Marine pollutions in Indonesia: Contradiction between regulations and settlement conditions

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Abstract. Exploration activities at sea continuously and lack of attention to environmental impacts actually have an impact on marine pollution such as Asphalt leaks in tankers in the North Nias sea in March 2023. Even though there has been a convention on the law of the sea to national legal regulations in Indonesia. The description of the above problems needs to be examined comprehensively in the following discussion, which is then formulated by examining the condition of marine pollution settlement in Indonesia and the legal construction of marine pollution liability in Indonesia. The results of the study show that the condition of marine pollution settlement in Indonesia has yet to be entirely carried out through concrete law enforcement. The disparity in the settlement of environmental pollution shows that there is still weak law enforcement carried out by the Indonesian government. It opens space for marine pollution to continue to recur. If referring to the 1982 UNCLOS and the Law on Ratification of UNCLOS and the PPLH Law, the settlement can be carried out by requesting absolute liability due to acts of pollution carried out by requesting compensation following the Polluter Pays Principle.

1 Introduction

The shape of the archipelago that forms Indonesia as a whole country is indicated by the percentage of 2/3 of Indonesia's territory in the form of waters or sea. Based on national territorial asset statistics released by the Ministry of Energy and Mineral Resources, Indonesia's territorial waters reach 5.9 million km², including the Exclusive Economic Zone (EEZ), with details of the archipelago area of 2.8 million km², territorial sea area of 0.4 km², and claims to the Continental Shelf beyond 200 miles covering 3500 km² west of Aceh [1]. Meanwhile, the number of islands is around 17,504, consisting of large and small islands. With the length of the coastline of the archipelago's islands reaching more than 81,290 km, Indonesia is in second place as the country with the longest coastline in the world after Canada. This shows that the sea has a strategic position in Indonesia. Not only as a traffic of goods and services, the Indonesian sea is also a prominent place in the lives of people who make a living as fishermen. So it is correct if it is identified that “The ancestors of the Indonesian people were sailors”.

The position that makes Indonesia have such a large sea area provides benefits for the people of Indonesia itself. There are various benefits of the sea for Indonesia, ranging from
food sources that provide fish [2] and marine resources that can be consumed, means of transportation of goods and services [3], for tourism and sports such as snorkeling and diving [4], to being one of the energy sources that are used for the benefit of many people through mining exploration contained under the sea [5]. These many benefits show that nature provides the sea as a suggestion that humans utilize [6].

In practice, the ocean occupies 71% of the earth's surface area, and it occupies a very important position in the history of human social development, providing humans with rich mineral resources [7]. Specific environmental settings will cause differences in a person's knowledge in interpreting the influence of the environment on their lives. This difference in meaning will lead to differences in the social and economic behavior of the surrounding community [8].

This then shapes the perspective of utilizing all things related to the sea, slowly harming the sea itself. Various activities that occur in the sea until exploration is carried out continuously with little regard for environmental impacts have an impact on the problem of marine pollution. Marine pollution is a global problem in several senses [9]. Such conditions also occur in Indonesian seas, which experience marine pollution problems.

The issue of marine pollution is not new in Indonesia, but it occurs repeatedly, both accidentally and intentionally [10]. The most recent case of marine pollution occurred in March 2023 due to an asphalt spill in the sea of North Nias caused by the ship's leakage. The Gabon-flagged tanker was loaded with 1,900 tons of asphalt and departed from the United Arab Emirates with the aim of Padang and Sibolga. The leak caused by the waves and the rusty condition of the ship caused the asphalt to flow slowly into the sea. As a result, the sea became polluted. It impacted various things, ranging from many marine biota dying from the asphalt, penetrating the Toyolawa-Lahewa Waters conservation area, to affecting fishermen and tourists who surf or travel in the coastal area [11].

Aside from active activities on the sea, such as the leakage case of the asphalt transport ship above, marine pollution also occurs due to drilling activities involving state companies engaged in oil management in Indonesia. An error in drilling that caused an oil spill hit the coast of Karawang-West Java. The incident occurred at an offshore drilling site owned by PT Pertamina Hulu Energi Offshore North West Java (ONWJ).

