

Legal Analysis of Marine Environmental Protection from Greenhouse Gas Emissions

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Abstract. Climate change due to drastic increases in greenhouse gas (GHG) emissions has damaged marine ecosystems through warming and acidification. This study aims to analyze the conformity of international law and the implementation of Indonesian national regulations in an effort to protect the marine environment from the impacts of anthropogenic GHG emissions. Using normative legal research methods, this study applies legislative and conceptual approaches to examine UNCLOS 1982, the Paris Agreement, the Environmental Management Law, and Presidential Regulation No. 110 of 2025. The results show that Article 192 of UNCLOS 1982 is now interpreted as a due diligence obligation that requires states to make maximum efforts to prevent marine pollution, including emissions released into the atmosphere. At the national level, Indonesia has made significant reforms through Presidential Regulation No. 110 of 2025 which allows for accelerated carbon trading without having to wait for the achievement of NDC targets. In addition, the enactment of Ministerial Regulation No. 1 of 2025 strengthens the technical governance of blue carbon as a mitigation instrument and economic asset. The study concludes that Indonesia has built a responsive legal foundation by integrating the Economic Value of Carbon into marine environmental protection. The implementation of MRV mechanisms and emissions certification demonstrates the state responsibility to fulfill international commitments. This legal harmonization is a prerequisite for slowing marine ecosystem degradation, safeguarding marine biodiversity, supporting food security for coastal communities, and advancing intergenerational environmental justice. Nevertheless, consistency between economic acceleration and ecosystem integrity remains necessary to ensure sustainable marine conservation.

Keywords: Marine Environment; GHG Emissions; Blue Carbon; Anthropogenic; State Responsibility

1. Introduction

The world is currently facing the threat of climate change as a primary consequence of increasing greenhouse gas emissions, a problem that has worsened since the industrial revolution (around 1750), when humans shifted from natural fuels to fossil fuels such as coal, oil, and natural gas. (1) The use of these fossil fuels contributes approximately 89% of carbon dioxide (CO₂) emissions to the atmosphere. As a result, CO₂ concentrations have continued to soar, reaching a record high of 422.8 ppm (parts per million) in 2024, an increase of more than 50% compared to pre-industrial times. (2)

The ocean plays a vital role as the “lungs of the world” in stabilizing the global climate. The ocean is able to absorb around 25% to 30% of anthropogenic carbon emissions and reduce 90% of excess heat on earth. Without the help of the ocean, CO₂ concentrations in the atmosphere would be much higher and the impact would be far more damaging. (3) Unfortunately, the continuously increasing emission load is actually damaging the health of

the ocean itself. Now the ocean is experiencing warming temperatures, rising sea levels, and acidification that disrupt the ecosystem within it. This condition ultimately reduces the natural ability of the ocean to absorb carbon back.(4)

Under international law, Article 192 of UNCLOS 1982 requires every state to protect and preserve the marine environment. This obligation is further strengthened by the legal opinion of ITLOS in May 2024 (5) and the ICJ in July 2025, (6) which states that states are legally responsible for preventing damage to the climate system due to anthropogenic greenhouse gas emissions.(7) As an archipelagic state that is very vulnerable to climate impacts, Indonesia has ratified various international agreements such as UNCLOS to the Paris Agreement and has developed national regulations.

These climate impacts are not socially neutral, they fall disproportionately on vulnerable coastal communities, including small-scale fishers and indigenous and local groups, whose livelihoods, cultural heritage, and human rights depend on healthy marine ecosystems. In this sense, strengthening marine environmental protection through robust and coherent legal frameworks is part of climate justice, safeguarding biodiversity and food security for millions of Indonesians living in coastal areas. However, these regulations in protecting the marine environment still need to be refined.

The relationship between UNCLOS 1982, the Paris Agreement, Presidential Regulation No. 110/2025, and Ministerial Regulation No. 1/2025 is illustrated in Figure 1 to clarify the multi-level regulatory architecture.

