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EDITED BY
Qi Xu,
Jinan University, China

REVIEWED BY
Levent Bat,
Sinop University, Türkiye
Kan Wang,
Guangdong University of Foreign Studies, China
Yanbing Ren,
School of Geographic Sciences, China

*CORRESPONDENCE
Xiaolin Pan
mavispanpan@163.com

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A strategy for risk control of marine pollution from land-based sources: establishment of Multilateral Guarantee Mechanism

Xiaolin Pan*

Law School, Dalian Maritime University, Dalian, China

Marine pollution from land-based sources (MPLBS) is currently one of the main sources of global marine pollution. The international community is facing a dilemma on regulating MPLBS: the lack of international rules makes it difficult to resort to international judicial institutes, while domestic laws have no extraterritorial jurisdiction. Along with developing and improving the international legal regulatory system, the Multilateral Guarantee Mechanism (MGM) can be established for MPLBS combat. With its unique advantages, the MGM is beneficial for controlling MPLBS risk, supervising pollutant sources, and providing effective compensation for damages. Section 1 of this article starts with a brief introduction to the definition and features of MPLBS. With its wide scope not limited to the coastal waters, MPLBS could lead to serious harmful consequences to the marine environment, and it is difficult to trace the real sources of the pollutants. Section 2 analyzes the legal challenges faced by MPLBS combat and points out the necessity of constructing the risk control mechanism for MPLBS. The absence of a specific worldwide international treaty becomes one of the deficiencies for international legal norms regarding MPLBS control, while comparatively integrated domestic legal frameworks on MPLBS control only take effect within territories and jurisdictional waters of states. The establishment of a risk prevention and control mechanism, which also aims to provide effective injury compensation, is more practical and appropriate. Section 3 discusses the necessity, feasibility, and advantages of the MGM for MPLBS risk control. The dilemma of MPLBS control constitutes the necessity of establishing MGM, and the commonalities between international investment risk control and MPLBS risk control show the feasibility of MGM establishment. The advantages of MGM also help to balance national interests and collective environmental protection. Section 4 explores how the MGM functions for MPLBS risk control by referring to a series of core contents, including fundamental convention, guarantee agency, types of risks, payment and

subrogation, dispute settlement, and so forth. Section 5 illustrates the implementation of the MGM under two hypothetical scenarios: plastic pollution in the Philippines and Japanese radioactive wastewater pollution. Restrictions of the MGM and corresponding solutions are also discussed. Section 6 concludes the main arguments and makes an expectation on the MGM.

KEYWORDS

marine environmental protection, marine pollution, pollution risk control, Multilateral Guarantee Agency, realization of subrogation

1 Introduction

"Marine pollution is a combination of chemicals and trash, most of which comes from land sources and is washed or blown into the ocean, and results in damage to the environment, to the health of all organisms, and to economic structures worldwide" (Tejaswini and Subhalakshmi, 2024). In fact, the marine environment of the world continues to be polluted by vessels, dumping at sea, and land-based sources of pollutants (Thiagarajan and Devarajan, 2025). Among these three major sources of marine pollution, 80% of marine pollution comes from land (Figure 1) (VanderZwaag and Powers, 2008). Land-based pollutants include untreated sewage, agricultural runoff, oils and heavy metals from industry, and sediment washed in from earthworks and logging (Delia, 2021). In recent decades, plastic debris and radioactive waters have become land-based pollutants of great concern (UNEP, 2020). "Land-based pollution is changing the world's oceans by feeding harmful algae strains and poisoning existing marine life" (Frady, 2004).

So far, the international community has concluded the 1973 International Convention for the Prevention of Pollution from Ships (Convention, 1973) and the 1972 Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter (1972 London Convention). Two conventions have established frameworks for controlling pollution from vessels and dumping at sea. Regarding marine pollution from land-based sources (MPLBS), which refers to marine pollution caused by pollutants originating from land-based sources, only a limited number of regional treaties have been concluded (UNEP), and general and broad legal system or framework has not yet formed.

As one regional treaty, the Convention for the Prevention of Marine Pollution from Land-based Sources (1974 Convention) defines "pollution from land-based sources" in Article 3(c) as follows:

The pollution of the maritime area (i) through watercourses, (ii) from the coast, including introduction through underwater or other pipelines, (iii) from man-made structures placed under the jurisdiction of a contracting party within the limits of the area to which the present convention applies, (iv) by emissions into the atmosphere from land or from man-made structures as defined above (1974 Convention, 1974).

To cover more issues, paragraph (iii) defines offshore installations as land-based sources of marine pollution.

As stated in this definition, although diverse origins of pollutants, including plastic pollution, agricultural runoff, industrial and municipal waste, marine litter, oil spills, and so forth (1974 Convention, 1974), result in different types of MPLBS, they still share the following common attributes.

Firstly, MPLBS could lead to serious harmful consequences to the marine environment, and it will inevitably infringe upon the maritime rights and interests and environmental safety of coastal states and other potential victim states (Beaumonta et al., 2019). Land-based sources of pollutants usually keep long-term effects since radioactive and chemical substances are cumulative and not easy to decay and degrade (EPA, Radioactive Waste). As one type of MPLBS, "marine plastic pollution poses a grave threat to our oceans and ecosystems" (Subha Sree, 2024).

Secondly, since the ocean is connected and water continuously moves, it is difficult to trace the real sources of the pollutants. Unless a specific pollution incident occurs in one region during a specific period of time, or a particular pollutant is detected by adjacent or opposite states, it is almost impossible to obtain sufficient evidence to pinpoint the accurate source state of land-based pollutants (Zhang et al., 2024). The discharge of nuclear contaminated water by Japan is one example. The Fukushima nuclear incident in 2011, one of the two largest nuclear disasters in history, was classified at level 7, the highest level, indicating "a major release of radioactive material with widespread health and environmental effects" (Strickland, 2011). In the early stages of the Fukushima nuclear accident, there was a leak of nuclear materials (IAEA, 2015). Japan officially launched the discharge of Fukushima nuclear-contaminated water into the ocean on 24 August 2023, after completing five batches of discharge (Finance Sina, 2024). On 7 May 2024, the fifth discharge was ended, with a total of 7,800 tons of nuclear-contaminated water discharged into the sea (RMZXW, 2024). According to the plan released by TEPCO, a total of approximately 54,600 tons of nuclear contaminated water are planned to be discharged into the ocean in seven stages during the fiscal year 2024 (China Daily, 2024). It was concerned that radioactive elements such as tritium could adversely affect marine biological resources and seawater quality in China and other states (Ren and Niu, 2022).

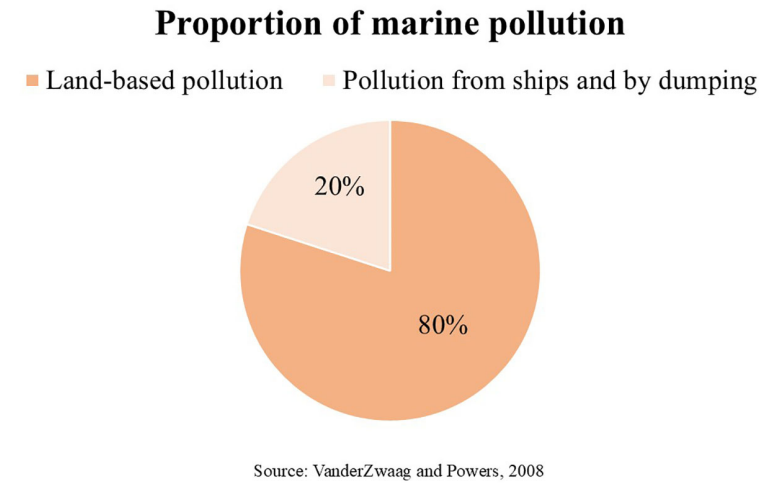

FIGURE 1
Proportion of marine pollution.

Most significantly, the scope of MPLBS is quite wide, not limited to the coastal waters under the jurisdiction of coastal states. MPLBS usually originates from an area under the sovereignty of an individual state (Zajacek, 1996), including internal waters and territorial sea. Then pollutants are carried by ocean currents to other marine zones, like the contiguous zone, exclusive economic zone, and continental shelf. Finally, pollutants expand to high seas and marine areas beyond jurisdiction of the coastal state with transboundary features (Maione et al., 2024). "Governance of land-based marine pollution and activities has been specifically targeted at both the global and regional levels" (VanderZwaag and Powers, 2008).

These features result in a dilemma on MPLBS prevention and control: on one side, a coastal state adopts domestic laws referring to MPLBS combat based on consideration of its own rights and interest; that is, domestic laws are framed to prevent land-based ocean dumping (Poddar, 2014). These laws can be applicable only within its territory. Even if this state has been harmed by MPLBS, it can hardly claim extraterritorial jurisdiction (Zerk, 2010). On the other side, an essential challenge is the lack of international treaties constraining transboundary MPLBS. Due to insufficient incentives for states to conclude international treaties regulating MPLBS, it will take a comparatively long time to establish a complete international legal regime. "International ocean law has emerged largely in reaction to some accident or perceived environmental crisis situation" (Christopher, 2000). In this process, excepting the implementation of specific international customs, like the good neighborliness principle in some specific cases (Hassan, 2003), any state affected by MPLBS may not intervene in the management and administration of responsible states in their coastal waters. In addition, it is also hard for the state to claim jurisdiction over MPLBS on the high seas since environmental issues have not yet been recognized as subject to universal jurisdiction (Kontorovich, 2009). Instead, MPLBS on the high seas still follows exclusive flag-state jurisdiction, which indicates ships sailing the high seas are subject to the exclusive jurisdiction of their flag state (Lampo, 2022).

