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Pollution Regulation of Shipping in East Asian Seas on the "21st Century Maritime Silk Road"

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Abstract. In the world situation where regional co-operation is constantly developing, the "21st Century Maritime Silk Road" has become an important system of trade and co-operation among the countries along the East Asian Seas. At the same time, the shipping pollution problem caused by maritime trade is getting seriously, which is really related to the environmental safety and economic interests of the countries along the route. This study focuses on the legal regulation of shipping pollution along the 21st Century Maritime Silk Road in East Asian waters from the perspectives of international law and environmental law, and adopts the methods of literature analysis, comparative analysis, and case study analysis, taking into account the differences between the countries in the fields of regulatory efforts and technical standards, etc. The study finds that it is possible to emphasise the application of international law and environmental law to the problem of shipping pollution along the 21st Century Maritime Silk Road in East Asian waters. The study finds that the application of international law and regional synergistic governance can be emphasised to unify the governance standards and strengthen the synergy of governance means. At the same time, the study also aims to improve the system of liability determination and damage compensation, to clarify the determination of liability, and ultimately to serve the relief of victims and the implementation of disciplinary measures against those responsible for pollution. This study provides a balance between marine environmental protection and maritime trade prosperity.

Keywords: "21st Century Maritime Silk Road", shipping pollution, legal regulation.

1. Introduction

With the acceleration of globalisation and the deepening of regional economic cooperation, the 21st Century Maritime Silk Road, as an important link connecting East Asia, Southeast Asia and the Indian Ocean littoral countries, has demonstrated an unprecedented strategic value in promoting trade and economic development. As the core corridor of the initiative, the East Asian seas carry intensive shipping activities and have become a key node in the global shipping network. However, the prosperity of the shipping industry has also brought about serious environmental challenges. Pollution problems such as fuel oil spills, ship rubbish discharges, and harmful exhaust emissions are becoming increasingly prominent, posing a serious threat to marine ecosystems, fishery

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resources, and the ecological security of coastal countries. Moreover, new types of marine pollutants, such as microplastics and Persistent Organic Pollutants (POPs), are not regulated [1].

The current regulation of shipping pollution in East Asian seas faces multiple dilemmas. On the one hand, the international regulatory system is fragmented. There are global frameworks such as the International Convention for the Prevention of Pollution from Ships (MARPOL) and regional agreements such as the Northwest Pacific Action Plan (NOWPAP) [2]. However, there are differences in the scope of application and implementation standards of different international regulations, resulting in the role played in practice is not being obvious. On the other hand, the mechanism of responsibility determination is vague. After the pollution accident, the transnational responsibility division and compensation implementation are difficult. In addition, the imperfection of regional cooperation mechanism also further enhances the difficulty of governance, and the divergence of regulatory efforts and technical standards among countries restricts the effectiveness of collaborative governance. Based on this, this study adopts the methods of literature research, comparative research and case study analysis, focusing on clarifying the criteria for determining responsibility, exploring the mechanism of trans-regional environmental joint enforcement, and forming a pollution risk assessment and early warning system, to provide theoretical basis and practical references for the long-term governance of shipping pollution.

2. Literature review

At present, there are fewer studies on the regulation of shipping pollution in the sea area related to the "Maritime Silk Road". Previous studies have focused on the prevention and control of inland shipping pollution in the Yangtze River Basin and the prevention of shipping pollution in extremely fragile ecological regions such as the Arctic [3,4]. Among them, the definition of pollution indicators and the identification of regional responsibility division have some reference value. Nowadays, the governance system closely related to the East Asian Seas is mainly centered around three international laws, MARPOL, NOWPAP and the United Nations Convention on the Law of the Sea (UNCLOS) [5]. Under the existing governance system, an incipient ocean governance system has been formed in the East Asian Seas, which covers people's life and health, marine resource utilisation and sustainable development, and has had a certain stable operation time. However, the governance system has a number of flaws, mainly in the lack of co-operation and coercion, the overriding of politics over environmental priorities, and the failure to take into account the changes in international relations.

Synthesising the results of previous research, this study argues that there are two controversial aspects. On the one hand, whether a hierarchical governance mechanism should be set up according to the level of economic development of different countries and their ability to control and deal with shipping pollution. On the other hand, in terms of the determination of responsibility, how should the responsibility be traced, whether it goes to the state, or to a specific shipping company, or to the shipper, and so on.