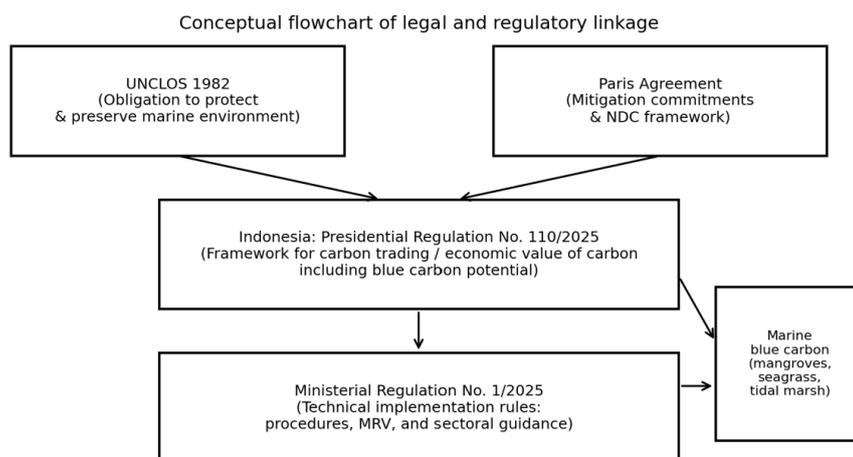


Figure 1. Conceptual flowchart linking international obligations and Indonesia’s implementing instruments for marine protection from GHG emissions.

Therefore, the purpose of this study is to analyze how international law and the implementation of regulations in Indonesia are in accordance with protecting the marine environment from GHG emissions. This research can be used as a basis for improving Indonesian regulations to be more effective in dealing with greenhouse gas emissions. Strengthening legal harmonization is not merely an academic exercise, but a prerequisite for slowing marine ecosystem degradation, safeguarding marine biodiversity, supporting food security for coastal communities, and advancing intergenerational environmental justice

2. Method

This research uses a normative legal research methodology that focuses on legal principles, legal systematics, and the level of synchronization of laws and regulations related to marine environmental protection and climate change.(8) By using a legislative approach used to examine national legislation and international conventions such as UNCLOS 1982, UNFCCC, the Paris Agreement, and Indonesian regulations including Law No. 32 of 2009 (PPLH), Law No. 32 of 2014 concerning Marine Affairs, and the latest regulations such as Presidential Regulation No. 110 of 2025. This research also uses a conceptual approach to analyze the principle of Common But Differentiated Responsibilities (CBDR), and the precautionary principle in international environmental law.

3. Results and Discussion

3.1. International Regulations for Marine Protection Against Greenhouse Gas Emissions

3.1.1. United Nations Convention On The Law Of The Sea 1982

Article 1 paragraph 1 number 4 of UNCLOS 1982, considers a phenomenon as marine pollution if it meets three main elements, namely originating from human activities either directly or indirectly, involving the entry of destructive substances or energy, and causing negative impacts on the ecosystem, human health, to disrupting legitimate marine activities such as fisheries. (9) With these criteria, the scope of marine pollution is now broader because it is not only limited to classic problems such as oil spills or waste disposal from ships, but also includes greenhouse gas emissions produced by humans because it has been proven to damage the sustainability and balance of the marine environment.

Marine environmental pollution is regulated in Chapter XII, Articles 192 to 237, which emphasizes that every state has a legal responsibility to protect and preserve the sea from various types of pollution.(10) The primary mandate contained in Article 192 is no longer considered a mere general rule, but has evolved into a " *due diligence* " obligation. This means that states have an Obligation of Conduct to make every effort to the maximum, reasonable, and effective to prevent environmental damage.(11) In fact, ITLOS (the International Tribunal for the Law of the Sea) has emphasized that to address the threat of greenhouse gas emissions that damage the sea, states must implement very strict monitoring standards (stringent standards) to ensure optimal marine protection.

Article 193 recognizes the sovereign right of every state to manage its natural resources, but this right is not an unlimited free license.(12) This sovereignty is limited by the state's obligation to maintain the sustainability of the sea as regulated in articles 192 and 194. This means that if a state continues to carry out large-scale exploitation, such as continuing to develop fossil fuels that increase greenhouse gas emissions and damage the temperature and acidity of the ocean, then this action can be considered a violation of international law. Legally, article 193 requires states to abandon Business As Usual practices in the energy sector and begin to implement stricter monitoring standards to protect the marine environment from carbon pollution.

