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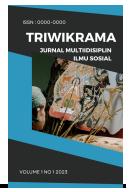

Geopolitical Implications and the Importance of Climate Change on the Emergence of Russia's Northern Sea Route (NSR)

Cakra Tri Sastrawiguna[1], Imam Fadhil Nugraha [2]
[1]Universitas Hasanuddin

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A B S T R A K

Perubahan iklim yang mempercepat pencairan es Arktik telah menjadikan wilayah tersebut sebagai pusat perhatian global, terutama dalam konteks perdagangan dan geopolitik. Salah satu dampak signifikan adalah munculnya Northern Sea Route (NSR), rute pelayaran yang menawarkan jarak lebih pendek dibandingkan jalur tradisional seperti Terusan Suez. Penelitian ini mengkaji potensi ekonomi, tantangan geopolitik, dan dampak lingkungan dari pengembangan NSR. Dengan metode kualitatif, analisis ini memanfaatkan tinjauan literatur, analisis kebijakan, dan teori geopolitik seperti Teori Heartland Mackinder. Hasil penelitian menunjukkan bahwa Rusia memanfaatkan NSR sebagai bagian strategis dari kebijakan Arktiknya, mencakup kontrol hukum yang ketat dan pengembangan infrastruktur. Namun, tantangan utama meliputi sengketa kedaulatan dengan negara-negara Barat, keterbatasan infrastruktur, dan risiko lingkungan yang signifikan. Meskipun menawarkan peluang besar untuk pengurangan jarak dan biaya pengiriman, rute ini masih menghadapi skeptisisme internasional terkait kelayakannya sebagai koridor perdagangan global. Artikel ini menekankan perlunya keseimbangan antara pengembangan ekonomi, perlindungan lingkungan, dan stabilitas geopolitik untuk memastikan keberlanjutan NSR di masa depan. Dengan demikian, NSR bukan hanya peluang ekonomi, tetapi juga cerminan dinamika global yang lebih luas, menjadikannya wilayah strategis yang membutuhkan perhatian dan kerja sama internasional.

A B S T R A C T

Accelerated Arctic ice melting due to climate change has transformed the region into a focal point of global interest, particularly in trade and geopolitics. A notable development is the emergence of the Northern Sea Route (NSR), offering a shorter alternative to traditional routes like the Suez Canal. This study examines the economic potential, geopolitical challenges, and environmental impacts of the NSR's development. Using a qualitative methodology, it incorporates literature reviews, policy analysis, and geopolitical theories such as Mackinder's Heartland Theory. The findings indicate that Russia leverages the NSR as a strategic component of its Arctic policy, enforcing strict legal controls and advancing infrastructure development. However, key challenges include sovereignty disputes with Western nations, infrastructural limitations, and significant environmental risks. Despite its promise of reduced shipping distances and costs, skepticism remains about the NSR's viability as a global trade corridor. The paper underscores the need for a balance between economic development, environmental protection, and geopolitical stability to ensure the NSR's sustainability. Thus, the NSR represents not only an economic opportunity but also a reflection of broader global dynamics, positioning it as a strategic area requiring international attention and cooperation.

*Corresponding author
E-mail addresses: tricakra32@gmail.com

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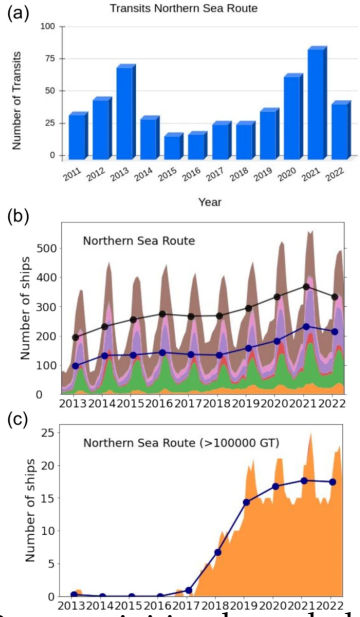
1. Introduction

The melting of Arctic ice as a consequence of climate change has transformed the Arctic region into a spotlight of global interest. Among the most significant developments is the emergence of the Northern Sea Route (NSR), which has become one of the most sought-after shipping investments for nations, particularly those in proximity to the Arctic. Over recent decades, Arctic shipping activities have increased by approximately 7% annually, with winter operations tripling despite the hazardous conditions posed by extreme temperatures and persistent sea ice (Müller et al., 2023).