Based on the above contradictions, this study argues that it is important to explore a collaborative governance system for shipping pollution with a high degree of flexibility and inclusiveness in order to ease such contradictions and thus promote the sustainable development of the Maritime Silk Road.

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3. Current status of maritime pollution regulation in East Asian Seas

3.1. Framework of core international conventions and agreements

The regulatory system for pollution in the East Asian Seas is based on UNCLOS as the cornerstone, supplemented by specialised international conventions to form a multi-tiered legal framework. Part XII of UNCLOS establishes the three dimensions of State responsibility. First, Article 192 establishes the obligation erga omnes, requiring States to assume mandatory responsibility for marine environmental protection; second, Article 194 establishes the principle of sovereignty limitation, seeking a balance between environmental protection and freedom of navigation; and third, Article 235 establishes liability for transboundary damage, but fails to specify the criteria for determining liability and the scope of compensation, leading to disputes in practice. The "Flag State-Port State-Coastal State Cooperative Enforcement Mechanism" created by Articles 213-222 of the Convention has shown implementation differences in East Asian waters-China, Japan and South Korea can effectively exercise port state supervision most of the time, while developing countries in Southeast Asia are difficult to implement due to the lack of resources for law enforcement. Southeast Asian developing countries are difficult to implement due to the lack of enforcement resources [6].

As a specialised convention, MARPOL builds up the whole process of pollution control standards through six bylaws, and its institutional breakthrough is reflected in three aspects. Firstly, it is mandatory for ships to be equipped with a double-hull structure to prevent oil spill accidents. The second is the establishment of special areas to implement strict emission restrictions. Thirdly, it provides for the obligation to report accidents to support regional emergency response co-operation. However, there are structural deficiencies in the Convention, which are highlighted by the fact that developing countries can apply for "equivalent exemptions" under Article 15, leading to the fragmentation of ship standards. As well as the optional mechanism in Annexes III-VI, the scope of the obligations of member states is unbalanced. Taking Cambodia as an example, it only accepts the constraints of Annex I, which creates room for regulatory arbitrage in the disposal of ship waste in the region.

3.2. Practical dilemmas of regional co-operation mechanisms

Currently, regional cooperation in the East Asian Seas is characterised by composite features, mainly relying on soft law arrangements. The NOWPAP relies on a voluntary commitment mechanism and does not set quantitative emission reduction targets. The East Asian Seas Action Plan uses project-based financing to maintain its operation and lacks legal continuity. The China-Japan-South Korea Environment Ministers' Meeting lacks a dispute resolution process and has no sanctioning power over violations by member states.

The Sanger oil tanker accident in the East China Sea in 2018 has, to a certain extent, exposed the shortcomings of mechanism synergy. China, Japan and South Korea have been working separately in pollution monitoring and information notification, with low coordination. In this case, the deeper obstacle to regional cooperation stems from the sovereignty dispute. On the Japanese side, Japan's adoption of the Basic Law of the Sea to strengthen unilateral law enforcement in disputed waters has triggered protests from China and South Korea. China's assertion of ex-officio coastal state jurisdiction over pollution incidents in the Exclusive Economic Zone (EEZ) is in direct conflict with Japan and South Korea's insistence on the principle of priority of flag state jurisdiction. And Non-Governmental Organization (NGOs), which should play a key role, are excluded from the core circle of decision-making, weakening the effectiveness of NGO consultation and monitoring [7].

DOI: 10.54254/2753-7048/2025.BR26115

3.3. Structural challenges of the current regulatory system

The above section describes the challenges faced by the 21st Century Maritime Silk Road at the practical level. One of the major reasons is the ineffective operation of the regulatory system, which has faced a series of structural challenges.

3.3.1. Legal application and enforcement dilemmas

Ambiguity in the determination of transboundary liability constitutes the first and foremost challenge. Section 235 of UNCLOS fails to address three major issues. The first problem is that ocean acidification caused by atmospheric deposition of pollutants is difficult to trace. The second is that the convention fails to distinguish between the liability of developed countries and developing countries, resulting in the jurisprudential conflict between the principle of strict liability and the cumulative theory of historical emissions in the 2019 case of South Korea v. China Fishing Vessel Pollution [8]. Thirdly, the fragmentation of remedies has led to inconsistencies in the determination of "significant pollution damage" by various adjudicatory bodies.