Therefore, MPLBS combat becomes one international issue that cannot be easily solved by any single state or some states in one region. "The collective body of water requires an international control of land-based sources of marine pollution" (Hassan, 2004). The ideal solution is to establish a regulatory framework on MPLBS control. This framework is based on the conclusion of a specialized international convention establishing duties of member states. And the universality of this convention is significant. However, due to the controversies on jurisdiction and other sensitive issues, the prospects for concluding such a convention in the short term are not optimistic. With the increasingly serious MPLBS, it is urgent and cardinal to seek more practical strategies for MPLBS risk control.

2 Legal challenges to combat MPLBS

2.1 International law on MPLBS control

Due to its transboundary and international nature, MPLBS needs to be regulated under an international legal regime. Unfortunately, the absence of a specific worldwide international treaty becomes one of the deficiencies for international legal norms regarding MPLBS control. So far, only some international customs and general conventions referring to marine environment protection and management are applicable. These customs and conventions have settled fundamental duties of states to prevent and control marine pollution from any source based on the consciousness of the human community with a shared future. In addition, judicial precedents and soft law can also provide some references.

2.1.1 The principle of good neighborliness

In the 1938 *Trial Smelter Arbitration*, the principle of good neighborliness was asserted as:

Under the principles of international law, no state has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is established by clear and convincing evidence (Reports of International Arbitral Awards).

Being generally accepted by the international community as one fundamental rule regulating states' activities even within their own territories, this principle has made great impacts on controlling transboundary pollution.

2.1.2 United Nations Convention on the Law of the Sea

As the constitution of the law of the sea (Koh, 1983), the United Nations Convention on the Law of the Sea (UNCLOS, 1982) establishes the chief principle of protecting the marine environment and preventing pollution to the ocean. Sovereign states have the right to utilize marine resources, but these rights are limited to protect the marine environment (Hu and Li, 2022). Part XII of UNCLOS focuses on the protection and preservation of the marine environment. Articles 192 to 206 firstly establish the general obligation of member states to prevent, reduce, and control marine pollution from any source. Article 207 introduces specific duties of MPLBS control, including adopting domestic laws, establishing international rules, and taking necessary measures to reduce, prevent, and control MPLBS (UNCLOS, 1982). The International Tribunal for the Law of the Sea (ITLOS) also confirms these provisions that are applicable for MPLBS control in the advisory opinion in the small island states on the climate change case (ITLOS, 2024):

Article 207 of the convention imposes upon states three main obligations: first, the obligation to adopt national legislation; second, the obligation to take other necessary measures; and third, the obligation to endeavor to establish international rules, standards, practices, and procedures. Those obligations are mostly concerned with establishing the legal framework, both national and international, necessary to prevent, reduce, and control MPLBS.

It is obvious that UNCLOS is applicable to MPLBS combat. However, the relevant provisions are quite vague and imprecise. Meanwhile, UNCLOS does not provide a framework for regulating and managing activities of coastal states that actually cause or have high potential to cause pollution. So far, a complete and maneuverable framework may depend on future progress, which is not predictable.

2.1.3 Convention on the high seas

Since MPLBS has impacts on both coastal waters and the high sea, the general legal basis of MPLBS control has been stipulated. Article 24 of the 1958 Convention on the High Seas confirms that:

Every state shall draw up regulations to prevent pollution of the sea by the discharge of oil from ships or pipelines or resulting from the exploitation and exploration of the seabed and its subsoil, taking account of existing treaty provisions on the subject (Convention on the High Sea, 1958).

This provision may be applicable for MPLBS since Article 3(c)(iii) of the 1974 Convention expands offshore installations as land-based sources of marine pollution (1974 Convention, 1974).

2.1.4 Convention on the prevention of marine pollution by dumping of waste and other matter (1972 London Convention)

The 1972 London Convention (1972 London Convention, 1972) was adopted to regulate marine dumping, but it establishes one essential obligation of member states to prevent and control all sources of marine pollution in Article 1. With its subsequent revisions, principles of environment management are also included, such as the precautionary principle and the polluter pays principle, and so forth (London Protocol, 1996). These principles can serve as references for MPLBS control.

2.1.5 Convention for the prevention of marine pollution from land-based sources (1974 Convention)

Compared to international practices, certain progress has been made in regions. As the first regional treaty dealing with MPLBS, with coastal states of the Northeast Atlantic as its parties, the 1974 Convention makes a clear definition of MPLBS, as well as stipulates duties of member states to prevent and control MPLBS. The 1974 Convention was replaced by the 1992 Convention for the Protection of the Maritime Environment of the Northeast Atlantic (1992 Convention).

2.1.6 *Mox Plant* case

In the *Max Plant* case, a proposal of the United Kingdom to build a plant on the coast was questioned by Ireland since it may lead to radioactive pollution in the Irish Sea (ITLOS, 2001). Ireland claimed that the United Kingdom violated certain obligations under UNCLOS, including cooperating and protecting the marine environment, carrying out a prior environmental assessment of the MOX plant, and taking all measures necessary to prevent and control pollution from all sources (ITLOS, 2001). This case contributed to the development of MPLBS control by interpreting the scope of Part XV of UNCLOS (Hassan, 2003).

To sum up, in addition, the incompleteness in the legal system for MPLBS control, current rules, and regulations at the international level mainly focus on the management of marine environment by emphasizing fundamental principles in environmental protection, including precautionary measures, sustainable development, and so forth. UNCLOS is the best example. "The principle of ocean management in an integrated and sustainable way has been enshrined in the preamble of the LOSC" (Hassan, 2004). "It provides the basic global framework for ocean governance" (Winther and Dai, 2020). In addition, state responsibilities for polluting the marine environment have also been stipulated in Article 235 asserts that member states are responsible for fulfillment of their obligations concerning marine environment protection and provision of prompt and adequate compensation in respect of damages caused by pollution.

Nevertheless, among all relevant issues, how to provide risk prevention and control for MPLBS has not been considered. The establishment and construction of MPLBS risk control could benefit from prompt and effective compensation for damages caused by pollution and are of great practical significance.

2.2 Jurisdiction in domestic law over MPLBS

Sovereign states are making great efforts to establish legal frameworks on MPLBS control in order to avoid increasingly serious marine pollution and the harmful consequences, as well as to fulfill their international obligations to protect the marine environment. In general, comparatively integrated legal frameworks on MPLBS control—consisting of management principles, enforcement procedures, liabilities, and compensations—have been established in states' domestic laws. "While most nations have recognized the priority of addressing land-based sources of pollution, their complexity, range, and intractability have made concerted effort elusive" (Wirth, 1995).

The Marine Protection, Research and Sanctuaries Act (MPRSA) (MPRSA, 1988) is one U.S. law regulating the transportation and dumping of materials into the ocean, and the 1972 London Convention is implemented within the United States by this act. With the aim to protect the marine environment from the harmful consequences of dumping, this act prohibits the dumping of harmful wastes—specifically, radiological, chemical, and biological warfare agents; high-level radioactive wastes; medical wastes, sewage sludge; and industrial wastes—into the ocean. The MPRSA applies to all ocean waters seaward of the baseline from which the territorial sea is measured (EPA, Summary of Marine Protection). In addition, the Clean Water Act also regulated discharge into the territorial sea and navigable waters of the United States (The Clean Water Act, 1972). However, "despite the growing recognition of the source-to-sea connection, significant legal and policy gaps remain in integrating freshwater and marine conservation efforts" (Tyagi and Pandya, 2024).

The main U.K. statutes concerning marine pollution are the Merchant Shipping Act 1995 (U.K. Public General Acts, 1995) and the Marine and Coastal Access Act 2009 (2009 Act) (U.K. Public General Acts, 2009). Marine pollution from land-based sources in England and Wales is regulated by a system of licensing under the 2009 Act. The corresponding legislation in Scotland is the Marine (Scotland) Act 2010 (Acts of the Scottish Parliament, 2010), and the Marine Act (Northern Ireland) 2013 (Acts of the Northern Ireland Assembly, 2013) in Northern Ireland. These acts establish a system of licensing for discharges into the marine environment.

The Marine Environment Protection Law of China (MEPL) (MEPL, 2024) establishes a legal basis for the enforcement of marine environmental law against MPLBS in China. It proposes "land-sea coordination and comprehensive governance" as a basic principle (Ministry of Ecology and Environment of China, 2023). Under the MEPL, the discharge of land-based pollutants into the sea strictly complies with state or local standards and relevant regulations (Article 46). The discharge of land-based pollutants that cause or may cause marine environmental pollution under Article 120, especially contaminated water from land into the sea under Article 51, constitutes a violation of the MEPL.