Gambar 1. Northern Sea Route activities through the year (Müller et al., 2023)

Spanning 13,000 kilometers, the NSR offers a shorter alternative to the 21,000-kilometer Suez Canal Route, making it an attractive, albeit underexplored, trade route. This shift, primarily driven by oil and gas projects, has led to the NSR becoming operational year-round. Russia has emerged as a dominant player in the region, continuously building infrastructure and deploying more icebreaker ships than any other nation. These efforts underline Russia's ambition to capitalize on the NSR's economic and geopolitical potential.

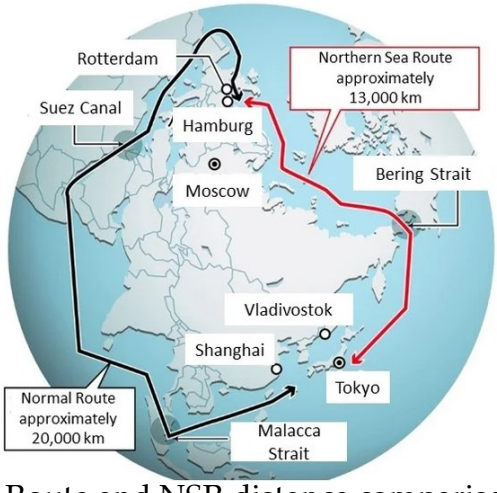


Figure 2. Suez Canal Route and NSR distance comparison (*Splash247.com*)

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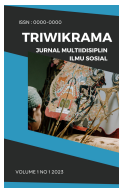


Perspectives on the NSR's viability and implications vary widely. While some studies highlight the NSR's potential as an economic and geopolitical investment, others remain skeptical. For example, Lasserre and Cyr (2022) acknowledge the expanded accessibility due to climate change but question its capacity to serve as a reliable alternative to traditional routes like the Suez Canal. Nonetheless, the NSR remains a topic of interest for Arctic and non-Arctic states alike. Russia asserts sovereignty over the route as part of its internal waters, while other nations, including the United States and European countries, argue it should be classified as an international strait, further underscoring its geopolitical significance. Despite these dynamics, existing research often overlooks the critical role of climate change in shaping the NSR's geopolitical development. With international frameworks increasingly prioritizing environmental protection—such as the Paris Agreement and the IMO's emission reduction strategy—the tension between economic development and sustainability becomes more pronounced. These policies pose challenges for the NSR, which relies heavily on oil and gas projects while raising concerns over environmental degradation and marine life endangerment (OECD, 2022).

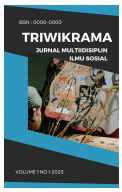
The environmental risks of Arctic shipping extend across multiple dimensions, including water pollution, air emissions, and threats to biodiversity (Qi et al., 2024; Dushkova, Krasovskaya, & Exsev, 2017). Oil spills in the Arctic, exacerbated by the harsh conditions, have devastating effects on marine ecosystems, as seen in cases like the Exxon Valdez disaster. Emissions of black carbon further accelerate ice melt, amplifying the impacts of climate change. Meanwhile, ballast water discharge introduces invasive species that disrupt local ecosystems. These environmental risks underscore the urgent need for sustainable practices and stricter regulatory standards to manage the NSR's development responsibly.

