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Integration of Law, Economics, and Environmental Science in Realizing Equitable and Sustainable Global Resource Governance

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Abstract: The increasingly complex global environmental crisis demands a resource governance approach that is no longer sectoral, but rather integrative, involving the disciplines of law, economics, and environmental science. This study aims to analyze how the integration of these three disciplines can create a just and sustainable model for global resource governance. Using normative legal research methods with a conceptual and comparative approach, this study examines various national and international legal instruments, such as Law Number 32 of 2009 concerning Environmental Protection and Management, Presidential Regulation Number 98 of 2021 concerning the Economic Value of Carbon, and the 2015 Paris Agreement. The analysis shows that law serves as a normative framework to ensure certainty and fairness in resource management, economics acts as an incentive instrument through carbon market mechanisms and green investment, while environmental science provides an empirical basis for evidence-based policymaking. Integration of these three is necessary to create multi-level governance that balances the interests of development and environmental conservation. This study also recommends strengthening global coordination through the application of the principle of common but differentiated responsibilities (CBDR) and harmonization of regulations between countries to support the transition to sustainable prosperity.

Keyword: Green Economy, Environmental Science, Global Governance.

INTRODUCTION

The current global environmental crisis has reached a level that threatens the sustainability of human life and ecosystems on Earth. The 2023 Intergovernmental Panel on Climate Change (IPCC) report shows that the global average temperature has increased by more than 1.1°C compared to the pre-industrial era, triggering an increase in the frequency of natural disasters such as floods, droughts, and forest fires. (Hakim, et al., 2024) Deforestation in tropical regions, including the Amazon and Southeast Asia, continues to accelerate biodiversity loss, while soil degradation threatens global food security. Furthermore, marine

pollution from plastic waste and industrial chemicals has reached a critical point, with an estimated 11 million tons of plastic entering the ocean annually. (Anwar, 2022) Global economic activities such as massive industrialization, fossil fuel consumption, and large-scale agricultural expansion are the main factors driving this environmental damage. A linear economic pattern oriented towards unlimited growth has created an imbalance between the exploitation of natural resources and the Earth's regenerative capacity. (Jamin, et al., 2024) This situation underscores the urgent need for collaborative, transnational environmental governance, as the ecological crisis is transnational and cannot be resolved by a single country or discipline.

However, global natural resource governance still faces serious challenges due to policy fragmentation and unequal distribution of responsibilities between countries. Developed countries generally have greater financial and technological capacity, but their historical contribution to greenhouse gas emissions is far higher than that of developing countries. (Muliadi & Nasri, 2023) Meanwhile, developing countries are often caught in a dilemma between the need for economic development and the obligation to preserve the environment. This fragmentation is also reflected in the overlapping of various international regimes, such as the United Nations Framework Convention on Climate Change (UNFCCC), the Convention on Biological Diversity (CBD), and the World Trade Organization (WTO), which often have different mandates without effective coordination. (Firdaus & Wandira, 2022) As a result, global policies for managing natural resources are often partial and unsynchronized, hampering the holistic achievement of sustainable development goals.

The weaknesses of the sectoral approach further exacerbate these global governance problems. Legal approaches are often normative without adequate economic implementation support, while environmental economic policies driven by carbon markets or emissions trading mechanisms often ignore the principle of ecological justice. Furthermore, environmental science findings, which should form the basis of public policy, are poorly understood or not optimally integrated into the decision-making process. (Sihotang, 2025) Consequently, environmental justice principles are difficult to apply equitably, especially for communities in developing countries that are most impacted by climate change but contribute relatively little to emissions. (Tampubolon & Purba, 2022)

Legal approaches to natural resource management play a fundamental role as a normative framework that provides certainty, legitimacy, and protection for environmental rights. Through instruments such as Law Number 32 of 2009 concerning Environmental Protection and Management and various derivative regulations, the state strives to uphold the precautionary principle, the polluter pays principle, and intergenerational sustainability. (Sholehuddin, 2021) However, the effectiveness of these regulations is still limited by weak law enforcement, overlapping regulations, and a lack of harmonization between national laws and international commitments. At the global level, many environmental legal instruments, such as the Paris Agreement and the Convention on Biological Diversity (CBD), rely on voluntary compliance by participating countries, resulting in inconsistent implementation. As a result, laws often serve only as symbols of moral commitment without strong coercive power to change environmentally damaging economic behavior or industrial policies. (Syahadat & Putra, 2022)