The MEPL further develops and clarifies the responsibilities of the ecological environment management departments regarding marine environmental protection (Wang and Duan, 2019). It provides that acts causing marine environmental pollution within China's jurisdictional waters fall under China's jurisdiction according to Article 2. Meanwhile, the Coast Guard Law of China establishes a maritime administrative law enforcement framework with features resembling those of a maritime police force (Chinese Law, 2021).

To some extent, states' integrated frameworks facilitate MPLBS control. However, domestic laws only take effect within territories and jurisdictional waters of states. This limitation on jurisdiction over MPLBS originating from other states' coastal waters becomes the most significant obstacle to the enforcement of domestic laws. Although the exercise of extraterritorial jurisdiction can be justified under certain circumstances, it still receives great controversy.

The U.S. MPRSA generally prohibits the dumping of materials into the ocean without permits. This includes materials transported from the United States for dumping, materials transported by U.S. agencies or vessels from outside the United States, and dumping of materials transported from outside the United States into U.S. waters. Similarly, in the United Kingdom, the Merchant Shipping (Prevention of Pollution) (Limits) Regulations 2014 (U.K. Statutory Instruments, 2014) specify the zone beyond the territorial sea of the United Kingdom. In this marine zone, the United Kingdom can exercise jurisdiction to protect and preserve the marine environment.

The MEPL, according to Article 2, is applicable to marine pollution and ecological damage occurring within China's jurisdictional sea area, even if they originate outside China. Meanwhile, the MEPL is also applicable to activities that take place in coastal areas or beyond China's jurisdictional waters if such activities cause or may cause marine pollution or ecological damage within waters under China's jurisdiction. As stipulated in Article 31 of the MEPL, if environmental pollution or ecological damage in a sea area under China's jurisdiction is caused, or is likely to be caused, by activities outside of China, the relevant departments and agencies have the authority to take necessary measures. Therefore, the MEPL applies to China's internal waters, territorial sea, exclusive economic zone (EEZ), and continental shelf, as well as all other sea areas under China's jurisdiction (Zou and Zhang, 2017).

The intention of states to expand the implementation scope of their domestic laws regarding MPLBS control beyond their territories can be found commonly in their legal theories and practices. However, the real exercise of extraterritorial jurisdiction is not a simple matter. It relates to the recognition of an enforcement agency's authorities and a judicial court's decisions and may easily result in disputes among states.

Another commonality among states' domestic laws on MPLBS control is the emphasis on regulating pollution-related activities and holding polluters accountable for their activities.

In the United Kingdom, the damages caused by marine pollution are compensated under the Environmental Damage

(Prevention and Remediation) Regulations 2009 (U.K. Statutory Instruments, 2009). In China, the MEPL contains a comprehensive range of legal liabilities. The violator is subject to administrative penalty, civil compensation, and criminal responsibility in accordance with Articles 93–119. It is worthy of discussion whether such sanctions can exert sufficient deterrence against MPLBS. The MPRSA of the United States focuses on preventing or limiting dumping of materials that could harm the marine environment. Violations of the MPRSA result in significant civil and criminal penalties, including fines and imprisonment.

Nevertheless, these domestic regulations seem not to achieve the expected effects. "In the ten years following passage of the MPRSA, dumping of industrial waste, construction debris, solid waste, and incineration of chemicals remained low, but dumping of sewage sludge doubled" (Boesch et al., 2001). In China, from 2020 to 2022, more than 19,000 inspections were conducted on marine engineering, oil platforms, islands, dumping areas, and so forth, and more than 360 cases of illegal land reclamation, illegal dumping, and destruction of islands were investigated and dealt with, severely cracking down on illegal and criminal activities in key areas of marine ecological environment protection (Ministry of Ecology and Environment of China, 2024).

In fact, the establishment of a risk prevention and control mechanism, which also aims to provide effective injury compensation, is more practical and appropriate. The mechanism designed with a semi-official and semi-commercial nature and more acceptable for states can minimize the limitations imposed by the current domestic legal frameworks on MPLBS control to the greatest extent. The proposal of the establishment of a Multilateral Guarantee Mechanism (MGM) deserves attention and discussion.

3 The necessity and significance of establishing MGM

3.1 Definition and features of MGM

Multilateral guarantee refers to the joint guarantee provided by multilateral national governments worldwide to support the risk prevention and control of the eligible projects or entities in each other's states. Its remaining features include large-scale financing, depoliticalization, and flexible procedures, which can meet the diverse needs of projects and entities and also enhance mutual understanding and confidence (Shihata, 1986). Each multilateral guarantee is designed to serve specific functions by safeguarding the rights and interests of different applicants. The MGM consists of fundamental rules and principles serving as the legal basis for multilateral guarantee operations, the established institution responsible for fulfilling multilateral guarantee duties, and the operations of the institution, including all activities related to guarantees that it undertakes (Ocran, 1988). Such a mechanism is usually established by a treaty or contract, depending on its features and functions.

In the practice of international investment, on 12 April 1988, the Multilateral Investment Guarantee Agency (MIGA) is established as an international institution that promotes investment in developing countries by offering non-commercial risk insurance, based on the Convention establishing the Multilateral Investment Guarantee Agency (MIGA Convention, 1988). The MIGA is a member of the World Bank Group and now has 182 member states, with 154 developing countries and 28 industrialized countries (MIGA. Member Countries).

The MIGA is designed as financially self-sufficient (Commentary to MIGA Convention) and began with a capital stock of $1 billion sponsored by 29 original member states (MIGA, History of MIGA). MIGA addresses the potential investment losses that international investors may encounter in the host state due to non-commercial risks, including losses resulting from risks of currency transfer, expropriation and similar measures, breach of contract, and war or civil disturbance in accordance with Article 11 of the MIGA Convention (MIGA Convention, 1988). In 1990, the MIGA issued the first investment guarantee contracts supporting a total of $1.04 billion in new guarantees across 40 projects (MIGA, 2024). In fiscal year 2024, a total of $8.2 billion was issued by the MIGA. These insurances are expected to provide 2.2 million people with access to mobile internet, add 12.2 million new subscribers to mobile money services, generate $657.8 million in tax revenue per year for the host, and avoid more than 647,000 metric tons of carbon dioxide emission annually (MIGA, 2024). The MIGA has transitioned beyond its original function as an investment guarantee institution, instead; "MIGA is committed to creating strong development impact and supporting projects that are economically, environmentally, and socially sustainable" (MIGA, 2024).

The non-commercial risks foreign investors face in the host state may cause significant economic losses to them, thereby resulting in passive impacts on their investment intentions. Under Articles 13 and 17 of the MIGA Convention, eligible investors can obtain a guarantee, and once the guaranteed risk arises, investors can receive effective compensation from the MIGA (MIGA Convention, 1988). Meanwhile, based on Article 18, the MIGA is subrogated to the rights or claims related to the guaranteed investment. In this way, effective prevention of investment risks can be achieved within a multilateral framework. This risk guarantee concept and practice are of significant reference value to MPLBS combat.

The MGM designed for MPLBS combat stands for a joint multilateral guarantee provided by member states worldwide to support the risk combat of MPLBS, which occurred in an eligible applicant state. MGM is constituted of a series of rules and regulations stipulated in a fundamental treaty serving as the legal basis of the framework and all relevant activities of the institute established for fulfilling multilateral guarantee duties.

In order to accomplish its functions of combating MPLBS risk, the MGM is designed with similar characteristics as the MIGA. First, the MGM has an international nature. Many states jointly participate in establishing this mechanism, with the aim of providing a guarantee for cross-border MPLBS. It does not only operate within one state. Second, the MGM is professional and

specializes in the field of risk guarantee. It has professional teams consisting of experts in the fields of law and environment protection. These teams can accurately assess the risks applicant states may face and provide assistance on decision-making. Thirdly, as the core institute of the MGM, the Multilateral Guarantee Agency (MGA) should be established on a semi-official and semi-commercial basis. The semi-official nature is reflected in its status as a multilateral institute that consists of all member states. Its decisions on providing guarantees and subsequent compensation are made standing for all member states. The semi-commercial aspect is manifested in its guarantee services to benefit MPLBS combat. Lastly, the primary function of the MGM is to provide effective compensation for the damages caused by MPLBS, rather than holding accountable the responsible states. This feature of the MGM is helpful to minimize the possibility of resistance of member states.

3.2 Necessity of establishing MGM

The most ideal way of MPLBS combat is to manage and regulate MPLBS within a legal framework and hold the polluters and perpetrators accountable. Nevertheless, there are obstacles to achieving this goal under both international and national law.

In international law, instead of specific regulations on MPLBS control, some general treaties and customs are applicable. Although the fundamental duties of states to prevent marine pollution from any source are accepted by the international community, these duties are too general and vague. In addition, current rules and regulations mainly focus on building fundamental principles in environmental protection, like precautionary measures and sustainable development, which need general recognition and acceptance from the international community and will take a long time. Regional treaties, like the 1974 Convention and the subsequent Convention for the protection of the marine environment of the North-East Atlantic (1992 Convention, 1992) , are not effective enough in combating MPLBS as expected so far.