The marine pollution that occurred in July 2019 was caused by the re-entry of drilling activity while drilling at the YYA-I well, which then caused gas bubbles to appear until there was an oil sheen or oil layer on the surface of the sea, which resulted in the status of an emergency immediately set followed by the suspension of company operations. As a result of this incident, oil spills began to appear around the platform. The oil spill reached the beach to the west, 2 km away [12].

The above issue raises a discourse on how the responsibility should be imposed on the parties directly involved with acts of marine pollution that harm the country and the community. Discussions on marine issues, including pollution, have been carried out repeatedly by almost all countries by producing various International Conventions, including Conventions on the law of the sea. Countries, except Indonesia, follow up on these international agreements by reorganizing them in national legal regulations.

2 Literature review

Marine pollution as part of environmental pollution has a particular theoretical meaning. Environmental pollution is defined as the entry or inclusion of living things, substances, energy, and other components into the environment by human activities so that it exceeds the established environmental quality standards. Meanwhile, specifically regarding marine pollution, Article 1 point (2) of Government Regulation of the Republic of Indonesia Number 19 of 1999 concerning Control of Marine Pollution or Destruction explains that
marine pollution is the entry or inclusion of living things, energy substances and other components into the marine environment by human activities so that its quality drops to a certain level which causes the marine environment to no longer followed its quality standards and functions.

In addition to Indonesian regulations, the meaning of marine pollution is also found in UNCLOS 1982, article 1 (4) explains that “pollution of the marine environment means the introduction by man, directly or indirectly, of substances or energy into the marine environment, including estuaries, which result or is likely to result in such deleterious effect as harm to living resources and marine life, hazards to human health, hindrance to marine activities, including fishing and other legitimate uses of the sea, impairment or quality for use of sea water and reduction of amenities”.

According to Mochtar Kusumaatmadja, marine pollution is a change in the marine environment that occurs as a result of direct or indirect human input of energy materials into the marine environment (including river estuaries), which produces such adverse effects as a loss of biological wealth, a danger to human health, interference with activities at sea including fisheries and other reasonable uses of the sea, deterioration of the quality of sea water and the decline of residential and recreational places [13].

Marine pollution is commonly caused by ships, offshore drilling and the discharge of hazardous substances into the sea. This certainly impacts the marine environment, especially on ecosystems and ecology, including marine resources [14]. One form of marine pollution is marine pollution from land, which occurs from all activities carried out on land, both through water and air to the sea. Marine pollution is dominated by organic and inorganic materials such as heavy metals (mercury, lead, selenium, and arsenic), which are generally contained in waste from industrial activities [15].

The description of the above problems must be examined comprehensively in the subsequent discussion. Therefore, this article aims to examine two essential things: the condition of marine pollution settlement in Indonesia and the legal construction of marine pollution liability in Indonesia.

3 Methods

Based on the research objectives and the title formulated by the author, this study is an example of library research, which is a kind of normative research. Legal study that relies only on secondary sources, such as books and articles, is known as this form of research [16]. This study is an example of library research, which is a kind of normative research. Legal study that relies only on secondary sources, such as books and articles, is known as this form of research.

The study's legal resources are sourced via a search of legal documents. The examination of documents is one method of gathering legal information that is relevant to and supports the issues raised by this inquiry. With the use of content analysis, document study is a method for gathering legal information from textual legal sources [17]. This method is helpful for gaining a theoretical grounding in the topic at hand by perusing and researching relevant printed and digital books, laws, records, reports, archives, and research findings.

The approach taken is the approach of legislation, case approach and conceptual approach. Through these three approaches are expected to answer the purpose of this study. Furthermore, the existing legal materials are then qualified in advance according to their type and then analyzed in accordance with the three approaches. In line with this, the analysis is carried out in an analytical descriptive manner based on the theory and conception of legal science that has been determined and analyzed using legal principles, legal rules, and existing legal norms.
4 Results and discussion

4.1 State of marine pollution settlement in Indonesia

The principle of the rule of law, which is established as one of the foundations of state administration and then outlined in the constitutional norms of Article 1 paragraph (3) of the 1945 Constitution, places all state administration based on law (Rechtsstaat). This has consequences for establishing various legal products as guidelines in carrying out all activities of legal subjects, and all actions of legal subjects that violate the law must be processed following existing regulatory provisions, including acts of marine pollution.