The melting of Arctic ice due to climate change has transformed the region into a big interest for global trade and competition. The NSR, emerging as a viable alternative to traditional routes like the Suez Canal, has attracted interest from both Arctic and non-Arctic states, intensifying disputes over sovereignty and access. As an underexplored trade corridor, the NSR offers economic opportunities but also fuels geopolitical competition, particularly among Arctic Council members and other stakeholders like China and the European Union.

2. METHODOLOGY

This writing uses a qualitative approach to explore the many aspects of the Northern Sea Route (NSR). The research is based on theories, analysis of policies, and a review of previous studies. Mackinder's Heartland Theory helps explain Russia's efforts to control the NSR by linking geography to global power. This theory is used to better understand how the NSR plays a key role in Russia's plans for economic and political influence in the Arctic. Using this framework, the study focuses on how geography, power, and international competition come together in the NSR.

The study includes a qualitative review of books, academic papers, government reports, and research from international organizations. This literature review identifies the main topics surrounding the NSR, such as ownership disputes, environmental risks, and its potential as a trade route. The review looks at opinions from both Western and Russian sources to understand different viewpoints on the NSR. This helps show how the route is seen as both an opportunity and a challenge by various countries and organizations. Analyzing policies is an important part



of the research. The study looks at how Russia uses laws like Article 234 of the United Nations Convention on the Law of the Sea (UNCLOS) to control the NSR. It also examines Russia's Arctic development plans, such as the Arctic Policy 2035, to understand its strategies for the region. In addition, the study explores international disputes over the NSR and how other countries, like the United States, challenge Russia's claims. This analysis highlights the legal and political issues that surround the NSR and affect its future.

The study also focuses on environmental impacts by reviewing examples of Arctic shipping activities. It looks at problems like pollution, oil spills, and the impact on Arctic wildlife. Reports and studies on climate change are used to assess how these issues could worsen as the NSR becomes more active. The research also considers international agreements, like the Paris Agreement, which aim to reduce environmental harm. This part of the study shows the conflict between using the NSR for economic growth and protecting the Arctic environment.

The melting of Arctic ice due to climate change has transformed the region into a focal point for global trade and competition. The NSR, emerging as a viable alternative to traditional routes like the Suez Canal, has attracted interest from both Arctic and non-Arctic states, intensifying disputes over sovereignty and access. As an underexplored trade corridor, the NSR offers economic opportunities but also fuels geopolitical competition, particularly among Arctic Council members and other stakeholders like China and the European Union. At the same time, sustainability frameworks emphasize the growing tension between environmental protection and economic development in the Arctic. Policies such as the Paris Agreement and International Maritime Organization (IMO) emission reduction strategies seek to mitigate the environmental impact of Arctic shipping, posing challenges for resource-driven initiatives like Russia's oil and gas projects. The framework integrates these dynamics, analyzing how climate change, geopolitical interests, and international sustainability policies intersect to shape the future of the NSR and Arctic governance.

3. RESULT AND DISCUSSION

The Northern Sea Route (NSR) has emerged as a critical point of interest in the shifting dynamics of global trade and geopolitics, largely driven by the accelerating impact of climate change. The steady retreat of Arctic ice has opened up possibilities for shorter shipping routes, creating opportunities for economic gain while also raising complex environmental and legal questions. Russia, with its expansive Arctic coastline, has positioned itself as a dominant force in the region, seeking to leverage the NSR as both an economic lifeline and a geopolitical tool. However, this ambition is met with significant challenges, including infrastructural limitations, international disputes over sovereignty, and the pressing need to address environmental risks in one of the world's most fragile ecosystems.

NSR's significance varies from different perspectives, it is important to explore not only the strategic motivations behind its development but also the broader implications for global governance and sustainability. The interplay of economic incentives, environmental responsibilities, and geopolitical rivalries defines the current discourse surrounding the Arctic. As nations grapple with the competing demands of development and preservation, the NSR stands as a symbol of both opportunity and contention. This discussion seeks to unravel these complexities, offering insights into how the Arctic's transformation is reshaping not just regional dynamics but also the global order.