"Government is often ascribed a pivotal role in protecting the environment" (Kulin and Sevä, 2019). In domestic law, although states usually adopt comprehensive laws to form integrated domestic frameworks regulating MPLBS, the flaw of limited jurisdiction is generally witnessed. Jurisdiction over MPLBS may only be exercised within states' territories, while extraterritorial jurisdiction is hard to be justify. "Due to national sovereignty over land-based activities, significant challenges exist regarding the creation of international legal frameworks for controlling marine pollution from land-based activities" (Takano, 2017).

These legal challenges for MPLBS control result in a dilemma: on one side, jurisdiction over MPLBS control is justified under international law; however, a complete international legal framework on MPLBS control has not yet been established. On the other side, comparatively integrated frameworks on MPLBS control have been set up within the national legal system of states; however, jurisdiction over MPLBS is restricted within states' territories, while MPLBS has a transboundary feature and usually results in harmful impacts on coastal waters of other states (Odeku and Paulos, 2017). The establishment of MGM can provide a better response to this dilemma.

Meanwhile, there are commonalities between non-commercial risk control for foreign investors and MPLBS risk control for coastal states. These commonalities show the appropriation of the establishment of MGM.

The primary commonality is the difficulty of getting the injuries compensated through conventional methods provided by both the international and national legal systems. Regarding foreign investors' economic losses caused by non-commercial risk, local remedies provided by host states can be resorted to. However, it is not easy for a foreign investor to bring a lawsuit against a state (Maffett et al., 2025). The initiation of international arbitration depends on the consensus of the conflicting parties, and the enforcement of arbitral decisions depends on the recognition and cooperation of the host states. The establishment of MIGA enhances the efficiency of compensation in the form of providing guarantees to investors from losses caused by specific kinds of non-commercial risks. "Beyond providing political risk insurance, its activities have a positive impact in promoting foreign investment and in contributing to further economic growth and development" (Schill, 2014). The investors can receive compensation through insurance instead of legal litigation. Compared to non-commercial risks of foreign investors, MPLBS risks of coastal states are more serious. Compensation requests issued by coastal states that suffered harmful consequences of MPLBS are even harder to be satisfied through litigation due to the obstacles of courts' jurisdiction and difficulty in calculating losses. While the MGM functions as an effective way to provide prompt compensation to eligible insured states.

Another commonality is the wide-ranged and severe losses and damages caused by the risks. Widespread marine pollution results in huge economic losses that are also hard to measure precisely. Marine litter damage to marine economies in the Asia-Pacific has increased eightfold since 2008 to $10.8bn per annum in 2015. Damage from marine litter globally was $18.3bn per annum in 2015, equating to $21.3bn in 2020 (McIlgorm et al., 2022). It also brings gross injuries to the marine environment. "Life in the oceans at the close of the twentieth century has become increasingly vulnerable to human-made environmental consequences of the postindustrial society" (Joyner, 2021). Neither commercial insurance companies nor coastal states are able to provide commercial guarantees or governmental funds for economic compensation and environmental recovery relevant to MPLBS. However, the compensation is necessary and urgent. From the perspective of environmental protection, it is even more urgent for damage compensation for MPLBS. Therefore, it is essential to establish one institute that is capable of providing adequate and prompt compensation for MPLBS to affected states based on a multilateral treaty.

It is also significant to notice that providing effective and prompt compensation should be strategic prior to condemning or blaming responsible states in the form of addressing their liabilities. This phenomenon can be manifested in risk control in both fields of

investment protection and environmental management. International rules relevant to state responsibility also reflect such a concept. The typical example is that the Draft Articles on State Responsibilities for International Wrongful Acts (Draft Articles, 2001) do not contain any penalty clause. In accordance with Articles 35 and 37, the assumption of responsibility should not impose unnecessary burdens on the state. Therefore, as to risk control in these two fields, the priority is to provide effective and prompt compensation rather than addressing state responsibilities.

Moreover, foreign investors' losses are caused by administrative activities and decisions of host states or armed conflicts, even wars, that host states are involved in. The decline in the importance of the international customs relating to diplomatic protection of companies was marked by the International Court of Justice (Juratowitch, 2008). Instead of issuing diplomatic protection by the nationality state of the investor, applying to and receiving a guarantee from the MIGA is a better choice, which can satisfy the request of the investor and avoid further conflicts. Similarly, the high risk of MPLBS can be better prevented and controlled through establishing the MGM. The economic and commercial incentives of participating in the practice of the MGM are more attractive to states.

3.3 Feasibility of establishing MGM

Although the MGM may raise sovereignty and political–economy concerns of states, there are still many incentives that attract states to join in. According to the classic statement of liberalism, preferences of a state determine its policy and corresponding activities (Table 1). "The shifts states decide to do in terms of their preferences are what he defines as state behavior, and the way in which a state behaves represents shifts in a state's preferences (Moravcsik, 1997)." Incentives facilitate states to accede to the fundamental convention and establish the MGM to combat MPLBS. However, the diversity of state preferences makes it significant to build common consciousness among the international community, most essentially, the consciousness of a human community with a shared future. The common consciousness is more stable compared to the changing state preferences and is consistently attractive for states. Meanwhile, "states can be held accountable to all members of the international community based on judicial endorsement of the significance and importance of the obligations involved for all other states (Pok, 2021)." Therefore, the combination of incentives originating from state preferences and common consciousness in conformity with *obligatio erga omnes* must be very helpful for states to get involved in the establishment of MGM and participate in MGM's subsequent practices.

TABLE 1 Incentives for states to participate in MGM.

Types of states	Incentives/benefits originated from state preferences
Developing states and low-income states	-guarantee for pollution risks -technological support for marine environmental management -effective compensation for marine environmental restoration -assistance from MGM avoiding becoming responsible state -referred payment of contributions
Developed states	-effective compensation for economic losses -saved litigation costs -avoid disputes over jurisdiction -promoted concept of marine environmental protection
Landlocked states	-bargaining chip for marine environmental management and negotiation for rules stipulation -preferential treatment on relevant issues, that is, environmental technology trading.

All global participants may find their incentives for joining the MGM since the primary goal of the MGM is designed to protect the marine environment and promote sustainable marine development of all member states, especially developing states and low-income states with a GNI per capita of $1,135 or less in 2024 (The World Bank, 2025).

By providing guarantees for pollution risks, as well as technological support for environmental management, the MGM helps developing states improve their marine environment greatly. Developing states affected by MPLBS can receive effective compensation from the MGA for their environmental restoration. Meanwhile, under the supervision and assistance of the MGA, MPLBS caused by developing states could be controlled, and the deterioration of pollution would be avoided. In this way, developing states can avoid becoming responsible states and thus becoming the targets of MGA's subrogation rights for recovery.

Regarding the funding burdens of developing and low-income states, there are a series of institutional regulations under the MGM that may be helpful. Member states may choose to apply for deferred payment of contributions or apply for low-interest loans to pay for contributions based on their own economic situation. Seeking help from international funds, that is, Funding Compact of the UN (UNSDG) is also possible. Moreover, being approved by the MGA, it is also possible for the qualified member states to obtain payment reductions. However, all these favorable treatments are conditional on developing states' willingness to comply with treaty obligations, including initiating environmental assessment, fulfilling the resolutions of MGA in good faith, accepting the supervision of MGA, and cooperating with the MGA to realize its subrogation.

As to developed states, the MGM is also attractive since it provides an effective way to receive compensation for their economic losses caused by transboundary MPLBS. Developed states need not resort to international judicial methods for solution; thus litigation costs can be saved. In fact, "costs function as a significant barrier to access to justice in public litigation (Pain and Pepper, 2019)." Moreover, due to jurisdiction issues, judicial measures may not always be initiated. The MGA acts as an intermediary to urge responsible states to fulfill their obligations to combat MPLBS. Participating in the MGM also helps developed states to negotiate with other member states to accept the environmental protection standards and principles they advocate.

Landlocked states seem not as eager as coastal states to participate in the construction of the MPLBS risk control

mechanism. However, once the MGM is established and a relatively stable binding relationship is formed among member states, getting involved in MGM's practice may become a bargaining chip for marine environmental management and negotiation for rule stipulation. Preferential treatment may also be promised among MGM member states, such as international investment and environmental technology trading.

In fact, in the era of globalization, participating in the MGM can also bring a series of potential effects, the most significant of which is the enhancement of states' international images. The image of a state is one of the most important factors in its competitiveness (Berdiev, 2023). The fact that a host state is willing to join an international cooperation mechanism to improve its marine environment is attractive for international investment. And fundamentally, the active participation of states in the MGM also benefits the establishment and development of an international legal framework for MPLBS combat.

3.4 Advantages of the MGM for MPLBS control

Compared to other political and legal methods, the establishment and operation of MGM show a series of advantages in MPLBS risk control. These advantages are helpful to balance national interests and collective environmental protection.