From an economic perspective, market instruments such as carbon trading, emission taxes, and renewable energy incentives are expected to be innovative solutions to internalize the external costs of environmental damage into the economic system. (Ramadhani & Djuyandi, 2022) The concepts of a green economy and low-carbon development are beginning to be adopted by many countries as strategies for achieving sustainability. However, in reality, these economic mechanisms are still dominated by developed countries with greater financial capacity, technology, and market access. Developing countries often

become mere recipients of policies without a balanced bargaining position. Furthermore, a purely economic approach tends to view nature as a tradable commodity, often neglecting the intrinsic value of ecosystems and biodiversity. (Wahyudi, 2022) This imbalance demonstrates that the economy cannot stand alone without the support of strong legal policies and a deep scientific understanding of the Earth's carrying capacity.

Meanwhile, environmental science plays a vital role in providing an empirical basis for decision-making and policy formulation. Numerous studies on climate change, land degradation, and marine ecosystems have provided a clear picture of the urgency of the ecological crisis facing humanity. (Purjayanto, 2022) However, these scientific findings are often not effectively integrated into the public policymaking process. Many strategic decisions are made based on short-term economic considerations or political interests, without considering scientific evidence regarding their long-term impacts on the environment. (Herman et al., 2023) The communication gap between scientists, policymakers, and economic actors renders environmental science powerless to influence the direction of development. (Ramadani & Muslimah, 2023) Thus, the three fields: law, economics, and environmental science—still operate independently, each with good intentions but without sufficient synergy to address the complexity of the global crisis.

This situation emphasizes the need for integration between law, economics, and environmental science as an interdisciplinary approach to global resource governance. The complexity of the environmental crisis cannot be resolved through a single discipline because it is systemic, multidimensional, and interconnected among ecological, social, and economic aspects. This integration enables the formation of evidence-based policies that rely not only on legal norms but also consider economic efficiency and scientific truth. Law can function as a regulator and guardian of environmental justice, economics provides incentives through fair market mechanisms, and environmental science ensures that every policy is based on data and empirical evidence. Therefore, this interdisciplinary integration is not merely an academic approach, but rather an urgent need to realize just, effective, and sustainable global governance.

The implementation of this integration aligns with the vision of the 2030 Agenda for Sustainable Development, launched by the United Nations, specifically Sustainable Development Goal (SDG) 13 on action on climate change and Goal 16 on strong, inclusive, and accountable institutions. In this context, the 2015 Paris Agreement became a significant milestone, committing countries to reduce greenhouse gas emissions through measurable and transparent national mechanisms. The principle of Common but Differentiated Responsibilities (CBDR) also emphasizes global fairness in the distribution of responsibilities, where developed countries are obligated to provide technological and financial support to developing countries. At the national level, Indonesia demonstrates its commitment through policies such as Law Number 32 of 2009 and Presidential Regulation Number 98 of 2021 concerning the Economic Value of Carbon, which serve as concrete instruments for integrating legal, economic, and environmental aspects. (Putra, 2021)

The integration of these three disciplines reflects efforts to build global solidarity in addressing transboundary ecological challenges. The transition to a green and low-carbon economy cannot be achieved without collective awareness and a just governance system. Environmental justice not only means protecting nature but also guaranteeing the rights of future generations to enjoy natural resources sustainably. Therefore, the synergy between law as a normative foundation, economics as a tool to drive sustainability incentives, and environmental science as a source of knowledge is the primary foundation for creating a just, collaborative, and planet-friendly global resource governance.

METHOD

This research employs a normative juridical method that focuses on the study of positive legal norms, legal principles, and doctrines relevant to equitable and sustainable global resource governance. The approach employed includes a statute approach, which examines various national and international legal instruments such as Law Number 32 of 2009 concerning Environmental Protection and Management, Presidential Regulation Number 98 of 2021 concerning the Economic Value of Carbon, as well as the 2015 Paris Agreement, the Convention on Biological Diversity (CBD), and the United Nations Framework Convention on Climate Change (UNFCCC). Furthermore, a conceptual approach is used to understand basic concepts such as environmental justice, sustainable development, the green economy, and the interdisciplinary integration of law, economics, and environmental science in global governance. The data sources used are secondary data consisting of primary legal materials (statutory regulations, international agreements), secondary legal materials (academic literature, scientific journals, previous research results), and tertiary legal materials (legal dictionaries, encyclopedias, and other supporting documents). Data collection techniques are carried out through library research by inventorying, reviewing, and interpreting various legal sources and relevant literature. Furthermore, data analysis techniques are carried out qualitatively normatively by interpreting legal provisions and theoretical concepts to produce systematic arguments regarding the importance of integrating law, economics, and environmental science in realizing equitable and sustainable global resource governance.

