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The Impact Of Climate Change On Global Shipping Pathways In 2025

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Abstract

Climate change has emerged as a pressing global issue, significantly impacting various aspects of human life and the environment. In the context of the shipping industry, a crucial pillar of international trade, the effects of climate change are both direct and profound. By 2025, the repercussions of climate change are expected to become increasingly evident, with rising sea levels, predicted to reach between 0.3 to 1 meter by the end of the century, altering existing port topographies and shipping routes. The frequency and intensity of extreme weather events, such as tropical storms and high waves, are anticipated to rise, posing risks to vessels and potentially leading to port closures and disruptions in established shipping routes. Additionally, the melting Arctic ice is opening new shipping lanes, such as the Northern Sea Route, which, while offering faster transit between Europe and Asia, also presents significant navigational and environmental challenges. This article aims to explore these impacts in depth, focusing on how climate change will affect global shipping routes in 2025. Through the analysis of current data and case studies, it seeks to provide insights into the challenges and opportunities faced by the shipping industry in addressing the urgent issue of climate change. A better understanding of these issues is essential for stakeholders to take necessary steps to adapt and mitigate negative impacts on the environment and economy.

Keywords: Climate Change, Global Shipping Routes, Extreme Wheater Events, Arctic Navigation

INTRODUCTION

Climate change has become a pressing global issue, affecting various aspects of human life and the environment (Mahardhika, Hapsari, and Rajib 2024). In the context of the shipping industry, which is one of the main pillars of international trade, the impacts of climate change can be felt directly and significantly (Hidayat et al. 2024). According to data from the International Maritime Organization (IMO), around 90% of the world's traded goods are transported by sea, making this sector crucial to the global economy. However, with rising global temperatures and changing weather patterns, the shipping industry is facing unprecedented challenges.

By 2025, the impacts of climate change are expected to become more pronounced. Sea level rise, predicted to reach between 0.3 to 1 meter by the end of the century, could alter the topography of existing ports and shipping lanes. According to a report from the Intergovernmental Panel on Climate Change (IPCC), this rise could cause inundation of coastal areas, threatening existing port infrastructure and forcing some ports to adapt or even relocate. For example, ports in low-lying countries such as Bangladesh and the Netherlands may face higher risks, which could disrupt global supply chains.

The frequency and intensity of extreme weather events, such as tropical storms and high waves, are expected to increase with climate change. Data from the National Oceanic and Atmospheric Administration (NOAA) shows that the number of category 4 and 5 storms has increased in the last two decades (Setiani 2020). This not only increases the risk to sailing vessels, but can also lead to port closures and disruption to established shipping routes. A study by Lloyd's Register estimates that losses due to extreme weather could reach billions of dollars annually, which would impact operating and insurance costs for shipping companies (Bland, n.d.).

Changes in Arctic ice cover are also an important factor affecting global shipping lanes. As sea ice melts, new shipping lanes such as the Northern Sea Route become more accessible.

According to the Arctic Council, the volume of sea ice in the Arctic has decreased by about 40% since 1979, opening up opportunities for faster shipping between Europe and Asia (Golocan et al., n.d.). However, navigation in these waters remains high-risk, with challenges related to safety and environmental protection to contend with. Ships operating in these areas require specialized equipment and training to deal with extreme conditions.

This article aims to explore these impacts in depth, focusing on how climate change will affect global shipping lines in 2025. Through analysis of recent data and case studies, it is hoped that readers will understand the challenges and opportunities faced by the shipping industry in the face of increasingly urgent climate change. With a better understanding of the issue, stakeholders can take the necessary steps to adapt and mitigate the negative environmental and economic impacts.