The implementation of the legal process against marine pollution, once it leads to the resolution of legal problems, must be separated from how all related elements, both government and law enforcement, act within the framework of environmental law enforcement. In Dutch literature, law enforcement is referred to as rechtsvoorwaarding or rechtshandhaving, while law enforcement in English is interpreted as law enforcement.

The resolution of marine pollution in Indonesia cannot be separated from existing law enforcement efforts. In essence, every law enforcement agency must enforce the law following the provisions of the legislation so that it will reflect the ideal law enforcement process without specializing in certain parties so that it will provide benefits to the broader community.

The use of discretion in law enforcement entails making judgments that are not too constrained by legal norms but do include aspects of individual judgment. To build, sustain, and maintain harmonious living relationships, law enforcement essentially entails harmonizing the connection of values outlined in stable norms and attitudes of action as a succession of final stage value elaboration. To make the philosophically grounded idea seem more tangible, it needs further explication [18].

A key component of law enforcement, according to Satjipto Rahardjo, is the endeavor to materialize legal concepts (such as fairness, certainty, and the advantages of the law) [19]. On a larger scale, however, law enforcement also encompasses all endeavors that aim to establish the rule of law as a system of normative regulations that govern and obligate all members of the society and state to behave in accordance with these regulations. As for the narrow sense of law enforcement, it is about how law enforcement actions on any violations or deviations from regulations in laws and regulations [19].

Concerning this, the form of law enforcement, especially in the settlement of marine pollution in Indonesia, must be based on efforts to enforce environmental law following the practice of direct mistakes categorized as violating or not following legal regulations governing the environment and the sea in Indonesia. In determining the condition of the settlement of marine pollution in Indonesia in law enforcement, it can be traced through the settlement of various cases of marine pollution in Indonesia and seizing public attention.

Against the case of environmental pollution described by the author in the background section, the case of ship leakage resulting in marine pollution in Nias law enforcement is carried out with environmental compensation [20] as well as coastal and marine recovery due to the impact of marine pollution. This is a kind of environmental accountability; it describes the procedure by which individuals or organizations that do harm to the environment are made financially liable for it [21].

Claims for compensation may be brought under the terms of Law No. 32/2009 on Environmental Protection and Management. According to Article 90, paragraph (1), environmental protection agencies and local governments have the authority to sue polluting companies and individuals for damages and compensation in order to recoup some of the losses suffered by the environment. In addition, disputes can also be filed by the community. The community can file a lawsuit because they are the affected community through
facilitation that can be done by the relevant ministry, namely the Ministry of Environment and Forestry. In addition, the form can be done by proposing actions to restore the affected coastal and marine areas.

Meanwhile, for the re-entry error from drilling activity while drilling at the well in Karawang waters, the losses consisted of First, material losses suffered by salt farmers reached Rp. 500 million to Rp. Seven hundred million due to the oil spill. In addition, the salt sold has decreased from Rp.2000 to Rp.3000 to Rp.700 per kilogram. Second, the immaterial losses suffered resulted in the salt management community no longer operating because the raw material of seawater as the main ingredient was contaminated with oil spills, and there were 108.2 hectares of salt ponds owned by 64 farmers in 3 villages affected [22].

Against this action, PT Pertamina Hulu Energi ONWJ (PHE ONWJ), as the party responsible for the pollution that occurred, compensated as compensation to the affected community. PHE ONWJ spent 18.54 billion rupiah for 10,271 people directly affected by the oil spill in Karawang Waters. Providing compensation as a form of compensation is PHE ONWJ's action in resolving environmental disputes outside the court [23].

The steps taken against marine pollution in the above case were only carried out with out-of-court dispute resolution efforts without legal proceedings. However, efforts to resolve marine pollution in Indonesia still leave various other problems, where not all marine pollution is handled through out-of-court efforts or law enforcement that leads to the court.

For example, the issue of marine pollution occurs in several regions. In Bima Bay, marine pollution due to the mineral mining industry, oil and gas, and PLTU has been allowed to occur in recent years. The result of this act of environmental pollution is a large number of dead fish, so fish and shrimp in fishermen's ponds located far from the center of the pollution location are also affected [24]. This impact certainly exacerbates the losses incurred from environmental pollution that occurs in addition to threatening biodiversity [25] and tourism [26] around the location of the pollution.