The most essential advantage of MGM is its semi-official and semi-commercial nature. On one side, the establishment of MGM is based on the general agreement of member states, and it is designed to function on behalf of them all. The objective of MGM is to prevent and eliminate the risk that MPLBS member states may face and then protect the marine environment within a collective and multilateral regime. "International environmental problems tend to be highly dynamic, and states have increasingly relied on multilateral environmental agreement" (Brunnée and Campbell-Duruflé, 2022). Under the MGM, a council of governors appointed by each member state is established, and all the substantive issues are vested in the council. The official nature of MGM helps to protect the common interests of member states. This official nature also reflects in its operation and practice. The authorized capital stock of MGA is divided into a certain number of shares having a fixed per value each and is available for subscription by member states. Member states make decisions together in the form of voting to provide a guarantee to applicant state for MPLBS risk control. "The intersection of sovereignty and environmental protection involves the balance between a nation's right to exploit its resources and the global imperative to maintain ecological integrity" (World Jurisprudence, 2024). The MGM accomplishes its functions with the precondition of respecting sovereignty and consensus of member states. This official nature also benefits the authority of MGA's decisions, as well as the ability to claim subrogation after issuing compensation to the eligible applicant.

On the other side, except for the conditions of eligible applicants and the procedures of making decisions on guarantee acceptance, the MGM operates in a commercial way. MGA has legal personality and legal capacity (Imran, 2021); thus, it can conclude contracts, acquire and dispose of movable and immovable property, and institute legal proceedings. To serve its objectives, the MGA is eligible to issue guarantees on MPLBS risk in a member state. The MGA is also authorized to carry out appropriate complementary activities to promote marine environment protection. Upon paying compensation under one guarantee, the MGA can be subrogated to the rights or claims related to the guarantee.

In addition, the semi-official and semi-commercial nature, the MGM also manifests a non-political nature, which ensures it can effectively prevent risks while fully respecting states' intentions. The purpose of MGM is to strengthen international cooperation on MPLBS combat and to foster the contribution to such cooperation of member states. MGA plays an important role in encouraging member states to comply with guarantee programs. Disputes arising during compensation payment and subrogation realization can be settled through legal methods, like arbitration, appropriately. Political negotiation may also be helpful, but it should not be regarded as a dominant solution. What makes developing states most wary would be the political orientation and intentions that accompany economic activities, as corporate political activity indicates that businesses leverage economic outcomes to influence policy decisions vis-a-via the government (Haq and Kuiken, 2025). The primary goal of MGM is to provide prompt and effective compensation to member states' losses caused by MPLBS. This consideration of economic interests is more acceptable for member states. Receiving prompt and effective compensation and further protecting the marine environment from land-based sources of pollutants become the most attractive incentives for states to conclude a multilateral treaty, which aims to establish the MGM. The development of enacting collective restrictions and regulatory mechanisms for risk control contributes to building an international legal framework for MPLBS combat.

Moreover, the design and operation of MGM benefit from enhancing international supervision on state activities that could result in MPLBS. As it is stipulated in UNCLOS Article 206 and Part IV of BBNJ (BBNJ Agreement, 2023), processing and issuing environmental assessments is one of the crucial duties of member states in environmental protection and management (Druel, 2013). However, because of the vague provisions and lack of an enforcement regime, this duty is criticized for not being effectively implemented. The MGM provides an opportunity to ensure member states perform this duty, since submission of an environmental assessment can be assigned as one condition of an eligible guarantee application. In this way, in order to receive a risk guarantee from the MGA, the applicant states should progress and submit an environmental assessment relevant to MPLBS in their coastal waters and further accept guidance and supervision of the MGA. The practice of Impact Measurement and Project Assessment Comparison Tool (IMPACT) by MIGA can serve as a reference. In 2018, MIGA implemented the IMPACT, a structured methodological framework to define and measure the potential development impact of MIGA projects. The IMPACT is now fully integrated into MIGA's operations, allowing development impact considerations at the project level to be weighed against a range of strategic objectives (MIGA, Impact Framework).

In fact, it is possible for commercial insurance to provide a guarantee to MPLBS, but MGM is more competitive. More types of risks can be covered by the MGM. Subject to the agreement of member states, the MGA may guarantee eligible applicants against losses resulting from one or more types or sources of MPLBS. As a nonprofit institute, MGM places greater emphasis on providing effective risk guarantees rather than seeking economic returns. On one side, member states' economic interests can be better protected based on state consensus under this multilateral regime; on the other side, the MGM is not a profit-oriented institute. Making profits is not the primary concern of the MGA, so the applicant state can receive a guarantee if the necessity is proved. In addition, the governmental support from member states makes the MGA have more capital stocks and funds to provide a guarantee.

Another advantage of MGM making it more comparative is the realization of subrogation. Compared to commercial insurance companies, the MGA may claim and exercise its right of subrogation easily for the following reasons:

Firstly, the right of subrogation is designed by member states' agreement, which manifests as the fundamental convention of MGM. Being subject to *Pacta sunt servanda*, stipulated in Article 26 of the Vienna Convention on the Law of Treaties (Vienna Convention, 1969), member states shall abide by the treaty provisions in good faith. This legal source of subrogation makes the MGA be subrogated to the rights or claims related to the guaranteed applicant state, as the holder of a guarantee may have had against the responsible state or other obligors. The enforcement measures of the fundamental convention can be implemented to make subrogation rights be realized.

Second, in one international organization, "the member states are themselves part of the decision-making process" (Hooghe et al., 2019). The MGA is eligible to utilize internal regulations of it to request the member states to fulfill their obligations, especially those of providing cooperation on the realization of subrogation. In most cases, the interaction among member states within the organization is more efficient than external pressure.

Third, the funds provided as guarantees by the MGA are sourced from capital stocks sponsored by member states. In other words, the funds MGA used to pay for compensation are from all member states' pockets. If the responsible state rejects to realize the subrogation of MGA, the interests of all member states will be violated. Pressure from other member states will force the responsible state to cooperate with the MGA.

The last reason that facilitates the realization of MGA's subrogation is the consideration of member states to preserve their state images. The image of a state, a part of its "soft power," is an important tool to "protect national interests, internal consolidation, strengthen of national pride, attract foreign investment, and increase influence in the world" (Koptyaeva, 2016). In an era of globalization, as to any state, being tagged with a poor marine environment and regarded as irresponsible is not beneficial for its future development.

4 Risk control of MPLBS under MGM

4.1 Fundamental convention

Also known as multilateral environmental agreements, environmental conventions are agreements among multiple governments intended as legally binding with a primary stated purpose of preventing or managing human impacts on natural resources (Escobar-Pemberthy and Ivanova, 2020). The fundamental convention establishing the MGM for MPLBS combat should be adopted and concluded by the international community. After entry into force of such a convention, the MGM is able to operate and fulfill its functions. In order to ensure the authority of the fundamental convention, it should be drafted by the United Nations Environmental Program (UNDP) or the International Law Commission (ILC), based on general opinions and agreement of the states that would like to be original member states. Taking into account the principle of universality, the fundamental convention is open to the whole international community instead of one specific region.

The fundamental convention and other treaties share the same ultimate objective and together serve to strengthen the international legal regulation of MPLBS. Despite the overlapping parts, the goals of the fundamental convention and other treaties—such as UNCLOS and the 1974 Convention—are different. The fundamental convention aims to provide MPLBS insurance to eligible applicant states. Once the guaranteed risk occurs, the MGA will provide effective compensation to the applicant state. The MGM is not designed to establish obligations of member states to reduce and prevent MPLBS, nor to hold state responsible for pollution. Even though a guarantee contract may require the applicant state to fulfill corresponding environmental obligations, these obligations actually derive from UNCLOS and other treaties. Therefore, the fundamental convention and MGM should be established independently. Meanwhile, the rights and obligations of member states under the fundamental convention shall not conflict with those stipulated in UNCLOS. The contents on MPLBS risk control in the fundamental convention and other regional treaties should also be maintained consistently to avoid conflicts with each other. On the premise of voluntary participation by states, the MGM and other existing international regime on MPLBS control may complement but not conflict with each other. If there are conflicting provisions, the rules on treaty interpretation and implementation stipulated in the Vienna Convention on the Law of the Treaties can be invoked to determine the priority of the conflicting provisions (Vienna Convention, 1969).

All relevant substantive and procedural issues of the MGM should be stipulated in the fundamental conventions (Figure 2).

First, the primary purpose of the convention is to establish an international organization titled MGA with the function of providing guarantees to the eligible applicant states for MPLBS risk control. The organization and management issues of MGA shall be stipulated in the fundamental convention.

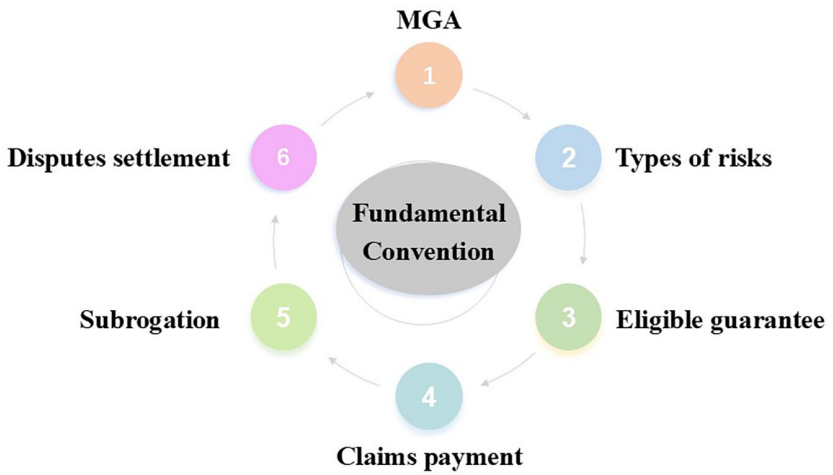

FIGURE 2
Risk control of MPLBS under MGM.