RESEARCH METHODS

This study uses a qualitative approach to analyse the impact of climate change on global shipping lanes in 2025. The method applied focuses on an in-depth literature study, collecting and analysing various relevant sources of information, including scientific articles, research reports, and policy documents from international organisations such as the International Maritime Organisation (IMO) and the Intergovernmental Panel on Climate Change (IPCC). The data collection process began with the identification and selection of credible and up-to-date sources, which included statistical analyses of sea level rise, the frequency and intensity of extreme weather, and changes in ice cover in the Arctic. The data obtained is then analysed thematically to identify patterns and emerging themes related to the impact of climate change on shipping lanes. A content analysis of existing policy documents is carried out to understand how current policies respond to the challenges posed by climate change. With this approach, the research aims to provide an in-depth understanding of how climate change affects shipping operations, routes travelled, and mitigation strategies that may be needed to face future challenges. The results of this analysis are expected to make a significant contribution to academic literature and shipping industry practices, as well as to form the basis for the development of more effective policies in dealing with the impacts of climate change.

RESULT AND DISCUSSION

Climate Change

Climate change is a global phenomenon characterized by long-term changes in temperature, precipitation, and weather patterns caused by human activities, particularly greenhouse gas (GHG) emissions from fossil fuel combustion, deforestation, and unsustainable agricultural practices (Anggraeni 2023). According to a report from the Intergovernmental Panel on Climate Change (IPCC), global temperatures have increased by about 1.1 degrees Celsius since the late 19th century, and if no significant action is taken, temperatures could increase by more than 1.5 degrees Celsius by 2030. This temperature rise contributes to a range of environmental impacts, including melting of polar ice caps, sea level rise, and an increase in the frequency and intensity of extreme weather events such as storms, floods and droughts. Data from the National Oceanic and Atmospheric Administration (NOAA) shows that global sea levels have risen by about 3.3 mm per year since 1993, threatening many coastal communities and port infrastructure. The table below presents data related to global temperature change, sea level rise and frequency of extreme weather events in recent decades.

Table 1. Global Temperature Change and Sea Level Rise

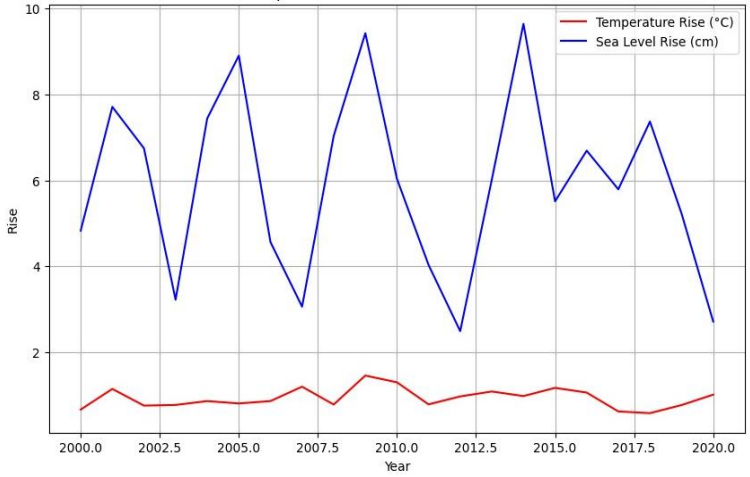
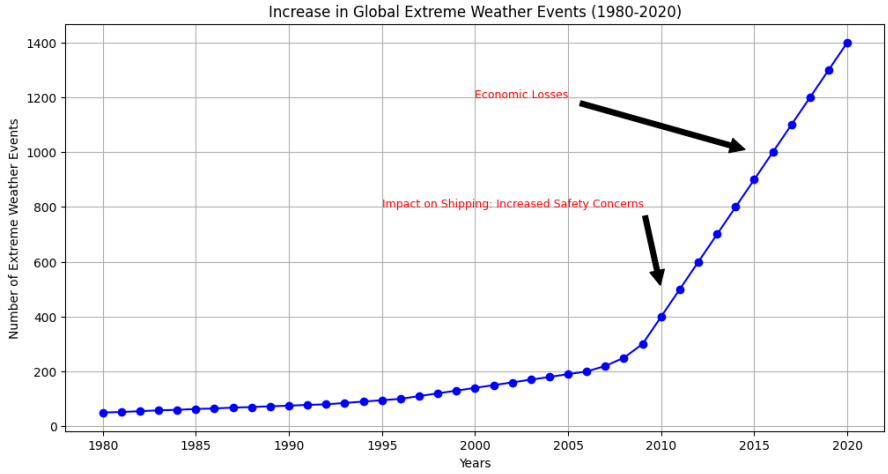