Article 194 details the obligations of states to prevent, reduce, and control marine pollution from all sources, including greenhouse gas emissions.(13) According to the ITLOS affirmation, each state is obliged to take "necessary measures" that are objective and tailored to the scientific, technological, and economic capabilities of each state in dealing with these environmental threats. In addition, Article 194 paragraph 2 places special emphasis on the prevention of transboundary pollution, where states must be responsible for ensuring that

activities within their jurisdiction do not damage the environment of other states or cause pollution to spread beyond their national borders.

Article 194 paragraph 3 requires every state to address all sources of marine pollution, from land-based waste and ship activities to marine installations. Specifically, this article mandates the reduction of hazardous substances released into the atmosphere (air). When combined with Article 212, this provision demonstrates that UNCLOS directly regulates greenhouse gas emissions from land-based and air-based activities, not just pollution from ships. This provides a strong international legal basis for states to tighten regulations in their domestic industrial, energy, and transportation sectors to comply with their maritime protection obligations.

3.1.2. International Legal Framework for Managing Greenhouse Gas Emissions

Global efforts to collectively address climate change are outlined in the United Nations Framework Convention on Climate Change (UNFCCC), agreed upon at the Earth Summit in Rio de Janeiro, Brazil, in 1992 and entered into force in 1994.⁽¹⁴⁾ This meeting marked the second milestone in international environmental law after the Stockholm Declaration of 1972. The Rio Summit produced five important agreements: the Rio Declaration, Agenda 21 for Sustainable Development, Principles of Forest Management, and the Convention on Climate Change and Biodiversity. This convention adheres to the principle of Common and Differentiated Responsibilities (CBDR-RC) in accordance with Article 3, paragraph 1. This means that although all states are responsible, developed states bear a greater burden due to their historical emissions, including in terms of providing climate finance assistance to developing states. The implementation of the UNFCCC is carried out through the Conference of the Parties (COP) which is held annually. This forum functions to evaluate global climate management measures by involving governments, the private sector, and civil society.

At COP-3 in 1997, the Kyoto Protocol was born as an additional technical regulation of the UNFCCC which came into effect in 2005. ⁽¹⁵⁾ This protocol focuses on stabilizing greenhouse gas levels in the atmosphere that have increased due to the use of fossil fuels. Unlike its parent convention, the Kyoto Protocol is more legally binding for industrialized states (Annex I) to reduce their emissions. Meanwhile, developing states do not have mandatory emission reduction targets to meet. Emission reductions are divided into two phases. The first phase (2008-2012) requires industrialized states to cut emissions by at least 5% from 1990 levels, with specific targets that vary for each state such as the European Union and Japan.⁽¹⁶⁾

In 2012, the Doha Amendment was agreed upon for a second term (2013-2020). However, this period faced challenges as several major states, such as Japan, Canada, and Russia, decided not to participate or withdrew. Despite the reduced number of participants, states that remained committed demonstrated tangible results, with an average emission reduction of 22%. This proves that the Kyoto framework is effective when supported by strong political will. After 2020, the Kyoto Protocol was replaced by the Paris Agreement (COP-21, 2015). This agreement brought significant changes because it involved all states voluntarily (bottom-up), unlike the Kyoto Protocol, which only focused on developed states. The main objective of the Paris Agreement is to hold global temperature rise below 2°C and strive to limit it to 1.5°C. The core of the Paris Agreement is the Nationally Determined Contributions (NDCs), which are each states promise to take climate action according to their respective

capabilities. Despite the lack of harsh legal sanctions, this approach has successfully embraced major emitting states such as the US and China.

Every five years, states are required to submit more ambitious Nationally Determined Contributions (NDCs). Compliance is monitored through diplomatic pressure and public transparency. There is also a Global Stocktake (GST) mechanism to assess the world's collective progress every five years. At COP 28 (2023), the first GST called for an accelerated transition away from fossil fuels to maintain global temperature targets.⁽¹⁷⁾ Furthermore, a Transparency Framework (ETF) requires states to regularly report on their concrete actions and financial support to build trust between states.