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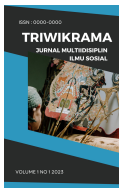


3.1 Russia's dominance over northern Sea Route

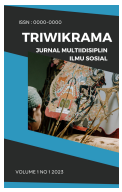
The Northern Sea Route (NSR) occupies a central role in Russia's Arctic strategy, functioning as both a domestic economic lifeline and a potential global shipping corridor. Moscow's efforts to dominate the NSR are deeply rooted in its economic ambitions, geopolitical strategies, and national security objectives. However, these efforts are fraught with challenges, ranging from infrastructural deficits to geopolitical tensions and environmental vulnerabilities.

Russia's dominance over the NSR is anchored in its legal framework and regulatory control, which it enforces rigorously under Article 234 of the United Nations Convention on the Law of the Sea (UNCLOS). This article allows coastal states to regulate ice-covered waters to prevent marine pollution. Russia has leveraged this clause to assert sovereignty over the NSR, designating it as internal waters and imposing strict rules on navigation, including mandatory use of Russian icebreakers and prior authorization for foreign vessels (Meade, 2020). These measures reinforce Russia's control but have drawn significant international opposition, particularly from Western nations that advocate for the NSR's status as an international waterway. The United States, for instance, has conducted Freedom of Navigation Operations (FONOPs) to challenge Russia's claims, exemplifying the broader geopolitical contest in the Arctic (Donahue, 2022). This tug-of-war over legal interpretations underscores the strategic importance of the NSR in global geopolitics

Economically, the NSR is integral to Russia's vision of Arctic development, providing a crucial link between its resource-rich Arctic zone and international markets. Projects like the Yamal LNG terminal have demonstrated the potential of the NSR to support large-scale resource exports, reducing transportation distances between Europe and Asia by up to 37% compared to the Suez Canal (Meade, 2020). However, transit traffic, a critical indicator of the NSR's global viability, remains limited. Most traffic is dominated by domestic and resource-based cargo, reflecting the NSR's underdeveloped role as an international trade corridor (Mekhdiev et al., 2021). High operational costs, coupled with limited infrastructure, further deter foreign shipping companies from adopting the NSR as a viable alternative to traditional routes

Infrastructure inadequacies present a significant hurdle to the NSR's development. Russia's vast Arctic coastline requires well-equipped ports, advanced navigation systems, and comprehensive search-and-rescue capabilities to support increased traffic. While Russia has made strides in modernizing its icebreaker fleet, including the deployment of nuclear-powered vessels like those in the Project 22220 series, the surrounding infrastructure lags behind. Many Arctic ports remain outdated, and the lack of robust emergency response systems increases the risks associated with NSR navigation. President Vladimir Putin's ambitious goal to increase Arctic shipping to 80 million tons annually by 2024 highlights the scale of Russia's aspirations. Yet, achieving this target is constrained by financial limitations and international sanctions, which restrict Russia's access to advanced technologies and foreign investments essential for Arctic development (Donahue, 2022)

Geopolitical dynamics further complicate Russia's efforts to assert dominance over the NSR. The militarization of the Arctic, including the deployment of advanced defense systems along the NSR, reflects Moscow's dual objectives of safeguarding its sovereignty and deterring foreign influence. These measures, however, have heightened tensions with NATO and other Western nations, resulting in reciprocal military exercises near Russian borders. Simultaneously, China's growing interest in the NSR as part of its Polar Silk Road initiative introduces a potential competitor. While Chinese investments in Arctic energy projects, such as Yamal LNG, have been



welcomed, Russia remains cautious of Beijing's long-term intentions in the Arctic, reflecting a complex interplay of cooperation and competition (Meade, 2020)