Second, the amount of authorized capital stock of MGA needs to be well defined. The capital stock may be divided into fixed shares and values, which should be available for subscription by member states. The capital stock serves as the main source of compensation the MGA may pay for the applicant states. As with the formal voting system within the International Monetary Fund (IMF), which entails weighted voting with basic votes of each member (Posner and Sykes, 2014), the MGA should also create a voting system that combines membership vote with weighted voting, which is determined by the shares each member state subscribes.

Third, based on the definition of MPLBS adopted in the 1974 Convention, at least four types of risks should be covered by the MGM, including the pollution of the maritime area through watercourses, from the coast, from man-made structures placed under the jurisdiction of the responsible state, and by emissions into the atmosphere from land or from man-made structures.

Fourth, an eligible guarantee needs to meet a series of conditions, which should be concluded in the fundamental convention, especially the conditions of the eligible applicant state. In addition, procedures of applying for a guarantee, concluding a guarantee contract, and issuing compensation should also be included.

Fifth, as the essential incentives of member states to accede to the fundamental convention, payment and subrogation should be well designed. In addition, in order to facilitate the payment of claims, guidelines and codes to calculate economic losses caused by MPLBS should be determined and stipulated in the annex of the convention.

Last, regarding potential disputes that occurred, appropriate dispute settlement methods may be resorted to depending on the dispute's content, nature, and type.

4.2 Organization and structure of MGA

The primary purpose of the fundamental convention is to establish an international organization titled MGA with the function of providing guarantees to eligible MPLBS risks. On the side, as an international organization, the MGA has some degree of international personality; "in a broad sense, international legal personality refers to the rights and duties held by entities under international law" (Hickey, 1997). The MGA enjoys certain privileges and immunity. The staff and assets of MGA may not be violated by any state illegally. On the other side, the MGA possesses the status of full juridical personality, which ensures the entity can exercise rights and fulfill obligations (Adriano, 2015). Therefore, the MGA is capable of concluding contracts with other parties, acquiring and disposing of movable and immovable property, and instituting legal proceedings, including paying compensation.

The organization and management of MGA shall be well designed. The MGA may have one Council of Governors, one Board of Directors, a president and staff to perform duties. The Council is composed of one governor appointed by each member state. All the powers of MGA should be vested in the Council, and the Council may delegate to the Board the exercise of any substantive power related to membership of MGA, adjustment of capital stock, and determination and payment of compensation. The Board, consisting of a fixed number of directors determined by the Council, is responsible for the general operations of MGA and takes any action required or permitted. The president conducts the ordinary business of MGA under the general control of the board. The president is appointed by the Board on the nomination of the chairman.

4.3 Capital stock and voting

The capital stock serves as the main source of compensation the MGA may pay for the applicant states covered by the MGA's guarantee. The amount of capital stock of MGA should be determined based on the consensus of all member states. The capital will be divided into a certain number of shares having, each a fixed value. All the shares are available for subscription by members. Subscribing shares is both an obligation and a right of member states. In addition to fulfilling the obligation of subscribing to basic shares required by membership, member states may voluntarily subscribe to shares according to their own needs.

Voting procedure needs to be arranged to reflect the equal interest as well as the financial participation of each member state in the MGA. Each member state should have a defined amount of membership votes and weighted votes determined by the share of stock subscribed and held by it. Within some period provided in the fundamental convention, the subscription votes of member states may be adjusted and rearranged based on the increase or decrease of capital stock determined by the Council.

In the Council, each governor representing his member state is entitled to cast the votes, and decisions shall be taken by a majority of the votes cast. In the Board, each director is entitled to cast a vote, and the decision of the board is taken by a majority of the votes cast.

4.4 Types of risks

The MGA may guarantee eligible applicant states against losses resulting from one or more types of MPLBS risks. In accordance with the definition of "pollution from land-based sources" stipulated in Article 3(c) of the 1974 Convention (1974 Convention, 1974), at least four types of risks are covered under the fundamental convention:

The pollution of marine areas through watercourses, including rivers and streams. Watercourses act as pathways for pollutants to reach the ocean (European Environment Agency, 2023). The pollutants, which originate from industrial and sewage discharge, agricultural runoff, and urban stormwater, impact the health and integrity of marine ecosystems. The pollutants carried by watercourses include nutrients, pathogens, sediments, plastics, and various chemicals (NRDC, 2023).

The pollution of marine areas from the coast, including the introduction through underwater or other pipelines. This type of pollution can originate from various sources like industrial and agricultural runoff, sewage, and direct discharges through pipelines (UNEP, Marine and Land-based Pollution). Pollutants from the coast, which may result in serious marine pollution and then cause harm to marine organisms. Typical examples are plastic waste and chemical runoff, Plastic waste pollutes and harms the environment, becoming a widespread driver of biodiversity loss and ecosystem degradation (IUCN, Plastic pollution).

The pollution of marine areas from man-made structures placed under the jurisdiction of the responsible state. Man-made structures may contribute to marine pollution thought various pathways, including runoff from construction sites, discharge of pollutants from industrial and residential areas, and the introduction of plastic and other debris (Thiagarajan and Devarajan, 2025). Nevertheless, the pollution generated during the process of exploring the international seabed area should not be covered by the MGA. Instead, such pollution should be handled by the International Seabed Authority (ISA), given the significant role and position of it in international seabed practices (About ISA).

The pollution of marine areas by emissions into the atmosphere from land or from man-made structures under the jurisdiction of the responsible state. Atmospheric deposition of pollutants, like nitrogen and various chemicals, for example, in the form of acid rain (EPA, Effects of Acid Rain), also results in polluting the marine environment.

In addition, by special majority, the Board may approve the extension of coverage to specific MPLBS risks that emerge as serious threats. This mainly targets specific types of MPLBS that occur in specific regions or during specific periods. It can also benefit from controlling high-impacting pollutants.

Microplastic pollution is one typical example. Unlike ordinary plastics, which are larger plastic products used in plastic packaging or other functions, microplastics are small plastic pieces less than five millimeters long, which can be harmful to the ocean and aquatic life (National Ocean Service). Microbeads and other plastic ingredients are present in different cosmetic products with percentages from less than 1% to more than 90%, and a total amount of 4,360 tons were used in 2012 in EU countries. These plastic ingredients poured down the drain after use cannot be collected for recycling (UNEP, 2015). Due to the harmfulness of microplastic pollution, the U.S. adopted the Microbead-Free Waters Act of 2015, prohibiting the sale or distribution of rinse-off cosmetics containing plastic microbeads (The U.S. Act, 2015). At the request of the applicant state, the Board may approve providing a guarantee against microplastic pollution risk by special majority.

Similar approval may be made by the Board regarding pharmaceutical runoff pollution. "Pharmaceuticals get into the water supply via human excretion and by drugs being flushed down the toilet, which can pass through water treatment (USGS, 2018)." "The consumption and excretion by humans and the improper disposal by industries are the major sources of pharmaceutical drugs in the environment (Samal et al., 2022)." The rising concentration of pharmaceutical residues has led to unprecedented changes in the ecosystem (Zhang et al., 2014). Pharmaceuticals have been shown to pose a risk to fish or other wildlife and contribute to the serious problem of antimicrobial resistance (European Commission, 2019). States affected by pharmaceutical runoff pollution can also submit guarantee applications to the Board.

4.5 Eligible guarantee

An eligible guarantee should satisfy specific conditions. In other words, the applicant and the risk covered should both be eligible; in addition, other relevant requirements should also be fulfilled.

Corporations and financial institutions can be eligible for the MIGA as long as certain requirements are met. Different from the MIGA, only member states with subscribing specific shares of capital stock may issue applications for guarantees in the MGA. The fact that a non-member state is not eligible to receive a guarantee in the MGA encourages states to accede to the fundamental convention.

Meanwhile, a series of conditions are also to be satisfied. The primary and most significant one is the accomplishment of obligations under the fundamental convention, including combating land-based pollutants and refraining from polluting the marine environment, conducting environmental assessments, and complying with the precaution principle, an approach to risk management (Schröder, 2014). If a company or an individual believes that they have suffered economic losses caused by MPLBS, they need to apply to their own state and have their state of nationality act on their behalf.

The MGA may guarantee eligible applicants against losses resulting from specific types of MPLBS risks stipulated in the fundamental convention. In addition, by special majority, the Board may approve providing guarantees to other types of MPLBS risks. Moreover, only if the losses and damages reach a certain level, determined by a series of specific indicators selected and recognized by the fundamental convention or other codes and guidelines, may the applicant state receive compensation.