RESULTS AND DISCUSSION

Synergy of Law, Economics, and Environmental Science in Global Resource Governance

Law plays a crucial role as a normative framework in global resource governance, establishing principles, norms, and standards for environmental protection that serve as the basis for all human activity. Through legal instruments, nations around the world establish agreements to regulate the fair and sustainable use of natural resources. Basic principles such as the precautionary principle, the polluter pays principle, and intergenerational equity serve as the foundation for the formation of international environmental policies. A number of global legal instruments have been established to uphold these principles, such as the United Nations Framework Convention on Climate Change (UNFCCC), which serves as the basis for climate change control efforts; the 2015 Paris Agreement, which affirms the commitment to reducing greenhouse gas emissions; the Convention on Biological Diversity (CBD), which emphasizes the importance of biodiversity conservation; and the Basel Convention, which regulates the control of the movement of hazardous waste across national borders. At the national level, Indonesia has internalized these global principles and commitments through legal policies such as Law Number 32 of 2009 concerning Environmental Protection and Management, which emphasizes a preventive and participatory approach to environmental management, and Presidential Regulation Number 98 of 2021 concerning the Economic Value of Carbon, which serves as the legal umbrella for the implementation of carbon market mechanisms domestically. However, significant challenges remain in harmonizing and enforcing environmental laws across countries, primarily due to differences in institutional capacity, political interests, and weak sanctions against violations at the global level.

On the other hand, economic approaches make a significant contribution to supporting the achievement of environmental protection goals through incentive instruments and market regulations. Economic mechanisms such as carbon trading, emission taxes, and Payment for Ecosystem Services (PES) function to internalize the external costs of environmental damage into market prices, thus encouraging economic actors to adopt more environmentally friendly

practices. In this context, the economy plays a role not only as a means of production and consumption but also as a policy tool to direct market behavior toward sustainability. The green economy concept emphasizes economic transformation toward resource efficiency, renewable energy, and green job creation, while the circular economy encourages waste reduction through recycling and resource reuse. Environmentally oriented economic policies can strengthen the effectiveness of laws by providing financial incentives for companies and individuals committed to sustainability, as well as providing a source of financing for clean energy transitions and low-carbon technological innovation.

However, the implementation of a sustainable economic approach is not free from various structural challenges and global inequalities. Developed countries tend to have greater financial capacity, technology, and access to carbon markets, thus reaping greater economic benefits from global environmental policies. Conversely, developing countries often face limitations in capital, technology, and institutional capacity to participate equally in green financing mechanisms. This creates a gap between responsibility and capacity, which can ultimately hinder the effectiveness of equitable global governance. Furthermore, there is a risk that a market-oriented economic approach will commodify nature, converting ecological value into purely financial value without considering aspects of social and ecological justice.

Environmental science plays a fundamental role in providing an empirical basis for evidence-based decision-making and public policy formulation. Through scientific research, environmental science provides quantitative and qualitative data on ecosystem conditions, climate change patterns, land degradation, water quality, and biodiversity, which serve as a reference in determining the direction of development policies. Scientific models developed by scientists, such as global climate models or Integrated Assessment Models (IAMs), can predict the impacts of various policy scenarios on the environment and the economy. Thus, environmental science serves as an early warning system for potential ecological crises and forms the basis for setting emission targets, climate change adaptation, and sustainable natural resource management. This scientific approach ensures that all environmental policies are driven not only by short-term political or economic considerations, but also by measurable evidence and data on their impact on the sustainability of the global ecosystem.

International research institutions such as the Intergovernmental Panel on Climate Change (IPCC), the United Nations Environment Programme (UNEP), and the Food and Agriculture Organization (FAO) play a crucial role in generating global knowledge on environmental conditions and natural resources. The IPCC, for example, produces periodic assessment reports on climate change that serve as the primary reference for formulating international policies, such as the 2015 Paris Agreement. The UNEP plays a role in coordinating global efforts to address pollution, climate change, and environmental degradation through research and policy advocacy, while the FAO focuses on environmental aspects related to agriculture, food security, and natural resource management. This interagency collaboration creates a shared knowledge base that countries can use to formulate contextual and effective environmental policies. However, a key challenge lies in translating the results of this scientific research into concrete, implementable policies at various levels of government.