Outside the UN framework, the MARPOL Convention, created by the International Maritime Organization (IMO) in 1973 and updated in 1978, regulates pollution from ships. It came into effect in 1983 to preserve the marine environment. The focus of MARPOL Annex VI has now expanded from regulating local air pollution to addressing global GHG emissions. Because ships contribute 3% of global emissions, the IMO is implementing short- and long-term strategies to reduce this contribution. MARPOL Annex VI establishes mandatory standards to ensure ships operate with optimal energy efficiency to reduce greenhouse gas emissions. For new ships, the Energy Efficiency Design Index (EEDI) standard applies, which is a calculation of CO₂ emissions based on the ship's design when it was built. Meanwhile, for ships already in operation, the Energy Efficiency Existing Ship Index (EEXI) was introduced, effective January 1, 2023. All ships with a tonnage of 400 GT and above that undertake international voyages must comply with the EEXI rules. Existing ships must meet these standards through periodic surveys to reissue their energy efficiency certificates. If a vessel does not meet the EEXI threshold, the shipowner is obliged to take corrective measures, such as limiting engine power or installing additional energy-saving devices.

In addition to technical standards on engines and design, MARPOL Annex VI also applies the Carbon Intensity Indicator (CII) to ships of 5,000 GT or more. Unlike EEDI/EEXI, which focus on design, the CII measures how efficiently a ship operates by calculating the amount of CO₂ emissions released per cargo capacity and distance traveled. Each year, ships are rated A (highly efficient) to E (less efficient). If a ship receives a D rating for three consecutive years or an E rating in one year, the ship is required to develop a corrective action plan to improve its performance. All results of this assessment are documented in a "statement of compliance" and detailed in the Ship Energy Efficiency Management Plan (SEEMP).

3.2. Indonesian regulations for controlling greenhouse gas emissions

3.2.1 Indonesia's obligation to control greenhouse gas emissions

The 1945 Constitution (UUD) is the highest legal basis that serves as a reference for all regulations in Indonesia. Through Article 28H paragraph (1) and Article 33 paragraph (4), the state constitutionally guarantees the right of every citizen to a good, decent, and healthy environment.⁽¹⁸⁾ This mandate requires Indonesia to be one step ahead in preserving nature compared to other states, where the government is obliged to prioritize environmental interests in every policy in order to fulfill its responsibility to the basic rights of the Indonesian people. ⁽¹⁹⁾

Furthermore, the current climate change crisis has become a real threat to human rights. Based on Principle 16 of the 2018 Framework for Principles on Human Rights and the Environment, states are obliged to respect and protect the rights of citizens in all actions taken

to address environmental challenges and sustainable development. If the government fails to implement adequate protection measures, this can be categorized as a form of gross human rights violation. Therefore, climate mitigation measures must focus on protecting the rights of the most vulnerable groups in society, as stipulated in Principle 14 of the framework.

As the world's largest archipelagic state with approximately 65% of its population and the majority of provincial capitals concentrated in coastal areas, Indonesia faces high vulnerability to the impacts of climate change caused by greenhouse gas emissions. In an effort to mitigate these risks and protect its territorial sovereignty, Indonesia has ratified UNCLOS 1982 through Law Number 17 of 1985. The consequence of this ratification is the birth of legal binding to a series of international obligations in maintaining aquatic ecosystems, as emphasized in Article 192 of UNCLOS 1982 which requires every state to protect and preserve the marine environment.(20)

On the other hand, Indonesia's commitment to controlling climate change is also strengthened through the ratification of the Paris Agreement, which was ratified in Law Number 16 of 2016. Despite its status as an affected state, this regulation legally binds Indonesia to realize its Nationally Determined Contribution (NDC) targets through comprehensive mitigation and adaptation strategies. The ratification of the Paris Agreement provides strategic benefits for Indonesia, which include: strengthening coastal protection from climate threats; increasing global recognition of national commitments in emission reduction, forest conservation, and empowering indigenous communities; gaining a voice in global decision-making mechanisms related to the implementation of the agreement; and opening access to financial support, technology transfer, and institutional capacity building.

The legal basis for implementing climate change mitigation due to greenhouse gas (GHG) emissions in Indonesia is rooted in Law Number 32 of 2009 concerning Environmental Protection and Management (UU PPLH), which was amended through Government Regulation in Lieu of Law (Perppu) Number 2 of 2022 and enacted as Law Number 6 of 2023 concerning Job Creation. The PPLH Law serves as a *lex generalis* that covers all systematic efforts to preserve environmental functions and prevent ecological damage. In this context, GHG emission mitigation is a direct manifestation of the mandate to protect Environmental Carrying Capacity, namely the limit of the environment's ability to absorb incoming substances or energy. GHG control is crucial to ensure that the emission load does not exceed this ecological threshold. This effort is now more specifically strengthened by Presidential Regulation Number 98 of 2021 concerning the Implementation of Carbon Economic Value, which acts as a *lex specialis* for emission reduction techniques. In addition, this mitigation measure also adopts the Precautionary Principle, which emphasizes that scientific uncertainty should not prevent states from taking preventive measures to prevent further environmental damage.