Moreover, guarantees provided by the MGA should be restricted to MPLBS that occurred after the registration of the application. The MGA is not obligated to compensate for pollution that has occurred before the guarantee is approved. Meanwhile, the MGA only provides compensation if the pollution, which meets the criteria of compensation, occurs within the jurisdictional waters of the applicant state, or if the pollution results in harmful impacts in the applicant state's jurisdictional waters.

4.6 Claims payment and subrogation

As long as the MPLBS risk specified in the contract between the applicant state and the MGA occurs and results in damages, the applicant state may claim compensation in the MGA. The decision of claims payment is made by the president under the direction of the board, in accordance with the contract. However, before making the decision of claims payment, it should be ensured that the legal remedies provided by both applicant states and responsible states have been exhausted, so-called the rule of exhaustion of local remedies or local redress (Poulantzas, 1965).

There is one core challenge the MGA may face in this process, which is the difficulty in calculating the applicant state's economic losses caused by MPLBS. The MGA needs to follow the guidelines and codes stipulated in the fundamental convention.

Upon paying or agreeing to pay compensation to the applicant state, the MGA shall be subrogated to the rights or claims related to the MPLBS as the applicant state may have against the responsible state or other obligors. The applicant state should submit the terms and conditions, as well as other relevant documents of such subrogation, in order to facilitate the MGA's claims and realize such subrogation. As described in the previous part, the MGA has advantages in the realization of subrogation due to its feature of being semi-commercial and semi-official, as well as the nature of a multilateral organization.

4.7 Dispute settlement

Disputes may arise between the applicant state and the MGA regarding the implementation of the guarantee contract. Any question referring to the interpretation and application of the contract is better resorted to commercial arbitration. If the dispute relates to the interpretation and application of the fundamental convention, the Board of MGA is obliged to review the dispute and provide a proposal of resolution. If the conflicting parties hold objections to the proposal, they may resort to the dispute settlement methods stipulated in the fundamental convention. If the applicant state and MGA achieve agreement to be subject to other methods for dispute resolution, such mutual consensus should be respected.

Disputes are more likely to arise in the realization of MGA's subrogation. If disputes occur between member states and the MGA, they can be appropriately settled under the framework of fundamental convention. Regarding the disputes between non-member states and the MGA, based on the subrogation, the MGA has obtained the right of claim and other related rights of the applicant state against the responsible state, and the dispute resolution methods originally agreed upon by the applicant state and responsible state are applicable. If such disputes are not related to the interpretation and application of fundamental convention, or the application of a guarantee contract, it is appropriate for the conflicting states to resort to other peaceful dispute settlement methods.

5 Implementation and restrictions of MGM

5.1 Stepwise process of MGM

If a member state of MGM faces MPLBS risks, regardless of whether the pollution occurs in its own territory or comes from waters under the jurisdiction of another state, as long as the pollution constitutes the risk specified in the fundamental convention, the member state can apply for a guarantee from the MGA. Even if the pollution is not a risk defined in the fundamental convention, the Board is entitled to approve providing a guarantee by special majority. For the member states that have already suffered pollution damages, in order to avoid further damages, an application can also be initiated.

After receiving the application initiated by a member state, the Board is obliged to conduct eligibility screening on the applicant's qualification, guarantee coverage, economic damages, and ecological impacts based on the provisions of the fundamental convention and its relevant annexes. If the application is approved,

a guarantee contract will be concluded between the applicant state and MGA. The contract and fundamental convention constitute legal sources of obligations and rights of two parties.

In the guarantee contract, a series of essential issues should be clarified. The type and timing of the guarantee should be clearly defined, and only damages incurred after the contract takes effect will meet the compensation criteria. Contribution and premium formula are determined subject to the fundamental convention. On the basis of comprehensive consideration of pollution damages and the capability of environmental protection of the applicant state, a premium formula can be negotiated between the Board and the applicant state within a limited scope. Claim validation and payout timelines are also significant contents of the contract. The conditions and guarantees for the realization of subrogation should also be stipulated in the contract.

After the contract takes effect, once the guaranteed MPLBS risk occurs, the applicant state can file a claim for compensation with MGA in accordance with the conditions and procedures stipulated in the contract. The MGA will conduct claim validation then. The approved applicant state can receive compensation within the valid payout period. After issuing compensation, the MGA obtains the right of subrogation. The applicant state should provide all necessary facilities and cooperation with the MGA to realize the subrogation.

5.2 Implementation of MGM under classic hypothetical scenarios

MGM is designed to control risks of various categories of MPLBS. In fact, regardless of different sources, the pollutions that MGM guarantees can be divided into two types: for one type, the applicant state is simultaneously the responsible state for the pollution; for another type, the applicant state is affected by the pollution originating from other states. Although there is no essential difference between these two types of pollution risks in terms of guarantee application, risk classification, contribution or premium, validation claim, payout timelines, and subrogation realization, the obligation clauses in the guarantee contracts in each type should reflect different emphases (Table 2).

Since the applicant state has a dual identity and applies for a guarantee from the MGA due to inadequate government management and lack of effective pollution risk control technologies, the eligibility screening should be stricter. Especially, it should be clarified that the compensation can only be obtained if the applicant state carefully fulfills its pollution prevention and control obligations, such as conducting environmental assessments and taking precautionary measures. Meanwhile, stricter obligations should be established in the contract to cooperate with the MGA in realizing subrogation rights. After the compensation is completed, the applicant state may also bear the obligation to properly use the compensation funds and technical support obtained actively to prevent and control pollution.

Belonging to the above two types, respectively, the most serious and urgent MPLBS that need to be addressed promptly are plastic pollution and radioactive wastewater pollution.

Plastic items are the most common type of marine debris in our ocean (Marine Debris Program). Every year, 19–23 million tonnes of plastic waste leak into aquatic ecosystems, polluting lakes, rivers, and seas (UNEP, Plastic Pollution). Taking account of production, consuming habits, and waste management, "coastal cities in middle-income countries are the world's plastic emission hotspots (Ocean Cleanup)." In the absence of stronger policies, it is estimated that 119 million tonnes (Mt) of plastic waste will be mismanaged1 per year by 2040 globally (OECD, 2024). Plastic pollution results in harmful impacts on both marine ecosystems and human health (Almroth and Eggert, 2019). The rise in plastic pollution is not only extremely harmful to the planet's biodiversity but also contributes to climate change (UN, Plastics). The prevention of plastic pollution is a long-term and comprehensive project that requires the joint efforts of the entire international community. However, the negotiations for the Global Plastics Treaty (GPT) that collapsed on 2 December 2024, were meant to be a step toward a plastics future informed by sustainable development principles (Welsh, 2025). Due to the current severe situation, it is a wise choice to resort to the MGM to prevent and control the risks of plastic pollution before the establishment of an international legal regime against it. Once the MGA provides coverage for the plastic pollution in the applicant state, other states need to be cautious to avoid becoming a responsible state and then facing subrogation claims.

TABLE 2 Comparation on implementation of MGM under two classic hypothetical scenarios.

Indicators	Hypothetical scenario 1 Applicant state is responsible state	Hypothetical scenario 2 Applicant state is affected by pollution
Applicant state	Dual identity	Single identity
Eligible guarantee	-Fundamental convention -guarantee contract	-Fundamental convention -guarantee contract
Eligibility screening	Stricker -obligations of preventing and controlling pollution prevention -obligations under guarantee contract -obligations after receiving compensation	General obligations under guarantee contract
Subrogation realization	Cooperating and fulfilling compensation responsibility	Assisting and facilitating the realization of subrogation
Classic cases	Plastic pollution in Philippines	Contaminated water discharge of Japan

The Philippines had the largest share of global plastic waste discarded in the ocean in 2019, and it was responsible for 36.38% of global oceanic plastic waste. According to a 2021 study, 80% of plastic waste comes from rivers, and seven of the top ten plastic-polluted rivers in the world are in the Philippines (Ramos, 2023). Annually, the Philippines generates 2.7 million tons of plastic waste, of which over 500,000 tons end up in the seas and oceans every year (Ramachandran, 2024). The consumer and packaging waste plastic products from the territory of the Philippines have gradually nbsp;spiraled out of control due to the lack of government actions. "Among the reasons behind plastic pollution being such a big issue in the Philippines is government mismanagement (Ramos, 2023)." This severe situation can be effectively alleviated under the MGM.

After becoming a member state, the Philippines may initiate the application for the marine plastic pollution guarantee from the MGA. If the MGA approves the application after review, a guarantee contract would be signed with the Philippines. The contract shall specify the following contents clearly: first, the Philippines should fulfill its obligations under the fundamental convention and other relevant treaties it acceded to in good faith. Second, marine environmental assessments should be submitted regularly. With the assistance of the MGA, production standards for plastic products and emission criteria for plastic waste should be announced domestically. Marine plastic waste management plans and schemes should be developed, too. The Philippines promises to accept MGA's regular inspections and supervision of the above measures in exchange for MGA's technical support. Third, from the date when the Philippines submits the guarantee application or the contract takes effect, if the guaranteed marine plastic pollution occurs, the Philippines may first define the economic losses in accordance with the calculation methods and procedures stipulated in the fundamental convention or agreed with the MGA in advance, and then obtain effective compensation after submission to the MGA for review. Finally, the MGA has obtained subrogation to seek payback from the companies, enterprises, and individuals who violated the preannounced standards for plastic production and criteria for plastic waste, as well as those who violated the marine plastic waste management plans and schemes. The Philippines should facilitate the realization of MGA's subrogation rights; otherwise, its future application under the MGM will be undermined.