The implementation imbalance is further exacerbated by deficits in regulatory capacity in developing countries. First, the Philippines has only three monitoring vessels covering 220,000 square kilometres [9]. Second, Cambodia has not transposed MARPOL Annex V into domestic law by 2020 [10]. Furthermore, the port of Ho Chi Minh, Vietnam, will have only 12 per cent port state surveillance coverage by 2022 [11]. The regulatory vacuum has given rise to the phenomenon of "Flag of Convenience Ship Pollution Transfer", which has led Japanese and Korean shipowners to register low-standard ships in lax jurisdictions such as Cambodia to circumvent emission controls.

3.3.2. Regulatory gaps in new pollution problems

In the field of microplastic emissions from ships, there are both qualitative disputes and lack of standards; MARPOL Annex IV does not explicitly include microplastics in the category of "waste", and the existing emission standards of the International Maritime Organisation do not set concentration limits, which puts the huge amount of microplastics discharged by 10,000 TEUs containerships in the blind spot of regulation [12].

There is a systemic disconnect in the regulation of biological pollution from ships. The Ballast Water Management Convention (BWMC) lacks mandatory binding force until its full implementation in 2024, and its discharge standards allow a five-year grace period for developing countries [13]. Existing rules ignore ship-attached biofouling, and studies have shown that ships can attach up to 400 g/m2 of organisms, which act as vectors for pathogens.

The environmental risks of low-carbon fuels highlight the lagging nature of the rules. The liquefied natural gas (LNG) fuels used to meet sulphur emission limits cause methane to escape and exacerbate the greenhouse effect; methane has a 30% higher temperature rise than conventional fuels, and its combustion by-products, polycyclic aromatic hydrocarbons (PAHs), are bioaccumulative but have not been included in the control list [14].

4. "21st Century Maritime Silk Road" maritime pollution regulation optimisation pathway

As the core carrier of the "21st Century Maritime Silk Road", maritime transport, while promoting regional connectivity and economic prosperity, is accompanied by increasingly serious pollution problems such as atmospheric emissions from ships, oil pollution, domestic sewage, ballast water bioinvasion, and emerging plastic particles, desulphurisation tower effluent, and so on. The existing

DOI: 10.54254/2753-7048/2025.BR26115

international regulatory framework centered on MARPOL has structural deficiencies such as fragmentation of implementation, lagging rules and ambiguous liability system, which makes it difficult to effectively respond to the governance challenges of the complex marine environment of the Sea Route. There is an urgent need to build a synergistic, efficient and responsible regional regulatory optimisation path.

4.1. Strengthening the synergistic governance of international law and regional regulation

One of the root causes of the current dilemmas in the governance of maritime pollution along the Sea Silk Road lies in the lack of adaptation between the universal applicability of global conventions and the specific needs of the region, as well as the loosening of regional cooperation mechanisms.

Countries along the route should be encouraged to revise or supplement bilateral and multilateral anti-pollution agreements. The minimum standards set by the existing MARPOL conventions fail to adequately take into account the risks of ecological sensitivity and shipping intensity in the sea area of the Sea Route. The countries along the route should actively make use of the regional cooperation platform to supplement and enhance the MARPOL Convention in the mode of "framework convention + regional protocol".

Stricter emission standards must be harmonised. Under the framework of MARPOL Annex VI, Prevention of Atmospheric Pollution, people should promote the establishment of a unified ship emission control area covering the whole sea route, significantly reducing the emission limit values of sulphur oxides, nitrogen oxides and particulates, and lay out in advance the regional synergistic control rules for greenhouse gas emissions.

Due to the continuous iteration of pollutants, the relevant sectors should also incorporate new types of pollutant control. Through regional protocols, pollutants that have not yet been adequately regulated by MARPOL, such as plastic particles, wastewater from desulphurisation towers, especially acidic from open desulphurisation towers, pollution of water by PAHs, and underwater noise from ships, should be included in the scope of mandatory control, with clear standards for monitoring, reporting and discharge.