In this context, science communication serves as a crucial bridge between scientists, policymakers, and economic actors. Without effective communication, scientific findings are often difficult for decision-makers without a technical background to understand. Science communication serves to simplify complex scientific concepts into relevant, concise, and easily interpretable information for the benefit of public policy and sustainable investment. For example, research findings on renewable energy potential or the impact of deforestation on the carbon cycle can be transformed into practical recommendations for governments and

businesses. However, a significant communication gap remains between scientists and policymakers, often hindering the integration of science and the political process. Environmental policies are often made based on pragmatic considerations, while scientific evidence is ignored as a perceived impediment to short-term economic growth. It underscores the need to strengthen scientific communication capacity so that environmental science can truly serve as a foundation for sustainable development policies.

When environmental science stands alone without legal and economic support, its impact on global governance is limited. Therefore, the integration of law, economics, and environmental science is essential to address the increasingly complex challenges of the ecological crisis. Law provides legitimacy and guarantees fairness in natural resource management, ensuring compliance and accountability among actors, both at the local and global levels. Economics provides incentive mechanisms through carbon markets, green investments, and sustainable fiscal policies to encourage behavioral change toward sustainability. Meanwhile, environmental science provides data- and evidence-based direction that helps determine policy priorities and development targets. The synergy of these three disciplines is evident in the implementation of the Paris Agreement, which includes binding international legal commitments for participating countries, a carbon market mechanism as an economic instrument, and a scientific basis established by the IPCC to guide global emission reduction strategies.

This synergy requires multi-level and multi-stakeholder governance, involving the active roles of governments, the private sector, academia, and civil society. At the local level, environmental science can serve as a basis for local governments in developing ecosystem-based conservation and disaster mitigation policies. At the national level, legal and economic integration can strengthen policy instruments such as carbon taxes and green investment. At the global level, collaboration between countries is needed to harmonize regulations and transfer environmentally friendly technologies. This multi-level approach creates a governance network that is adaptive and responsive to global environmental dynamics. Through cross-sectoral participation and transparency of scientific data, global governance can be directed toward a balance between economic development and environmental conservation, thereby achieving ecological justice for all humanity.

However, efforts to strengthen this synergy are not free from various complex challenges. Sectoral egos between agencies, differing political and economic interests between countries, and resource disparities are major obstacles to building effective integration. Developed countries often have greater capacity in research, financing, and technology, while developing countries still struggle to meet basic needs while facing the most severe impacts of climate change. On the other hand, significant opportunities exist through the digitization of environmental data, which accelerates access to global information, strengthens climate diplomacy to align national interests, and increases institutional capacity to manage the transition to a green economy. By strengthening cross-disciplinary and cross-border collaboration, the world can build a more equitable, efficient, and sustainable global resource governance system that not only maintains ecological balance but also ensures the survival of future generations.

Implementation of the Principles of Justice and Sustainability in Global Governance

The concept of justice and sustainability in global governance is rooted in the view that every human being has an equal right to enjoy a clean, healthy, and productive environment without compromising the rights of future generations. Environmental justice emphasizes the fair distribution of benefits and burdens resulting from human activities on the environment, with vulnerable groups not being the most impacted by ecological degradation. This justice has three important dimensions: first, distributive justice, which

highlights the equitable distribution of environmental benefits and risks; second, procedural justice, which demands the active involvement of all parties in environmental decision-making; and third, restorative justice, which emphasizes the restoration of environmental conditions and communities affected by damage. Meanwhile, sustainable development comprises three main pillars: economic, social, and environmental, which must be implemented in a balanced manner. Economic development cannot be separated from social justice and environmental protection, as all three support each other in creating long-term prosperity. Therefore, global governance is required to maintain a balance between the right of every nation to develop and the collective obligation to preserve the planet. The principle of Common But Differentiated Responsibilities (CBDR) is one of the pillars of global justice in international environmental governance. This principle was born out of the 1992 Rio Declaration on Environment and Development and reinforced in the 2015 Paris Agreement. The CBDR recognizes that while all countries share the same responsibility to protect the environment, the capacity and historical contribution to ecological damage differ between developed and developing countries. Developed countries, which have enjoyed the benefits of industrialization for centuries, have a greater responsibility to provide financial, technological, and capacity support to developing countries. The implementation of this principle is evident in mechanisms such as the Green Climate Fund, which funds climate mitigation and adaptation projects in developing countries, as well as the transfer of clean energy technology. However, the implementation of the CBDR has faced criticism due to the weak commitment of developed countries to fulfill promised funding, as well as the unequal access of developing countries to green technology and resources. It indicates that global justice has not yet been fully realized, despite the existence of a legal framework.