The discharge of contaminated water from Japan after the Fukushima nuclear incident constitutes a great challenge to the neighboring states and the whole international community. The wastewater contains more than 60 radionuclides, many of which do not yet have effective treatment technologies, and some of the long-lived nuclides may spread with ocean currents (Permanent Mission of China to the UN, 2023). It results in global social welfare loss, and the total loss could reach up to $219.8 billion, accounting for 0.26% of global GDP in 2020 (Guo et al., 2022). The Global Trade Analysis Project model was employed to simulate the future impact of Japan's discharge, and the result showed that the discharge will lead to a global decline in aquatic products. As a result, China's GDP, total imports, total exports, and social welfare will decrease by 0.03%, 1.21%, 0.08%, and $728.15 billion, respectively (Liang et al., 2024).

The MGM provides an alternative scheme to combat a radioactive wastewater pollution. The state affected by pollution may initiate and obtain radioactive wastewater pollution guarantee from the MGA, or it has already obtained an MGA guarantee for pollution of the marine area from the coast before the Fukushima nuclear incident. From the date of submission of the application or the effective date of the guarantee contract signed with the MGA, once the guaranteed pollution occurs and satisfies the indicators defining pollution or meets the criteria for determining pollution degree, which are stipulated by the MGA or specified in the contract, the state shall calculate economic losses in accordance with the fundamental treaty or the contract and then report to the MGA for review. The qualified application results in effective compensation provided by the MGA. After the compensation is completed, the MGA will obtain the right of subrogation and make claims against Japan and other relevant Japanese companies for recovery. It solves the problem of many member states being unwilling to resort to judicial measures. Meanwhile, the litigation risk transferred to the MGA is further buffered in multilateral mechanisms.

5.3 Restrictions of MGM and corresponding solutions

The MGM is beneficial for MPLBS risk control. However, it inevitably has restrictions. The primary one is that the realization of MGA's subrogation largely relies on the compliance of states. Effective implementation and compliance are recurring challenges (Foster and Voigt, 2024). However, "compliance can be achieved if a reward outweighs the benefits from breaching international law (Aaken and Simsek, 2021)." Under the MGM, applicant states have undertaken the obligations to accept MGA supervision and cooperate with the MGA in preventing and controlling MPLBS risks. In order to obtain a guarantee and compensation from the MGA, the applicant states they often actively fulfill their obligations. In addition, the states receiving compensation are obliged to transfer all materials and documents that are required for the realization of subrogation under the fundamental convention and the contracts signed with the MGA.

Regarding the responsible states, the situation is much more complicated. If the responsible state is also a member state of the MGM, MGA's subrogation has been recognized. Therefore, the enforcement mechanism of fundamental convention and the internal pressure among member states are helpful in encouraging the responsible state to cooperate with the MGA to realize subrogation. On the contrary, if the responsible state does not accede to the fundamental convention, the MGA can only seek other solutions, which largely depend on the agreement concluded between the applicant state and the responsible state. If there does not exist such an agreement, then the MGA may negotiate with the responsible state to find a solution. Due to the principle of sovereignty, the jurisdiction of international judicial institutions is very limited. For instance, the jurisdiction of the International Court of Justice in contentious proceedings is based on the consent of the states to which it is open (ICJ). Political methods

may be more effective, and the collaboration with other international organizations, that is, the UN, also helps. In fact, the MGA may learn from the experience of the MIGA to cooperate with and seek to complement the operations of national entities of members and regional entities the majority of whose capital is owned by members, which carry out activities similar to those of the Agency, with a view to maximizing both the efficiency of their respective services and their contribution to MPLBS combat (MIGA Convention, 1988).

If the responsible party for guaranteed pollution is a company or enterprise, legal methods would be more welcomed. In addition, the domestic remedy procedures provided by the state, international arbitration may be a good choice. However, the achievement of an arbitration agreement is a prerequisite for initiating arbitration. The concept of requiring the company to assume social corporate responsibility—a management concept whereby companies integrate social and environmental concerns in their business operations and interactions with their stakeholders (UNIDO)—is conducive to promoting the conclusion of the arbitration agreement. And the pressure from the state to which the company belongs also works.

Another limitation of the MGM comes from its funding obligation for member states, especially for developing and low-income states. Regulating MPLBS requires a certain level of economic capability, and subscribing to stock capital may become an additional burden for member states. In fact, the MGM is designed as a multilateral mechanism for mutual assistance and technical support among member states in preventing and controlling MPLBS risks. Member states will receive far more than they pay. "Benefits from participating in economic, political, and legal ties with one another can generate the necessary incentives to enter and comply with a commitment (Aaken and Simsek, 2021)." Meanwhile, for developing and low-income states, as long as they comply with the fundamental convention and fulfill their obligations in good faith, they can receive preferential treatment, including applying for deferred payment and exempted or reduced payment. Low-interest loans to pay for their contributions may also be available.

To sum up, the fundamental strategy for eliminating the restrictions of the MGM is to attract more member states by enhancing incentives for states to accede to the fundamental convention. The fundamental convention should avoid discrimination and political attributes and avoid prioritizing the accountability of polluters. The primary goal should be clarified as regulating MPLBS risks and providing effective pollution compensation while offering assistance to developing and low-income states. Meanwhile, international organizations led by the UN should make efforts to promote and establish the awareness of a community with a shared future for the ocean and call on companies to take their social corporate responsibilities.

5.4 Promoting collaborative relationship with other institutes

"The international environmental community is poised to advance universal goals of curbing the harms to the environment and human health caused by land-based pollution (Laydon, 2003)." The operation of MGM enhances international cooperation in environmental protection and constitutes the best chance for regulatory development of MPLBS combat. It also provides an opportunity for MPLBS control to evolve from general and vague duties written in convention into more practical and specific obligations of states. Moreover, the MGM also accelerates the improvement of international environmental management by promoting the fulfillment of relevant obligations of states. These obligations may include initiating environmental assessment, pursuing sustainable development, and abiding by precautionary principles.

The UN is the most appropriate forum to promote the establishment of MGM. It is not only because the UN plays an essential role in the formation of international rules and norms but also because protecting the marine environment is one of the goals of the UN. "Conserve and sustainably use the oceans, seas, and marine resources for sustainable development" is adopted as one of the 17 Sustainable Development Goals (The UN, Sustainable Development Goals). As the leading department and authoritative institution responsible for global environmental affairs within the UN system, the UNEP (UN Environmental Programme) has worked closely with industry in developing environmental management strategies (UNEP, History). The UNEP thus has a greater advantage in lobbying states to accept advanced environmental concepts and rules in practice. In fact, the UNEP has already accumulated a lot of practical experience in promoting environmental protection through the insurance industry. The Forum for Insurance Transition to Net Zero (FIT) is "an UN-led and convened structured dialogue and multistakeholder forum to support the necessary acceleration and scaling up of voluntary climate action by the insurance industry and key stakeholders" (UNEP, Forum for Insurance Transition to Net Zero). In order to foster availability of insurance and finance for transition projects and technologies and net-zero activities, FIT cooperates with insurance market participants and engages with insurance regulators and supervisors (UNEP, Forum for Insurance Transition to Net Zero). Although both are led by international organizations and fully accelerate the role of commercial insurance in the field of environmental protection, unlike FIT, the MGM is not a loose forum but a more normative treaty mechanism. In addition, depending on different types of pollutants, the MGM may collaborate with different specialized agencies. Particularly, since radioactive wastewater is one of the main pollutants from land-based sources, the evaluation and recommendation made by the International Atomic Energy Agency (IAEA) is significant for the MGA to decide whether to provide a guarantee.

6 Conclusions

If existing international and domestic regulatory measures are somewhat inadequate, finding alternative solutions may provide new references for MPLBS combat. The MGM benefits MPLBS risk control, especially in the typical case of severe pollution, which has spiraled out of control due to the state's poor management, like plastic waste pollution in the Philippines. Accessing the responsible state's environmental management matters by providing an effective semi-commercial guarantee instead of interfering in internal affairs directly seems more acceptable. This strategy could be attractive for developing states, especially low-income states, to solve their own problems caused by MPLBS.

Meanwhile, for the states affected by MPLBS originating beyond their jurisdictional waters, claiming and exercising jurisdiction over the pollution could be impeded, even if harmful consequences occur within their jurisdictional waters. In this case, the MGM can provide effective compensation for the affected states. In addition, the operation of MGM plays an important role in promoting the standardization and development of MPLBS control regulations. It is also beneficial for developing states and low-income states to obtain technological support for pollution control.

By addressing urgent risk control and providing compensation for damages through guarantee practices, the MGM would benefit from the future formation of an international legal regime for MPLBS combat. It should also be noted that the shortcomings and deficiencies of MGM are expected to be addressed in its future construction and operation.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material. Further inquiries can be directed to the corresponding author.

Author contributions

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Publisher's note

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