Port State monitoring procedures and standards can be further coordinated. A unified list of inspection priority levels, guidelines for handling defects and a database for immediate sharing of information along the sea route can be established to reduce the arbitrariness of inspections and enhance the deterrent effect on low-standard ships. A Memorandum of Understanding on Port State Supervision Cooperation along the Sea Silk Road can be formulated, drawing on the mature experience of the Tokyo Memorandum of Understanding.

Strengthen scientific and technological means and build an information-sharing hub. With reference to other information-sharing models, a "Maritime Environment Information Centre of the Sea Silk Road" can be set up to integrate ship data, inspection results, pollution report information and satellite remote sensing monitoring data to provide real-time risk early warning and law enforcement lead support for member countries. It is worth noting that the system needs to establish a strict hierarchical data access and confidentiality system, balancing transparency and sovereignty concerns.

In terms of actual inspections, regular joint cruises should be combined with boarding and inspection. In high-risk pollution areas, such as the Straits of Malacca, the entrance to the Strait of Hormuz and other maritime trade hubs with high vessel traffic, the relevant littoral states should take the lead in forming a "Joint Pollution Law Enforcement Task Force", equipped with specialised vessels and personnel, and in accordance with the pre-agreed scope of authorisation and procedures at , to carry out regular joint cruises, and carry out joint boarding and inspections of suspected non-

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compliant vessels. Joint boarding and inspection of suspected non-compliant vessels. This can, to a certain extent, overcome the problems of insufficient enforcement capacity and jurisdictional limitations of a single State. The core of this set of joint cruises and boarding and inspection lies in the signing of a legally binding agreement on joint enforcement procedures, with clear authorisation, sharing of responsibilities and dispute resolution mechanisms.

In the course of joint law enforcement teams, targeted law enforcement capacity building assistance is required. More economically capable countries and international organisations should provide targeted maritime monitoring equipment, personnel training and technology transfer to some of the less-developed countries along the route in order to narrow the capacity gap for enforcement. In addition, they should focus on strengthening the efficiency of rapid detection of new pollutants, e-discovery of evidence and the ability to deal with lawsuits, taking into account the dilemma of managing new pollutants.

4.2. Improve the liability and compensation system

A clear and enforceable liability and compensation framework is the final guarantee that pollution victims can obtain relief and prevent pollution from occurring. The existing system is weak and ineffective in dealing with transboundary, cumulative and new types of pollution. Therefore, the liability and compensation system should be improved.

4.2.1. Clarify the jurisdiction and liability subject to transboundary pollution incidents

Pollution in the sea area of the Sea Silk Road is often transboundary in nature, such as oil pollution drifting and cross-border transmission of atmospheric pollutants. The spread of pollutants with such complex paths is prone to trigger complex jurisdictional conflicts. Therefore, a more flexible response to the division of jurisdiction and liability is needed.

Establish the principle of complementary jurisdiction. On the basis of respecting the primary jurisdiction of the flag state established by UNCLOS, the jurisdiction of the state where the damage occurred or the affected coastal state should be strengthened. This study argues that this can be clarified through regional agreements. When the flag state fails to effectively pursue liability, the court of the injured state can directly accept the relevant compensation litigation. At the same time, a coordination mechanism for conflicts of jurisdiction among member States can be established to complement the implementation of jurisdiction.

Holding the actual beneficiaries of the company liable. In response to the difficulties in pursuing liability caused by the single-ship company and the flag of convenience system, regional rules should allow the option of directly pursuing the actual controller behind the company, which may be the shipowner, management company, demise charterer, or even the cargo owner, for joint and several liability under specific conditions, i.e., for intentionality or gross negligence that leads to pollution, and when the company is significantly undercapitalised [15].

Reinforce the preventive liability of the port state. Clarify the port state's preventive inspection responsibilities for ships calling at its ports that are known to have a record of serious defects or violations. If it fails to effectively exercise its inspection powers and detain or rectify the situation, and if the ship subsequently causes transboundary pollution, the port state should assume complementary state responsibility in order to force strict enforcement of the law.