Environmental challenges compound the NSR's operational and strategic difficulties. Climate change, while opening Arctic waters for extended periods, also destabilizes infrastructure built on permafrost and increases the risk of ecological disasters. Oil spills, emissions of black carbon, and the introduction of invasive species are pressing concerns associated with increased Arctic shipping. Russia's Arctic Policy 2035 recognizes these risks but falls short of offering comprehensive solutions, particularly given the financial and logistical challenges of implementing robust environmental safeguards. The fragility of the Arctic ecosystem demands greater international collaboration, yet geopolitical rivalries often overshadow cooperative efforts in the region (Donahue, 2022)

Russia's control of the Northern Sea Route (NSR) is a key part of its strategy to strengthen its position in global affairs by securing an important Arctic shipping route, reflecting ideas from Halford Mackinder's Heartland Theory. Mackinder argued that controlling key geographic regions gives a nation the power to influence global events (Mackinder, 1904). In the case of Russia, its claim over the NSR, investment in infrastructure, and focus on exploiting Arctic resources align with this idea. The NSR's potential to shorten shipping routes between Europe and Asia provides Russia with an opportunity to play a central role in global trade while boosting its standing in the energy market. However, Russia faces significant challenges, including high operational costs, limited infrastructure, and environmental risks that could hinder the route's full development. Additionally, the increasing military presence in the region shows how crucial Russia sees its dominance over the Arctic.

Mackinder's theory also helps explain why Russia's control of the NSR is so important. The Arctic, once largely inaccessible, has become a key area due to climate change, which has opened up new shipping routes. Russia's control of the NSR positions it as a major player in this newly accessible region, much like Mackinder viewed the Heartland as central to global power. Yet, this control is contested by Western countries pushing for free access to the Arctic and China's growing interest in the region. The NSR, in this sense, is more than just an economic asset—it's a strategic point of global importance. How Russia manages its infrastructure, environmental concerns, and geopolitical relations will determine whether it can fully capitalize on the Arctic's potential and maintain its dominance in this increasingly contested region.

Russia has positioned itself as the dominant actor on the NSR, but their ambitions are faced by significant challenges. Legal disputes, infrastructural gaps, geopolitical rivalries, and environmental vulnerabilities collectively hinder the realization of the NSR's potential as a global maritime corridor. Addressing these issues requires not only substantial investment and innovation but also a recalibration of Russia's approach to balance national interests with international cooperation. The future of the NSR will likely affect Moscow's ability to navigate these complexities effectively.

3.2 The emblematic role of climate change towards Northern Sea Route future

Climate change plays a central role in transforming the Northern Sea Route (NSR) from an almost impassable ice-bound corridor into a major point of global interest. The Arctic is warming faster than anywhere else on Earth, with average temperatures increasing nearly twice as fast as the global rate. This warming has caused Arctic ice to melt at an alarming rate, significantly changing the region's landscape and creating new opportunities for human activity. The NSR,

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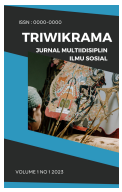

which stretches along the northern coast of Russia, has become more accessible as ice cover decreases during the summer months (Winther and Østhagen, 2024). This increasing accessibility has made it a focus for trade, resource extraction, and geopolitical strategy. However, these changes come with serious challenges, both environmental and logistical, and raise important questions about the future of this fragile region.

One of the most striking effects of climate change on the NSR is the loss of sea ice. In recent decades, Arctic sea ice has been shrinking in both extent and thickness. The ice, which once served as a natural barrier to navigation, now melts earlier in the year and refreezes later, creating longer periods of open water during the summer. Reports show that the 12 lowest ice levels on record have all occurred since 2007, highlighting the rapid and ongoing impact of global warming. This has extended the navigation season along the NSR, making it possible for commercial vessels to travel through the Arctic without requiring constant support from icebreakers (Norchi and Lynch, 2022). The thinning ice also reduces costs and makes the NSR more appealing to shipping companies looking for faster and cheaper routes between Europe and Asia.