In its operational framework, Article 13 paragraph (3) of the Environmental Management Law requires the Central Government, Regional Governments, and business actors to control environmental pollution and damage in accordance with their respective authorities. This legal obligation is comprehensive, covering sovereign space on land, sea, and air. Through this relationship, the Environmental Management Law demands an active role for the state in taking preventive, mitigating, and remedial measures for the impacts caused by GHG emissions. Constitutionally, this state responsibility is an implementation of Article 28H paragraph (1) of the 1945 Constitution which guarantees the right of every citizen to a good and healthy environment. From a maritime perspective, fulfilling this domestic

obligation also serves as an instrument for Indonesia to fulfill its international commitment to protecting marine ecosystems from the impacts of global warming, such as rising sea levels and ocean acidification, which seriously threaten the stability of Indonesia's coastal areas.

Article 63 of Law Number 32 of 2009 concerning Environmental Protection and Management (UU PPLH) explicitly regulates the division of duties and authorities between the Central Government, Provincial Governments, and Regency/City Governments in maintaining ecosystem sustainability. Based on Article 63 paragraph (1) letter f, the Central Government through the Minister has the constitutional authority to conduct an inventory of national natural resources and greenhouse gas (GHG) emissions. This process aims to produce an accurate, integrated, and systematic database as a basis for making sustainable development policies and controlling climate change. Its implementation adopts a bottom-up approach: starting from the Regency/City level which collects data on industrial, transportation, and waste sector activities (Article 63 paragraph 3 letter e); then coordinated and verified by the Provincial Government (Article 63 paragraph 2 letter e); until finally compiled into the National GHG Inventory. In practice, this mechanism is integrated through the National Greenhouse Gas Inventory System (SIGNAS) and the National Climate Change Control Registry System (SRN PPI) to ensure that the data meets the Measurement, Reporting, and Verification (MRV) standards required in reporting Nationally Determined Contributions (NDCs) to the UNFCCC.

The implementation of this authority is a manifestation of the state's responsibility in its function as a provider of a decent quality of life for its citizens. Protection of citizens' rights to a good and healthy environment, as guaranteed in Article 28H paragraph (1) of the 1945 Constitution, requires the state to be present through preventive and protective regulations. In addition to its role as a provider, the formation of a series of regulations regarding central-regional authority and community participation in environmental conservation demonstrates the state's role as a regulator that directs environmental-based state governance (eco-government). Doctrinally, this step strengthens Indonesia's position in fulfilling the principle of "Common but Differentiated Responsibilities and Respective Capabilities" (CBDR-RC) in international law, where Indonesia demonstrates its national capacity in managing domestic emissions to protect global interests, while maintaining the ecological security of its coastal and marine areas from the threat of climate change.

3.2.2 Regulations for Mitigating Greenhouse Gas Emissions in the Marine Sector

The implementation of greenhouse gas (GHG) emission mitigation in Indonesia's maritime sector is a structured effort regulated through multi-layered legal instruments to integrate national policy with operational implementation in the field. The fundamental foundation of this mitigation action was initially based on Presidential Regulation Number 98 of 2021 concerning the Implementation of the Economic Value of Carbon (NEK).⁽²¹⁾ This regulation marked a paradigm shift where mitigation efforts were no longer merely viewed as ecological obligations but rather measured as economic assets through a nationally determined contribution framework (NDC). However, to align the policy with the 2025-2029 National Medium-Term Development Plan (RPJMN), the government then enacted Presidential Regulation Number 110 of 2025 on October 10, 2025. This latest Presidential Regulation revokes the validity of Presidential Regulation Number 98 of 2021 in its entirety to create an emissions control system that is more responsive and adaptive to the dynamics of national development.