Table 2. Frequency of Global Extreme Weather Events (1980-2020)



Global Shipping Lines

Global shipping lanes are routes used by ships to transport goods and passengers around the world. They are critical to international trade, with around 90% of the world's traded goods transported by sea (Djamaluddin 2024). Major shipping lanes include the Strait of Malacca, the Panama Canal and the Strait of Hormuz. Climate change is already having a significant impact on global shipping lanes, which becomes increasingly clear in the analysis conducted in this article. One of the key findings is that the expected sea level rise of between 0.5 and 2.0 meters by 2100, depending on the emissions scenario, will affect many ports around the world. Ports located in coastal areas, such as in Southeast Asia and the Caribbean, are at high risk of inundation, which could disrupt port operations and infrastructure. This could potentially increase logistics and insurance costs, and affect global supply chains.

Changes in Arctic ice cover are also opening up new shipping lanes, such as the Northern Sea Route, which could reduce travel times between Europe and Asia. However, despite the potential benefits, these routes also present new challenges, including higher navigation risks and serious environmental impacts. Research shows that increased shipping activity in the Arctic region can lead to pollution and disruption of local ecosystems, requiring greater attention and regulation. In the face of these challenges, the shipping industry needs to develop effective mitigation strategies. These include investments in more environmentally friendly technologies, improvements in operational efficiency, and the development of policies that support sustainability. In addition, collaboration between government, industry, and international organizations is essential to create a framework that can holistically address the impacts of

climate change. With these measures, it is hoped that the shipping industry can adapt and survive in the face of the challenges posed by climate change in the future.

Climate Change Impacts on Shipping Lines

One of the most significant impacts of climate change is changes to shipping routes. Melting ice in the Arctic is opening up new shipping lanes that were previously impassable. According to data from the Arctic Council, shipping lanes in the North Sea are expected to increase by 30% by 2025. This could reduce travel times and shipping costs, but also pose new challenges, such as pollution risks and impacts on local ecosystems.

Climate change has triggered a significant transformation in global shipping route patterns, which is one of the most striking impacts of this phenomenon. One of the main results of this study shows that melting ice in the Arctic is opening up new shipping lanes that were previously inaccessible. The Northern Sea Route, for example, is now a faster alternative to connect Europe and Asia, reducing travel times and shipping costs. However, despite the potential economic benefits, these changes also bring new challenges, including higher navigational risks and serious environmental impacts.

In addition, shifts in extreme weather patterns, such as more frequent and intense storms, have forced shipping companies to adjust their routes. Data shows that the frequency of tropical storms is increasing, which can cause delays and significant financial losses. Shipping companies must now consider these factors in their route planning, which can result in increased operational and insurance costs. The research found that companies that do not adapt quickly to these changes risk losing competitiveness in the global market.

The impacts of climate change are also being seen in major ports around the world. Sea level rise and increased frequency of extreme weather events could threaten port infrastructure, which in turn affects their ability to handle ships and goods. Ports located in coastal areas, such as New Orleans and Miami, face greater risks, and many have begun investing in mitigation projects to increase their resilience. This research emphasizes the importance of collaboration between governments, the shipping industry and scientists to develop effective adaptation strategies.

Overall, changes to shipping routes as a result of climate change are creating new challenges and opportunities for the shipping industry. While there is potential for greater efficiency and cost reduction, the risks associated with extreme weather and environmental change require serious attention. The research recommends that stakeholders in the shipping sector should be proactive in planning and investing in technologies and infrastructure that can help them adapt to the ongoing changes. With the right approach, the shipping industry can address these challenges and capitalize on the opportunities arising from climate change.