The role of climate change in increasing human activity along the NSR cannot be overstated. As the ice retreats, it opens up new opportunities for global trade. Shipping companies have realized that the NSR offers a route that is up to 40% shorter than the traditional path through the Suez Canal. This reduced travel time translates into lower fuel costs and faster delivery, providing a strong economic incentive for businesses to explore this option. Additionally, as the NSR becomes more viable, Russia has invested heavily in developing the necessary infrastructure, including new ports, ice-resistant ships, and navigation systems, to support the growing traffic (Sharapov, 2023). These investments aim to solidify Russia's control over the NSR and to capitalize on the economic benefits that the route offers.

Climate change has also revealed vast reserves of untapped natural resources in the Arctic, including oil, gas, and minerals. As ice recedes, these resources become more accessible, drawing attention from energy and mining companies around the world. The potential for resource extraction has turned the NSR into a critical area of economic interest, particularly for Russia, which has prioritized Arctic development as a national strategy. However, the increase in shipping and industrial activities also poses significant risks to the Arctic environment (Norchi and Lynch, 2022; Sharapov, 2023). The fragile ecosystem of the Arctic is already under stress from warming temperatures, and additional human activity could further disrupt habitats, harm biodiversity, and threaten the traditional ways of life for indigenous communities.

One of the most concerning aspects of climate change in the Arctic is its ability to amplify itself through feedback loops. As sea ice melts, it exposes darker ocean waters, which absorb more sunlight and heat. This process accelerates warming and leads to even more ice melting, creating a vicious cycle known as Arctic amplification. This feedback loop not only affects the Arctic region but also contributes to global climate change, influencing weather patterns and sea levels worldwide (Winther and Østhagen, 2024). By enabling increased activity along the NSR, climate change further adds to these challenges, making the Arctic both a symbol and a driver of broader environmental shifts.

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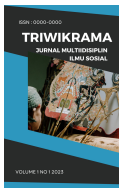


The NSR remains a challenging environment for navigation and development, despite its growing importance. The unpredictable effects of climate change, such as shifting ice patterns and extreme weather, make the region difficult to navigate safely. Infrastructure to support large-scale shipping and resource extraction is still limited, with few ports and insufficient emergency response capabilities. Additionally, the environmental risks associated with increased activity, such as oil spills and pollution, pose a major threat to the Arctic's delicate ecosystem. These risks highlight the need for international cooperation to ensure that the NSR is developed responsibly and sustainably.

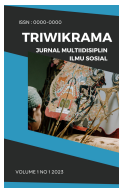
Climate change is the driving force behind the transformation of the NSR, shaping its future as a vital maritime corridor and a hub for economic and geopolitical activity. However, this transformation comes with significant challenges that must be addressed to protect the Arctic's environment and ensure its sustainable use. The NSR stands as a powerful example of how climate change can simultaneously create opportunities and risks, emphasizing the need for global action to balance economic ambitions with environmental responsibility. The future of the NSR will depend on how nations respond to these challenges, making climate change not only a backdrop but a central player in its story.

3.3 Geopolitical Implications of the Northern Sea Route

The geopolitical relevance of the Northern Sea Route (NSR) has grown significantly in recent years, driven by the intersection of Arctic sovereignty disputes, economic ambitions, and the strategic importance of the route in global trade. This section discusses these dynamics, drawing on the comprehensive analyses of Moe et al. (2024) and Meade (2020), to explore the geopolitical complexities that shape the NSR's role in Arctic governance and international relations.