The same act of marine pollution also occurred in the waters of the Bintan-Riau Islands. Marine pollution occurs due to waste oil (sludge oil) disposed of by foreign ships in the middle of the sea and then pollutes the coast of Bintan. Pollution incidents that result in environmental pollution of the sea and surrounding ecosystems have occurred several times and for years until the area polluted by black oil waste is increasingly widespread, even almost the entire northern coast of Bintan is affected [27]. Usually, operational spills are related to unintended or deliberate releases through routine ship activities, including oily ballast water from fuel tanks, bilge water dumping, engine effluent discharges (sludge), heavy residuals, lubrications, etc [28].

In Lampung, marine pollution occurred in Rawa Laut Village, Panjang Subdistrict, Bandar Lampung City, where waste resembling oil and grease was seen along the shoreline, black and smelling like diesel oil. Based on data from the Indonesian Forum for the Environment, marine pollution occurs in several areas, starting from Lampung Bay, Semaka Bay and the West Coast of Lampung. The culprit is strongly suspected to be a state-owned company. The total amount of oil material successfully transported was approximately 18.5 thousand barrels throughout 2021. The impact of the pollution is pervasive to the waters of Banten [29].

The disparity in handling marine pollution shows that the conditions for resolving marine pollution in Indonesia still need to be fully implemented. It can even be categorized that the law enforcement carried out is still only optimal once the incidents of marine pollution recur. In addition to the law enforcement issue, the lack of a budget for settling marine pollution is also one of the obstacles. This can be seen from the case in Bintan, where efforts to resolve marine pollution require a sizeable operational budget. However, some agencies still need the allocated budget, especially agencies in the regions [27].
Efforts to resolve environmental pollution require attention from all parties, especially from law enforcers in carrying out law enforcement. So, law enforcement can be practiced in accordance with the total enforcement concept, which states that all values underlying legal norms must be strictly enforced in order for it to be comprehensive (total enforcement concept), and with the knowledge that law enforcement is a related social sub-system [30].

4.2 Legal construction of marine pollution liability in Indonesia

Steps to resolve marine pollution carried out within the framework of environmental law enforcement must be based on various existing legal bases, both agreed upon jointly by various countries and expressly stipulated by a country, which becomes an internal regulation in that country. Through the existing legal basis, it will be possible to determine the form of liability that can be imposed on the parties.

4.2.1 United Nations convention on the law of the sea as a reference for international law

The ocean, as part of the environment, plays a significant role in the activities of every human being on earth. Humans and the sea are inseparable from all the ecosystems that exist in it [4]. However, besides being a source of livelihood and an area in a country, the sea also has various problems that need to be resolved, not only the issue of marine ecosystems but also the constitutional life of countries connected by the sea.

The development and intensity of humans utilizing the sea have made countries pay more attention to resolving issues related to the sea. This effort was realized with the birth of the United Nations Convention on the Law of the Sea (UNCLOS), or if interpreted in Indonesian, it is called the International Law of the Sea Convention. This convention was born from the United Nations (UN) Conferences on the law of the sea in 1958, 1960 and 1973-1982. UNCLOS 1982 is the current international legal instrument in the marine sector and a reference for all countries in resolving issues related to the sea. UNCLOS 1982 has extensive arrangements ranging from maritime zones that can be claimed by a country about marine research pollution to dispute settlement procedures between countries. The breadth and fundamentality of UNCLOS 1982 has led to UNCLOS being dubbed the Constitution of the Oceans. Regarding state attempts to preserve and maintain the maritime environment, the 1982 UNCLOS mostly includes a part that controls this matter specifically. In Chapter XII (twelve) of UNCLOS 1982, the rules regulating the preservation of the maritime environment, as well as the prevention, mitigation, and management of marine pollution, are laid down.

When it comes to pollution, the United Nations Convention on the Law of the Sea (1982) states that anything that is introduced into the water by humans, whether directly or indirectly, and has the potential to harm marine life, humans, the environment, or other lawful uses of the sea like fishing, as well as the water quality (including estuaries), is considered a pollutant of the marine environment (See Article 1 point 4 of UNCLOS 1982).

Furthermore, the regulation of marine pollution in this convention is found in Articles 194-196. To avoid, minimize, and regulate contamination of the maritime environment from any source, as described in Article 194, governments shall implement all appropriate measures. In addition, every state must implement its own strategies to decrease and regulate pollution in a way that does not cause harm in one place and changes the kind of pollution in another.

