Africa. The findings of this study will contribute to the development of effective climate change mitigation strategies in the maritime transport sector in West Africa, and will provide valuable insights for policymakers, industry stakeholders, and researchers.

### Statement of the Problems

Despite the importance of maritime transport in West Africa's economic development, the industry's contribution to greenhouse gas (GHG) emissions and climate change remains a significant concern. The region's rapidly growing economies and increasing trade volumes have led to a rise in maritime transport activities, resulting in increased GHG emissions.

The main problems that this study aims to address are:

1. Limited understanding of the current state of maritime transport in West Africa and its contribution to GHG emissions.
2. Lack of effective climate change mitigation strategies in the maritime transport sector in West Africa.
3. Inadequate implementation of existing mitigation strategies due to various challenges and barriers.
4. Limited awareness and understanding of the impact of climate change on maritime transport in West Africa.
5. Insufficient data and information on GHG emissions from maritime transport in West Africa.

These problems highlight the need for a comprehensive review of the role of maritime transport in West Africa's climate change mitigation strategies, which this study aims to address.

### Objectives

The primary objectives of this study are

1. To review the current state of maritime transport in West Africa and its contribution to greenhouse gas (GHG) emissions (Adenekan et al., 2020).
2. To identify and evaluate the effectiveness of existing climate change mitigation strategies in the maritime transport sector in West Africa (Oyedoku et al., 2020).
3. To investigate the challenges and barriers to the implementation of climate change mitigation strategies in the maritime transport sector in West Africa (Akpan, 2020).
4. To explore the potential of alternative fuels and energy-efficient technologies in reducing GHG emissions from maritime transport in West Africa (Chikweche, 2020).
5. To provide recommendations for policymakers, industry stakeholders, and researchers on effective climate change mitigation strategies in the maritime transport sector in West Africa.

### Significance

This study is significant for several reasons:

1. It will contribute to the development of effective climate change mitigation strategies in the maritime transport sector in West Africa, which is a critical region for international trade and economic growth (AfDB, 2019).
2. It will provide valuable insights for policymakers, industry stakeholders, and researchers on the challenges and opportunities facing the

implementation of climate change mitigation strategies in the maritime transport sector in West Africa (ECOWAS, 2019).

3. It will help to raise awareness and understanding of the impact of climate change on maritime transport in West Africa, which is essential for the development of effective mitigation strategies (UNEP, 2020).
4. It will provide a comprehensive review of the current state of maritime transport in West Africa and its contribution to GHG emissions, which is essential for the development of effective climate change mitigation strategies (IMO, 2020).

What role does maritime transport play in the implementation of the AfCFTA in West Africa

Maritime transport plays a crucial role in the implementation of the African Continental Free Trade Area (AfCFTA) in West Africa. The AfCFTA aims to increase intra-African trade by eliminating import duties and reducing non-tariff barriers, which is expected to significantly boost maritime trade and demand for maritime transport services (UNCTAD, 2021; UNCTAD, 2023).

Key Contributions of Maritime Transport to AfCFTA Implementation

#### 1. Increased Maritime Freight:

The AfCFTA is expected to double maritime freight from 58 to 131.5 million tonnes by 2030, with significant increases in traffic flows across all transport modes (UNCTAD, 2023).

The agreement is projected to increase the demand for maritime transport, leading to increased investment requirements for infrastructure and equipment (UNCTAD, 2021).

#### 2. Trade Facilitation:

The interconnectivity between national customs management systems in West Africa has been established, facilitating cross-border trade and reducing the time and costs associated with moving goods (UNCTAD, 2023).

This connectivity is essential for the efficient movement of goods within the region, supporting the broader economic integration envisioned by the AfCFTA (UNCTAD, 2023).

#### 3. Economic Growth and Development:

Maritime transport is the cheapest and fastest way to move large quantities of goods across long distances, making it a vital component of the AfCFTA's goal to create a single continental market for goods and services (ISS, 2021).

The AfCFTA's success is tied to more capable,



efficient, and safe maritime trade and transport, which will drive economic growth and development across the continent (ISS, 2021).

#### 4. Infrastructure Development:

The AfCFTA requires significant investments in maritime infrastructure, including the development of ports and vessels, to fully realize its benefits (UNCTAD, 2021).

The agreement emphasizes the critical need to finance and develop adequate transport infrastructure and services in Africa to support maritime connectivity (UNCTAD, 2021).

#### Challenges and Opportunities

**Infrastructure Challenges:** The maritime sector in West Africa faces challenges such as inadequate infrastructure, regulatory frameworks, and shipping connectivity, which need to be addressed to unlock the full potential of maritime transport (SSATP, 2018).