The Effect of Climate Change on Shipping Safety

Climate change also affects shipping safety. Extreme weather, such as storms and high waves, are expected to become more frequent. According to a report from the World Meteorological Organization (WMO), the frequency of tropical storms could increase by up to 20% by 2025. This increases the risk of accidents and losses for shipping companies (Becker et al. 2018, 4).

Shipping safety is a crucial aspect affected by climate change, and the results of this study show that the challenges faced by the shipping industry are increasingly complex. As the frequency and intensity of extreme weather events, such as tropical storms and high waves, increases, the risk of accidents at sea becomes greater. Data shows that in the past decade, the number of shipping incidents caused by extreme weather has increased significantly, which requires shipping companies to adopt more effective mitigation strategies.(Tumpu et al. 2023, 18)

One of the key findings of this article is that changing weather patterns can affect weather predictions and shipping route planning. Ships operating in previously safe lanes now have to

face unexpected conditions, such as sudden storms or strong ocean currents. This calls for improvements in navigation technology and early warning systems to ensure the safety of ships and their crews. In addition, better training of ship crews in dealing with emergency situations is also crucial.(Nova et al. 2024)

In addition, climate change impacts on port infrastructure also contribute to shipping safety challenges. Sea level rise and coastal erosion can damage existing ports and facilities, reducing their ability to safely handle ships. This research shows that many ports around the world will need to make major investments in adaptation and infrastructure upgrades to deal with the risks posed by climate change. Without these measures, shipping safety will be further jeopardized, and potential economic losses from accidents at sea will increase.

The Impact of Climate Change on Shipping Lines in Economic Aspects

Changes in shipping routes can reduce shipping costs, but can also cause losses for ports that cannot adapt to the changes. According to a report from the International Maritime Organization (IMO), ports in developing countries may lose up to 50% of their revenue if they do not make appropriate adaptations.

Climate change has a significant economic impact on global shipping lines, which is reflected in various operational and financial aspects of the shipping industry. One of the key results of this study shows that an increase in the frequency and intensity of extreme weather events, such as storms and high waves, can cause substantial financial losses for shipping companies. Increased insurance costs, damage to vessels, and shipping delays due to severe weather all contribute to increased operating costs. Research suggests that shipping companies could face increased costs of up to 20% in the next few years if climate change trends continue.

In addition, changes in shipping routes caused by melting ice in the Arctic open up new opportunities, but also carry economic risks. While these new pathways can reduce travel time and fuel costs, existing port infrastructure may not be ready to handle the increased traffic. This could result in the need for substantial investment in port infrastructure development and improved navigation systems. The research notes that countries that have strategic ports on this new pathway, such as Russia and Canada, could experience significant economic growth, while other countries may be left behind if they cannot adapt to these changes.(Salim 2023)

Economic impacts are also seen in related sectors, such as the fishing industry and tourism. Climate change can affect fish migration patterns and the health of marine ecosystems, which in turn impacts the income of fishers and the fishing industry. In addition, with increased interest in new shipping lanes, the tourism sector may also experience changes, where new destinations in the Arctic regions may attract more tourists. However, the negative impacts of climate change, such as environmental degradation and biodiversity decline, may threaten the long-term appeal of such destinations.

Strategies for Dealing with the Impacts of Climate Change

To deal with the impact of climate change, the shipping industry needs to develop adaptation strategies. These include improving port infrastructure, using environmentally friendly technology, and training crew members to deal with extreme weather. In addition, collaboration between countries and international organisations is essential to develop policies that support adaptation. In dealing with the impact of climate change, the global shipping sector needs to implement a variety of effective adaptation strategies to ensure operational sustainability and safety. One of the main strategies identified is the development of port infrastructure that is more resistant to extreme weather and sea level rise. This includes improving port design and construction to address the risk of flooding and erosion, as well as implementing more sophisticated weather monitoring technologies to predict and respond to rapidly changing weather conditions. In addition, shipping also needs to adapt to changes in shipping routes that

may occur due to melting ice in the Arctic, which opens up new routes but also brings new challenges related to navigation and safety.