Consequently, the Convention requires all signatory states to take all necessary steps to avoid, mitigate, and regulate contamination of the maritime environment as a result of activities using technologies that are under their control or authority [31]. Each state may
take action by regulating, evaluating, and analyzing the potential hazards and repercussions of marine environment contamination using scientific techniques [32].

Section 5 of the United Nations Convention on the Law of the Sea (1982) addresses national laws and international regulations aimed at preventing, reducing, and controlling pollution in the marine environment. This section is relevant in practice for categorizing marine pollution, namely [33]:

(a) Marine pollution originating from land-based sources (UNCLOS 1982, Article 207)
(b) Marine pollution originating from seabed activities subject to national jurisdiction (UNCLOS 1982, Article 208)
(c) Marine pollution originating from activities in the region (UNCLOS 1982, Article 209)
(d) Marine pollution due to dumping (UNCLOS 1982, Article 210)
(e) Marine pollution from water vehicles (UNCLOS 1982, Article 211)
(f) Pollution of the sea from or by air (UNCLOS 1982, Article 212)


a. Marine Environment Pollution

Article 194 states that countries shall take all appropriate action to prevent, mitigate, and control contamination of the maritime environment. Governments are prohibited from moving hazards or dangers from one site to another or from one kind of pollution to another, according to Article 195 of the United Nations Convention on the Elimination of All Forms of Pollution (CEDAP). Every state must take all reasonable steps to safeguard the marine environment against the negative impacts of any technology that falls within its jurisdiction or authority, as stated in Article 196 of the United Nations Convention on the Rights of the Child. This can, therefore, be done following Article 204 by various methods, including regulatory measures, risk assessment and research into the hazards or consequences of marine pollution based on a scientific approach.

b. Efforts to Protect and Preserve the Marine Environment

Articles 197-201 of the United Nations Convention on the Law of the Sea require all states to cooperate regionally and internationally to safeguard and maintain the marine environment (1982). Environmental Science & Technology explains that collaborative efforts include jointly reporting on pollution in the marine environment, establishing emergency plans, conducting research, and developing scientific standards to govern procedures and practices to prevent, reduce or control marine pollution.

c. National Law Regulation and Enforcement

The various causes include land pollution, activities over which the national government has jurisdiction, pollution caused by local operations and discharges, and air pollution, all subject to regulation under the United Nations Convention on the Law of the Sea. Constitutional articles 207 to 212 cover these sections.

d. Liability and Indemnification

As a member of the international community, every state has a responsibility to fulfil its responsibilities towards preserving and conserving the marine environment. The state must
also provide the legal framework for people to seek redress for the harm they have suffered. Specifying must ensure that they can seek compensation under Article 235 on Responsibility and Commitment for Compensation, which states that states must fulfill their obligations for protecting and conserving the maritime environment. International cooperation [34] in applying applicable international law is necessary to develop international law on responsibility and liability for compensation and resolve any disputes that may arise during the process to ensure the provision of such compensation through the legal system.

Regarding pollution management, prevention and remediation efforts, including regulation and enforcement at both national and international levels, as well as compensation, should be pursued as stipulated in UNCLOS 1982. Regarding preserving marine ecosystems, UNCLOS 1982 mandates that the participation of all states, including those that are members of international organizations, is encouraged to ensure their long-term viability. Members of international organizations, as well as their residents, play an essential role in protecting the marine environment.

The utilization and management of the sea, which causes problems, is then answered through the construction of international law, namely in UNCLOS 1982, also referred to as the constitution of the sea. Through such a position, UNCLOS 1982 plays a vital role in resolving the issue of marine pollution, which should be utilized by countries that have ratified it as a legal basis for resolving marine pollution and ensnaring perpetrators of marine pollution.

4.2.2 Legal construction of marine pollution in Indonesia


Not only did Indonesia ratify UNCLOS 1982, but it also passed Law No. 6 of 1996 regarding Indonesian Waters. Various maritime rules and regulations, such as those pertaining to environmental protection, are included under this statute. According to this legislation, all aspects of Indonesian waterways, including their use, management, protection, and preservation, are carried out in accordance with relevant national and international standards.