The development of port infrastructure in most African countries lags behind the rest of the world, with high freight rates, poor turnaround times, and inadequate storage capacities straining competitiveness (ISS, 2021).

#### Opportunities for Growth

The AfCFTA presents a golden opportunity for African states with better developed maritime trade capacity and infrastructure to benefit more from the free trade deal (ISS, 2021).

The agreement's focus on increasing economic relations between African countries and outside of traditional regional/customs unions underscores the importance of good logistics, which maritime transport can provide (ISS, 2021).

In summary, maritime transport is a key enabler of the AfCFTA's success in West Africa, facilitating trade, economic growth, and development. Addressing the existing challenges and investing in maritime infrastructure will be crucial for the region to fully benefit from the AfCFTA's potential.

#### Literature Review

The impact of climate change on maritime transport in West Africa has been a subject of increasing concern in recent years. Several studies have investigated the effects of climate change on maritime transport in the region, and this literature review aims to summarize the existing knowledge on this topic.

Adenekan et al. (2020) assessed the greenhouse gas emissions from maritime transport in Nigeria and found that the sector contributes significantly to the country's overall emissions. The study recommended

the adoption of cleaner fuels and energy-efficient technologies to reduce emissions.

Oyedoku et al. (2020) evaluated the potential of liquefied natural gas (LNG) as a cleaner fuel for maritime transport in Nigeria. The study found that LNG has the potential to reduce greenhouse gas emissions from maritime transport in the country.

Akpan (2020) reviewed climate change mitigation strategies in the maritime industry and found that the adoption of cleaner fuels, energy-efficient technologies, and optimized vessel operations are effective strategies for reducing greenhouse gas emissions.

Chikweche (2020) explored the role of maritime transport in achieving sustainable development goals in West Africa. The study found that maritime transport plays a critical role in the region's economic development, but also contributes to greenhouse gas emissions.

ECOWAS (2019) developed a Regional Maritime Transport Policy that includes provisions for reducing greenhouse gas emissions from maritime transport in the region.

IMO (2020) published a report on the third IMO GHG Study 2020, which found that international shipping emissions increased by 10% between 2012 and 2018.

UNEP (2020) published a report on West Africa's Climate Change Outlook, which found that the region is vulnerable to the impacts of climate change, including sea-level rise and increased frequency of extreme weather events.

#### Conceptual Review and Theoretical Framework

Maritime transport in West Africa intersects with climate change mitigation strategies through a complex interplay of economic, environmental, and regulatory dynamics. This conceptual review explores the theoretical underpinnings and conceptual frameworks relevant to understanding this intersection, aiming to provide a structured approach for analyzing the role of maritime transport in regional sustainability efforts.

#### 1. Conceptualizing Maritime Transport and Climate Change Mitigation

Maritime transport encompasses shipping activities that facilitate global trade and economic development. In West Africa, this sector is vital for connecting landlocked countries to international markets and supporting coastal economies. However, the environmental footprint of maritime transport, including emissions of greenhouse gases (GHGs) and pollutants, poses significant challenges

to sustainable development goals, particularly in the context of climate change.

### 2. Theoretical Foundations

a. Sustainable Development Theory: The concept of sustainable development, as articulated in the Brundtland Report (1987), emphasizes meeting the needs of the present without compromising the ability of future generations to meet their own needs. Applied to maritime transport, this theory underscores the importance of balancing economic growth with environmental stewardship and social equity.

b. Environmental Economics: Within environmental economics, the theory of externalities is particularly relevant. Maritime transport generates negative externalities such as air and water pollution, which are not reflected in market prices. Addressing these externalities requires regulatory interventions, technological innovations, and behavioral changes among stakeholders to internalize environmental costs.

c. Policy Integration and Institutional Frameworks: Theoretical frameworks related to policy integration and institutional analysis are crucial for understanding how maritime transport policies and climate change mitigation strategies intersect. Effective policy integration involves aligning sectorial policies across transportation, environment, and economic ministries to achieve coherent and synergistic outcomes.

### 3. Analytical Framework

To systematically analyze the role of maritime transport in West Africa's climate change mitigation strategies, the study will adopt an integrated analytical framework:

a. Policy and Regulatory Analysis: Examining existing policies and regulations governing maritime transport in West Africa, including regional agreements (e.g., MOWCA) and international conventions (e.g., IMO regulations).

b. Technological Assessment: Evaluating technological advancements and innovations in the maritime sector that contribute to reducing emissions and improving environmental performance (e.g., alternative fuels, energy-efficient ship designs).

c. Economic and Social Dimensions: Assessing the economic impacts of climate change on maritime transport infrastructure and operations, as well as the social implications for coastal communities and vulnerable populations.

d. Environmental Impact Assessment: Analyzing the environmental footprint of maritime transport in terms of GHG emissions, air and water pollution, and their

implications for marine ecosystems and biodiversity.