The fundamental difference in Presidential Regulation Number 110 of 2025 lies in Article 58, which allows for the immediate implementation of carbon trading without having to wait for the NDC target to be met. This acceleration provides strategic advantages for Indonesia's marine sector, particularly in optimizing the potential of Blue Carbon, such as mangrove ecosystems and seagrass beds, as active carbon absorbers with high market value. Internationally, this step synchronizes domestic regulations with market mechanisms in Article 6 of the Paris Agreement, which strengthens Indonesia's bargaining position in global climate finance. Although carbon trading can be executed earlier, its implementation remains bound by strict MRV (Measurement, Reporting, and Verification) standards and the principle of Environmental Integrity.⁽²²⁾ This demonstrates the state's commitment to ensuring that economic progress through NEK remains in line with its legal obligation to preserve the marine environment as mandated by Article 192 of UNCLOS 1982.

Indonesia's commitment to reducing greenhouse gas (GHG) emissions is formally articulated through the Nationally Determined Contribution (NDC) document, which, according to Article 7 of Presidential Regulation Number 110 of 2025, is implemented through the pillars of climate change mitigation and adaptation. Mitigation is a structural intervention to reduce emission sources or increase GHG absorption, while adaptation aims to strengthen national resilience to climate risks. In the marine sector, these two aspects intersect through the Nature-Based Solutions approach, where ecosystem restoration functions not only as a carbon sink (mitigation) but also as a natural barrier to protect the coast from sea level rise (adaptation).

From a regulatory perspective, Article 9 paragraph (2) of Presidential Decree Number 110 of 2025 establishes the marine sector as an independent mitigation sector, which is detailed in Article 9 paragraph (3) through the sub-sector of mangrove and blue carbon management. Legal recognition of blue carbon now extends not only to mangrove ecosystems, but also includes seagrass meadows and estuaries as active carbon absorbing units. This step emphasizes the state's responsibility in maximizing the ecological potential of its marine areas in order to fulfill the obligation to protect the marine environment mandated by Article 192 of UNCLOS 1982.

As an operational instrument, the Ministry of Maritime Affairs and Fisheries established Ministerial Regulation Number 1 of 2025, which regulates the technical procedures for implementing the Carbon Economic Value (NEK) in the maritime sector. This regulation includes a strict MRV (Measurement, Reporting, and Verification) mechanism and mandatory data integration into the National Climate Change Control Registry System (SRN PPI) to prevent double counting of emissions.⁽²³⁾ Through the issuance of Emission Reduction Certificates (SPE-GRK), the state provides legal evidence of emission reduction achievements in the maritime sector. Doctrinally, the implementation of MRV and certification is a form of fulfillment of the principle of reasonable precaution (due diligence) by the Indonesian government on an international scale, to ensure that emission reduction claims have high environmental integrity in accordance with the standards of Article 6 of the Paris Agreement.

Conclusion

From a climate justice perspective, the effectiveness of these legal frameworks should be assessed not only in terms of doctrinal coherence and market instruments, but also by their capacity to protect the livelihoods, cultural heritage, and human rights of vulnerable coastal communities in Indonesia that bear disproportionate climate harms. Robust marine environmental protection therefore functions as a legal safeguard for millions of people who depend on healthy marine ecosystems for food security and socio-cultural continuity, today and across generations. Anthropogenic greenhouse gas (GHG) emissions have been legally classified as a form of marine environmental pollution that triggers *due diligence obligations* for each state based on Article 192 of UNCLOS 1982 and supported by international legal opinions from ITLOS and the ICJ. As a form of state responsibility in protecting citizens' constitutional rights to a healthy environment, Indonesia has made significant reforms by integrating the mandate of the PPLH Law into a more responsive regulation, namely Presidential Regulation Number 110 of 2025 which replaces Presidential Regulation Number 98 of 2021. The main legal breakthrough in this new regulation, particularly in Article 58 which permits the implementation of direct carbon trading without waiting for the fulfillment of NDC targets, as well as technical support from the Minister of Maritime Affairs and Fisheries Regulation Number 1 of 2025, demonstrates Indonesia's commitment to optimizing the potential of blue carbon as a mitigation instrument and national economic asset. This comprehensive synergy between international and national legal instruments is a concrete manifestation of Indonesia's efforts to fulfill its obligation of conduct *to* sustainably preserve marine ecosystems from the threat of climate change.

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Conflict of Interest

Declare any conflict of interest or state "The authors declare no conflict of interest."

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