In contemporary times, as each country increases its ability to engage in commercial and long-range fishing, there are concerns about pollution and damage to marine resources [35]. In response to this, the sea is an environmental ecosystem. Its regulation is then reinforced through Law Number 32 of 2009 concerning Environmental Protection and Management (UU PPLH).

Referring to its substance, this Environmental Law can be applied to activities that cause damage or pollution of the sea, which are carried out within or outside the jurisdiction of Indonesia. Furthermore, Article 67 of this Law stipulates that "Everyone is obliged to maintain the preservation of environmental functions and prevent and overcome environmental pollution and destruction". Accordingly, the concept of strict liability might be used in the case of a breach of this provision, as stated in Article 88 of this Law. The provisions of the UUPLH, namely Article 88, are in line with the requirements of UNCLOS 1982, specifically Article 235, which include the duties of responsibility and compensation [32].

The concept of "absolute responsibility" or strict liability is defined in the UUPLH Explanation of Article 88 as the absence of a burden on the plaintiff to establish fault in order to get compensation [36]. According to the legal concept of strict liability, businesses may be held entirely liable for any harm to the environment caused by their operations, regardless of whether the corporation was negligent or not [37].
In every case involving a claim of wrongdoing, the clauses included below constitute lex specialist. Polluters and environmental destroyers may be subject to a maximum amount of compensation, as stated in this Article.

In its implementation, the absolute liability effort can be obtained through two paths that can be taken by the parties to the dispute freely (voluntarily) and can choose the path of a court lawsuit or outside the court. The out-of-court compensation claim can use the services of a mediator/arbitrator. Furthermore, a lawsuit through the court can only be pursued to make compensation for the out-of-court route chosen by the parties declared unsuccessful by one or the parties to the dispute [22].

Specifically, regarding the form of absolute responsibility through the form of compensation when referring to the Environmental Law, it is determined based on the Polluter Pays Principle as one of the principles of environmental protection and management. Applying the polluter pays principle includes instruments for prevention, control, recovery and law enforcement. The implementation of pollution control is carried out following the authority, roles and responsibilities of stakeholders, one of which is the person in charge of the business. The elements of the Polluter Pays Principle are then reaffirmed, namely [23]:

First, applying the polluter pays principle as a preventive instrument provision is applied in Articles 14-53 of Law 32/2009. Pollution prevention is applied through environmental instruments. Namely, (1) KLHS (Strategic Environmental Assessment); (2) spatial planning; (3) quality standards and environmental damage standards; (4) EIA; (5) UKL-UPL; (6) licensing; (7) environmental economic instruments, one of which is a guarantee fund (discussed further below); (8) environment-based laws and regulations; (9) environment-based budgets; (10) environmental risk analysis; (11) environmental audits; and (12) other instruments as needed and the development of science.

Second, the polluter pays principle is applied to the mitigation provisions in Article 53 of Law 32/2009. The regulation is that every polluter must overcome the pollution they cause by providing warning information, isolating the pollution, stopping the source of pollution and other methods following the development of science and technology.

Third, the polluter pays principle is also applied in the recovery provisions in Articles 54-56 of Law 32/2009. Article 54 of Law 32/2009 requires polluters to restore the environment due to the pollution they cause. By stopping the source of pollution, remediation, rehabilitation, restoration and other methods following the development of science and technology.

Fourth, the polluter pays principle is also applied in law enforcement provisions. For example, the explanation of Article 87 paragraph (1) of Law 32/2009 states the polluter pays principle explicitly. Settlement of environmental disputes results in compensation, recovery actions, specific actions to ensure the non-recurrence of violations, and certain actions to prevent adverse impacts. The compensation is available to victims in the form of the environment and the community and can be obtained through the dispute resolution process both inside and outside the court.

5 Conclusion

Based on the description of the above discussion, it can be concluded that:

(1) The condition of marine pollution settlement in Indonesia has yet to be entirely carried out through concrete law enforcement. The disparity in the settlement of environmental pollution shows that there is still weak law enforcement carried out by the Indonesian government. It opens space for marine pollution to continue to recur.

(2) If referring to the 1982 UNCLOS and the Law on Ratification of UNCLOS and the PPLH Law, the settlement can be carried out by requesting absolute liability
due to acts of pollution carried out by requesting compensation following the Polluter Pays Principle. This is intended so that the consequences of marine pollution can solve the problem of marine pollution comprehensively, including prevention, control and recovery

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