DOI: 10.54254/2753-7048/2025.BR26115

4.2.2. Clarify the division of responsibility at source for new pollutants

The complexity of new types of pollutants makes it difficult to trace responsibility. Therefore, the traditional "polluter pays" principle needs to be applied in a more refined way. In the case of plastic particles generated by the use of ships, the liability should be clearly defined as that of the ship operator, who has direct responsibility for the ship's equipment, choice of materials and waste management. For plastic particles contained in the cargo itself that are dispersed into the sea during transport, it is necessary to explore a joint and several liability frameworks between the cargo owner and the carrier, or to promote the purchase of special pollution liability insurance by the cargo owner.

Liability for wastewater from desulphurisation towers. The decision to install and use desulphurisation towers is usually made by the shipowner on the basis of economic considerations, and the shipowner should be responsible for the wastewater treatment effect, so the shipowner should be the primary liability subject. However, if the equipment itself is designed and manufactured in such a way as to cause excessive emissions, the manufacturer should also bear the corresponding product liability. Regional rules need to clarify the discharge standards, monitoring requirements and liability allocation rules [16].

Liability apportionment for cumulative or composite pollution should be considered comprehensively and modelled. For ecological damage caused by air pollutants or underwater noise that is difficult to trace back to a single ship, a regional "pollution contribution" assessment model based on ship tonnage, fuel consumption and voyage data can be explored as a basis for collecting ecological compensation or apportioning collective liability.

4.2.3. Explore the establishment of a regional pollution compensation fund or compulsory insurance system.

The existing international oil pollution compensation fund system has limited coverage and does not apply to air pollution and plastic pollution. The establishment of a "Sea Silk Road Marine Pollution Compensation Fund" can be tried as an important regional supplement to the global fund.

Funding sources could include the following. Firstly, assessed contributions from oil shippers in the region; secondly, tonnage taxes or fuel surcharges on ships in the region; thirdly, allocations from the governments of member countries to reflect shared responsibility; and lastly, fines and recoveries.

The scope of compensation should cover non-oil pollution not covered by the International Olympic Committee (IOPC), such as chemicals, rubbish, sewage, etc.; the portion of oil pollution that exceeds the limit of the Global Fund; damages caused by new types of pollutants; and clean-up and ecological restoration of pollution incidents for which the responsible person cannot be found or is unable to pay. The management of the fund needs to establish an independent board to ensure the transparent and efficient operation of the compensation process [17].

Compulsory liability insurance systems should operate in conjunction with direct action procedures. The regional agreement should require all eligible ships navigating in the Sea Route area to take out mandatory liability insurance covering all types of pollution risks in full or obtain other financial guarantees. The key breakthrough is the establishment of a direct right of action for victims against the insurer, i.e., to allow pollution victims to file a lawsuit to claim compensation directly against the responsible party's insurer or guarantor after an accident, bypassing the litigation barriers that may be put in place by the responsible party, and ensuring the accessibility of compensation [18].

DOI: 10.54254/2753-7048/2025.BR26115

It is worth focusing on the fact that the coverage clearly includes new types of pollution risks. The policy terms need to clearly define that damage caused by discharges of desulphurisation wastewater, plastic particles, etc. will be covered.

5. Conclusion

This paper adopts methods of literature research, comparative research and case analysis to explore the legal regulation path of the "21st Century Maritime Silk Road" maritime pollution problem and summarises a series of theoretical innovations and practical paths. At the theoretical level, the study deepens the understanding of the integration of international law and regional practice, provides legal ideas to break through the existing regulatory bottlenecks, and helps to promote the improvement of the marine governance system in the East Asian Seas. At the practical level, it builds standards for determining responsibility, a cross-regional joint enforcement mechanism and a pollution risk assessment and early warning system. This study further points out "21st Century Maritime Silk Road" the problem of shipping pollution governance in the East Asian Seas to systematically analyse the dilemma of the fragmentation of the current regulatory system and the ambiguity of the liability determination mechanism, to strengthen the coordination of the legal regulations of the countries along the route, and to achieve flexibility and unity in the standards.

The significance of this study lies not only in solving the current realities of shipping pollution in East Asian waters, but also in providing a new paradigm for regional cooperation in governance, in order to seek longer-term regulatory effectiveness. In the future, countries along the route should coordinate the interests of multiple subjects, integrate the regulatory system, and strengthen collaborative governance, and East Asian countries should work together to build a governance mechanism of shared responsibility and shared benefits, so as to realise the green and sustainable development of the "Maritime Silk Road".

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