Russia's claim over the NSR is rooted in Article 234 of the United Nations Convention on the Law of the Sea (UNCLOS), positions the route as part of its internal waters, granting Moscow regulatory authority over its use (Meade, 2020). This claim has been met with opposition from the United States and other Western nations, who argue that parts of the NSR qualify as international waters. These conflicting interpretations have led to increased tensions in the Arctic, exemplified by actions such as the United States' Freedom of Navigation Operations (FONOPs) in Arctic waters. The 2018 transit of a French naval supply ship through the NSR without seeking Russian permission, followed by the United States and United Kingdom's joint naval exercises in the Barents Sea, further highlight the contentious nature of Arctic sovereignty (Meade, 2020). These operations are designed to assert the principle of free navigation, directly challenging Russia's attempts to exert control over the NSR. Such actions underline the broader geopolitical rivalry between Moscow and Western powers, with the NSR becoming a focal point of strategic competition.

Responding to these external challenges, Russia has taken decisive measures to reinforce its sovereignty claims over the NSR. New regulations require foreign military vessels to seek prior permission before transiting the route, reflecting Moscow's intent to assert control and deter unauthorized activities (Meade, 2020). This policy aligns with Russia's broader Arctic strategy, which includes military modernization and the deployment of a robust icebreaker fleet to secure its interests in the region (Moe et al., 2024). The construction of advanced nuclear-powered icebreakers, such as those under the Project 22220 series, underscores Russia's commitment to maintaining a year-round navigable NSR while projecting its influence over Arctic waters. These



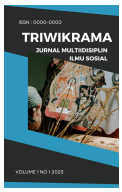
developments reveal the dual purpose of Russia's Arctic policy: to solidify territorial claims and ensure the economic utility of the NSR as a critical trade route.

The economic ambitions associated with the NSR are another key driver of geopolitical tensions. Russia's Arctic Policy 2035 underscores the route's importance as a global transport corridor, aiming to capitalize on its shorter transit distances compared to traditional routes like the Suez Canal (Meade, 2020). The NSR offers a reduction in shipping distances between Europe and East Asia by approximately 37%, translating to potential fuel and time savings for international shipping companies (Moe et al., 2024). However, despite these theoretical advantages, the NSR faces significant challenges in achieving its envisioned role as a competitive international trade route. Currently, the majority of traffic on the NSR consists of domestic and resource export shipping, primarily serving Russia's internal needs. Transit traffic, which is critical for establishing the NSR's global viability, remains underdeveloped, hindered by infrastructure deficits and harsh environmental conditions (Moe et al., 2024).

Infrastructure development along the NSR is pivotal to realizing its potential as a global trade artery but has proven to be a persistent challenge. Delays in the construction of key facilities, such as ports, icebreakers, and search-and-rescue operations, have raised concerns about Russia's ability to meet its ambitious targets for increasing shipping volumes (Meade, 2020). President Vladimir Putin's directive to increase Arctic shipping to 80 million tons annually by 2024 has been described as overly optimistic, given the current pace of development. Furthermore, the high costs associated with Arctic infrastructure projects and the need for substantial state subsidies pose additional hurdles to the NSR's growth (Moe et al., 2024). These economic pressures are compounded by international sanctions, which restrict Russia's access to foreign investments and advanced technologies necessary for Arctic operations. The resulting delays and financial constraints threaten to undermine Moscow's strategic objectives for the NSR, creating vulnerabilities that could be exploited by rival powers seeking to challenge Russia's dominance in the Arctic.

The geopolitical rivalry over the NSR also extends to its environmental and sustainability dimensions. While Russia promotes the route as a climate-friendly alternative to traditional shipping lanes due to its shorter distances, the environmental risks associated with increased Arctic traffic cannot be ignored (Moe et al., 2024). The potential for oil spills, emissions of black carbon, and the introduction of invasive species through ballast water discharge highlight the ecological challenges of Arctic navigation. These risks are exacerbated by the region's fragile ecosystem and the limited capacity for effective disaster response in remote Arctic areas. Moreover, the rapid warming of the Arctic, as evidenced by the unprecedented melting of permafrost and ice cover, presents both opportunities and challenges for the NSR. While reduced ice levels may facilitate navigation, they also amplify environmental vulnerabilities and complicate Russia's infrastructure development efforts (Moe et al., 2024).