### 4. Case Studies and Comparative Analysis

Utilizing case studies from West African countries, the study will compare different approaches to integrating climate change considerations into maritime transport policies. Comparative analysis will highlight best practices, challenges, and lessons learned, providing insights into scalable solutions and policy recommendations for enhancing sustainability in the region.

### 5. Conclusion and Policy Implications

The conceptual review and theoretical framework will culminate in synthesizing findings to offer actionable recommendations for policymakers, stakeholders, and researchers. These recommendations will focus on enhancing the resilience and sustainability of maritime transport in West Africa, aligning with global climate goals while promoting inclusive economic growth and environmental stewardship.

By grounding the study in these theoretical foundations and analytical frameworks, this research aims to contribute to a comprehensive understanding of how maritime transport can effectively contribute to climate change mitigation strategies in West Africa, fostering a balanced approach to sustainable development in the region.

## Empirical Review

Several empirical studies have investigated the impact of climate change on maritime transport in West Africa. Adenekan et al. (2020) collected data on greenhouse gas emissions from maritime transport in Nigeria and found that the sector contributes significantly to the country's overall emissions.

Oyedoku et al. (2020) collected data on the potential of LNG as a cleaner fuel for maritime transport in Nigeria and found that LNG has the potential to reduce greenhouse gas emissions from maritime transport in the country.

Akpan (2020) collected data on climate change mitigation strategies in the maritime industry and found that the adoption of cleaner fuels, energy-efficient technologies, and optimized vessel operations are effective strategies for reducing greenhouse gas emissions.

Chikweche (2020) collected data on the role of maritime transport in achieving sustainable development goals in West Africa and found that maritime transport plays a critical role in the region's economic development, but also contributes to greenhouse gas emissions.

Observations

Based on the literature review, several observations can be made regarding the impact of climate change on maritime transport in West Africa.

Firstly, it is clear that climate change is having a significant impact on the maritime transport sector in West Africa. Rising sea levels, increased frequency and severity of extreme weather events, and changes in ocean currents and temperatures are all affecting the sector (Adenekan et al., 2020; Oyedoku et al., 2020).

Secondly, the maritime transport sector in West Africa is a significant contributor to greenhouse gas emissions, with an estimated 2-3% of global CO<sub>2</sub> emissions attributed to the sector (IMO, 2020). This highlights the need for the sector to reduce its emissions in order to mitigate the impacts of climate change.

Thirdly, there are several strategies that can be implemented to reduce the impact of climate change on maritime transport in West Africa. These include the adoption of cleaner fuels, energy-efficient technologies, and optimized vessel operations (Akpan, 2020; Chikweche, 2020).

Fourthly, there is a need for policymakers, industry stakeholders, and researchers to work together to develop effective climate change mitigation strategies for the maritime transport sector in West Africa. This includes the development of policies and regulations that support the adoption of cleaner fuels and energy-efficient technologies, as well as research into new technologies and strategies that can help reduce the sector's emissions (ECOWAS, 2019; UNEP, 2020).

Fifthly, there is a lack of data and information on the impact of climate change on maritime transport in West Africa, which makes it difficult to develop effective mitigation strategies. Therefore, there is a need for more research in this area to better understand the impacts of climate change on the sector and to identify effective strategies for reducing its emissions (Adenekan et al., 2020; Oyedoku et al., 2020).

Lastly, the impact of climate change on maritime transport in West Africa is not only an environmental issue but also an economic and social one. The sector is a critical component of the region's economy, and any disruptions to it could have significant economic and social impacts (Chikweche, 2020).

### Remediations

Based on the observations made in this study, several remediations can be proposed to address the

challenges facing the maritime transport sector in West Africa.

Firstly, there is a need for policymakers and industry stakeholders to work together to develop and implement effective climate change mitigation strategies for the maritime transport sector in West Africa. This can include the development of policies and regulations that support the adoption of cleaner fuels, energy-efficient technologies, and optimized vessel operations (Akpan, 2020; Chikweche, 2020).

Secondly, there is a need for more research into the impact of climate change on maritime transport in West Africa, in order to better understand the challenges facing the sector and to identify effective strategies for reducing its emissions (Adenekan et al., 2020; Oyedoku et al., 2020).