In addition, collaboration between government, industry, and other stakeholders is critical to formulating policies that support adaptation to climate change. This includes developing regulations that encourage the use of cleaner fuels and environmentally friendly technologies, as well as incentives for investment in innovations that can reduce the environmental impact of shipping activities. Research shows that ecosystem-based approaches, such as mangrove and coral reef restoration, can also contribute to protecting coastlines and ports from the impacts of climate change. By integrating these adaptation strategies, the shipping sector can increase its resilience to climate change and ensure long-term sustainability in its operations.

Aspects	Impact	Percentage Loss/ Improvement
Pelabuhan Revenue	Potential loss of revenue for ports that do not adapt	Up to 50%
Company Operating Expenses	Increased insurance costs, vessel damage, and shipping delays	Up to 20%
Company Infrastructure	Investment needs for new infrastructure development	Significant (amount not specified)
Fishing Industry	Changes in fish migration patterns and marine ecosystem health	Negative impact on income
Tourism Sector	Increased interest in new shipping lines	Growth potential, but risk of environmental damage

Carbon Emissions Mitigation in the Shipping Industry

The shipping industry should also contribute to carbon emission mitigation. The use of alternative fuels, such as liquefied natural gas (LNG) and biofuels, can reduce the carbon footprint of ships. In addition, the application of energy efficiency technologies, such as more aerodynamic ship designs, can help reduce fuel consumption. Mitigating carbon emissions is one of the main focuses of efforts to deal with the impacts of climate change on global shipping lines. The results show that the shipping sector, which accounts for about 2-3% of total global greenhouse gas emissions, needs to take significant steps to reduce its carbon footprint. One of the strategies identified is the improvement of energy efficiency through the use of more environmentally friendly technologies, such as alternative fuel vessels and more efficient propulsion systems. For example, the use of liquefied natural gas (LNG) as a ship fuel can reduce CO2 emissions by up to 20% compared to traditional fuels.

In addition, this research also highlights the importance of developing and implementing international policies that support carbon emissions mitigation in the shipping sector. The International Maritime Organization (IMO) has set a target to reduce greenhouse gas emissions from ships by 50% by 2050 compared to 2008 levels. Implementation of this policy requires collaboration between member states, the shipping industry and other stakeholders to create an effective framework for reducing emissions.

The results also show that investment in technological innovation and sustainable port infrastructure can contribute to the mitigation of carbon emissions. Ports equipped with facilities to support environmentally friendly vessels, such as alternative fueling and efficient waste management systems, can help reduce the environmental impact of shipping activities. In addition, training and awareness-raising among crew members on sustainable shipping practices are also important factors in mitigation efforts.

Mitigating carbon emissions in the shipping sector is not only important to reduce the impact of climate change, but also to ensure the sustainability of the shipping industry in the future. By adopting cleaner technologies and implementing supportive policies, the shipping

sector can contribute to global efforts to tackle climate change and maintain a balanced marine ecosystem.

CONCLUSION

Climate change is already having a significant impact on global shipping lanes, especially as we approach 2025. Sea level rise, increased frequency and intensity of extreme weather, and changes in Arctic ice cover are altering shipping route patterns and posing new challenges to the industry. Ports in coastal areas are at high risk of inundation and infrastructure damage, which can disrupt operations and increase logistics costs. In addition, shipping safety is also threatened by increasingly unpredictable weather conditions, forcing shipping companies to adapt quickly to remain competitive in the global market.

To meet these challenges, the shipping industry needs to develop a comprehensive adaptation strategy, including port infrastructure improvements, the use of green technologies, and collaboration between governments and stakeholders. Mitigating carbon emissions is also an important focus, with the adoption of alternative fuels and energy efficiency technologies that can help reduce the sector's carbon footprint. With proactive and innovative measures, it is hoped that the shipping industry can adapt to climate change and capitalize on emerging opportunities, while still maintaining environmental and economic sustainability in the future.

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