The NSR holds importance for the broader geopolitical, economic, and environmental tensions that define the Arctic in the 21st century. Russia's efforts to assert sovereignty over the route and develop it as a strategic transport corridor are central to its Arctic ambitions but face significant opposition from Western powers advocating for international access. Economic challenges, coupled with environmental risks, further complicate the NSR's development trajectory. As the Arctic becomes increasingly integrated into global geopolitics, the NSR will likely remain a critical battleground for competing national interests, with its future shaped by the interplay of sovereignty claims, infrastructure investments, and sustainability considerations.



This dynamic underscores the need for comprehensive governance frameworks that balance economic development with environmental protection and geopolitical stability.

4. Conclusion and Recommendations

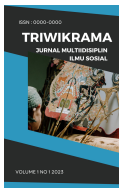
The Northern Sea Route (NSR) has emerged as a strategic maritime corridor with the potential to reshape global trade patterns, driven largely by climate change and Russia's ambitions to capitalize on the opportunities presented by melting Arctic ice. The retreat of ice has made the NSR increasingly navigable, offering a shorter alternative to traditional routes such as the Suez Canal, thereby reducing transit times and costs. However, the NSR's development is fraught with challenges, including sovereignty disputes with Western nations, insufficient infrastructure, and significant environmental risks associated with increased human activity in the Arctic.

Russia's dominance over the NSR, backed by legal claims under Article 234 of the United Nations Convention on the Law of the Sea (UNCLOS) and investments in infrastructure such as nuclear-powered icebreakers, underscores its intent to control this strategic corridor. Despite these efforts, international skepticism remains regarding the route's viability due to logistical hurdles and geopolitical tensions. Additionally, the fragile Arctic ecosystem faces growing threats from increased shipping, oil and gas exploration, and industrial activity. The interplay of economic potential, environmental vulnerabilities, and geopolitical rivalry makes the NSR a complex yet pivotal issue in Arctic governance and global trade.

The sovereignty dispute surrounding the Northern Sea Route (NSR) remains a major challenge to its development. To address this, Russia and other Arctic and non-Arctic nations must engage in serious diplomatic negotiations. These discussions should take place within established international frameworks such as the Arctic Council and the United Nations Convention on the Law of the Sea (UNCLOS). The goal should be to reach a clear, legally binding agreement on the NSR's status, which would reduce geopolitical tensions and create a cooperative approach to managing the route. It is essential that the resolution respects the interests of all stakeholders, balancing the rights of Russia with the needs and concerns of other nations, both within and outside the Arctic region.

Environmental protection must be a top priority in the development of the NSR. The Arctic is one of the most vulnerable ecosystems on Earth, and increased shipping activity poses significant risks, including oil spills, pollution, and harm to marine life. To prevent this, strict environmental regulations should be put in place, with a focus on minimizing ecological damage. These regulations should align with global environmental frameworks like the Paris Agreement, but also include specific guidelines for Arctic shipping. The adoption of clean technologies and practices, such as reducing emissions and preventing oil spills, must be mandated for all shipping operations. Effective monitoring and enforcement mechanisms will be essential to ensure compliance and prevent environmental degradation, with penalties for violators to ensure accountability.

There is also a critical need for enhanced research and monitoring to better understand the environmental impacts of shipping and industrial activities along the NSR. International collaboration between Arctic states, environmental organizations, and scientific institutions should be strengthened to monitor changes in the Arctic environment, including the effects of climate change, shipping traffic, and resource extraction. Research should focus on tracking pollution levels, the health of marine ecosystems, and the broader ecological impacts of increased



human activity. The data collected will be invaluable for informing future policies and ensuring that development is carried out in a sustainable manner. Continuous scientific monitoring will help manage risks and support adaptive strategies to protect the Arctic's fragile ecosystem.

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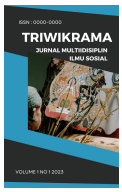

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