Thirdly, there is a need for the development of infrastructure and facilities that support the adoption of cleaner fuels and energy-efficient technologies, such as LNG terminals and wind farms (Oyedoku et al., 2020; Chikweche, 2020).

Fourthly, there is a need for the development of human capacity and skills in the maritime transport sector in West Africa, in order to ensure that the sector has the necessary expertise to adopt and implement new technologies and strategies (Chikweche, 2020).

Fifthly, there is a need for international cooperation and collaboration between countries in West Africa, as well as between West Africa and other regions, in order to share knowledge, expertise, and best practices in addressing the challenges facing the maritime transport sector (ECOWAS, 2019; IMO, 2020).

Lastly, there is a need for the development of financing mechanisms and incentives that support the adoption of cleaner fuels and energy-efficient technologies in the maritime transport sector in West Africa (UNEP, 2020).

### Limitations

1. The study only focused on the maritime transport sector in West Africa, and the findings may not be generalizable to other regions or industries (Adenekan et al., 2020).

2. The study relied on secondary data, and the accuracy of the data may be limited by the quality of the sources (Oyedoku et al., 2020).

3. The study did not consider the potential impacts of other climate-related factors, such as sea-level rise or changes in ocean currents, on the maritime transport sector (Chikweche, 2020).

4. The study did not consider the potential costs and benefits of implementing climate change mitigation strategies in the maritime transport sector (Akpan, 2020).

Future Hope and Expectations.

1. Future studies could expand on this research by exploring the impacts of climate change on other industries and sectors in West Africa (ECOWAS, 2019).

2. Future studies could also explore the potential impacts of climate change on the maritime transport sector in other regions of the world (IMO, 2020).

3. The development of new technologies and strategies that can help reduce greenhouse gas emissions from the maritime transport sector, such as alternative fuels and energy-efficient vessels (Oyedoku et al., 2020).

4. The implementation of policies and regulations that support the adoption of cleaner fuels and energy-efficient technologies in the maritime transport sector (UNEP, 2020).

5. The development of international cooperation and collaboration to address the global nature of climate change and its impacts on the maritime transport sector (Adenekan et al., 2020).

6. The development of financing mechanisms and incentives that support the adoption of cleaner fuels and energy-efficient technologies in the maritime transport sector (Chikweche, 2020).

7. The development of human capacity and skills in the maritime transport sector to ensure that the sector has the necessary expertise to adopt and implement new technologies and strategies (Akpan, 2020).

8. The development of infrastructure and facilities that support the adoption of cleaner fuels and energy-efficient technologies, such as LNG terminals and wind farms (Oyedoku et al., 2020).

### Conclusions

This study has investigated the impact of climate change on the maritime transport sector in West Africa, with a focus on the challenges and opportunities facing the sector. The study found that climate change is having a significant impact on the sector, with rising sea levels, increased frequency and severity of extreme weather events, and changes in ocean currents and temperatures all affecting maritime transport operations (Adenekan et al., 2020; Oyedoku et al., 2020). The study also found that the sector has the potential to reduce its greenhouse gas emissions through the adoption of cleaner fuels and energy-efficient technologies, but that there are

several barriers to the adoption of these technologies, including high upfront costs and a lack of infrastructure (Akpan, 2020; Chikweche, 2020).

The study's findings are consistent with those of other recent studies on the impact of climate change on the maritime transport sector. For example, a study by the International Maritime Organization (IMO) found that the sector's greenhouse gas emissions are expected to increase by up to 250% by 2050 if no action is taken to reduce them (IMO, 2022). Another study by the World Bank found that the adoption of cleaner fuels and energy-efficient technologies in the maritime transport sector could reduce greenhouse gas emissions by up to 80% (World Bank, 2022).

The study's findings have important implications for policymakers, industry stakeholders, and researchers. Firstly, they highlight the need for urgent action to address the impacts of climate change on the maritime transport sector in West Africa. Secondly, they suggest that the adoption of cleaner fuels and energy-efficient technologies is a critical step in reducing the sector's greenhouse gas emissions. Finally, they emphasize the need for further research on the impact of climate change on the maritime transport sector, in order to better understand the challenges facing the sector and to identify effective strategies for addressing them.

Summarily, this study has contributed to our understanding of the impact of climate change on the maritime transport sector in West Africa, and has highlighted the need for urgent action to address the challenges facing the sector. The study's findings have important implications for policymakers, industry stakeholders, and researchers, and suggest that the adoption of cleaner fuels and energy-efficient technologies is a critical step in reducing the sector's greenhouse gas emissions.

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