At the national level, Indonesia is striving to internalize the principles of justice and sustainability through policies and legal instruments that align with global commitments. Law Number 32 of 2009 concerning Environmental Protection and Management affirms the right of every citizen to a good and healthy environment, while placing the state's responsibility in ensuring the sustainability of natural resources. Meanwhile, Presidential Regulation Number 98 of 2021 concerning the Economic Value of Carbon is a concrete step in regulating a national carbon trading mechanism oriented towards reducing emissions and transitioning to a green economy. Indonesia's commitment to the Nationally Determined Contribution (NDC) within the Paris Agreement framework affirms its determination to reduce carbon emissions by 31.89% independently and 43.2% with international support by 2030. Furthermore, recognition of the role of indigenous communities and public participation in environmental management demonstrates an effort to integrate the social dimension into national environmental policy. This approach not only strengthens ecological justice but also broadens the basis for public policy legitimacy.

The link between the 2030 Agenda for Sustainable Development and sustainable global governance is manifested through 17 Sustainable Development Goals (SDGs), which integrate legal, economic, and environmental aspects. Goal 13 emphasizes the importance of action on climate change, Goal 16 encourages strengthening inclusive and transparent institutions, and Goal 17 highlights the importance of a global partnership for sustainable development. The SDGs serve as a universal framework uniting countries in a moral and operational commitment to a more just and sustainable world. Sustainability indicators such as carbon emissions, biodiversity, and access to clean energy serve as important benchmarks for assessing the effectiveness of global governance. In this context, the successful implementation of the SDGs depends not only on national policies but also on consistent international collaboration in integrating science, law, and economic policy in a balanced manner.

The success of the transition to a green economy depends heavily on the level of collaboration and solidarity among countries. Countries must work together to provide climate finance, transfer clean technologies, and strengthen the capacity of developing countries to adapt to climate change. Climate diplomacy through forums such as the Conference of the Parties (COP), the G20, and ASEAN is an important means of building global solidarity to achieve common goals. However, challenges remain in the form of differing political interests, economic dependence on fossil fuels, and resistance to change in traditional industrial sectors. In this context, ecological justice must be prioritized over short-term economic interests. A just transition is a key concept to ensure that the shift to a low-carbon economy does not create new social inequalities.

Although global policy directions are increasingly favoring sustainability, significant challenges remain in implementing the principles of justice and sustainability. Economic disparities between developed and developing countries lead to disparities in climate mitigation and adaptation capacity. Weak enforcement of environmental laws in various countries and low commitment to global emissions targets also hamper effective governance. However, opportunities to strengthen synergies remain through clean technology innovation, the digitalization of environmental data, and increased global transparency and accountability. The principles of justice and sustainability must be interpreted not only as moral ideals but as the ethical and operational foundations for all global policies. By placing ecological justice at the heart of global resource governance, humanity can ensure that the Earth remains a suitable home for present and future generations.

CONCLUSION

The increasingly complex global environmental crisis emphasizes that natural resource governance can no longer be carried out sectorally but must be implemented through an integrative approach involving law, economics, and environmental science. Law serves as a normative framework that guarantees certainty, justice, and accountability; economics provides incentive instruments through carbon market mechanisms, green investment, and sustainable fiscal policies, while environmental science provides an empirical basis for evidence-based policymaking. All three form a mutually reinforcing synergy in realizing equitable and sustainable global resource governance. The implementation of principles of justice and sustainability, such as Common but Differentiated Responsibilities (CBDR) and the 2030 Agenda through the Sustainable Development Goals (SDGs), reflects a global commitment to balancing the right to development with the obligation to preserve the environment. Although various international legal instruments, such as the Paris Agreement, the Convention on Biological Diversity (CBD), and national policies such as Law No. 32 of 2009 and Presidential Regulation No. Despite the implementation of Law No. 98 of 2021, challenges persist, including weak regulatory harmonization, unequal responsibility between countries, and low effectiveness of environmental law enforcement. Therefore, cross-disciplinary integration and multilateral cooperation are key to strengthening inclusive and ecologically just global governance.

Going forward, strengthening global resource governance must focus on developing collaborative mechanisms capable of bridging the gap between legal policies, economic dynamics, and scientific findings. National governments need to strengthen institutional capacity in enforcing environmental laws and ensure public participation in decision-making. At the international level, developed countries must increase their commitments to climate finance and green technology transfer to support developing countries in the transition to a low-carbon economy. Meanwhile, academics and research institutions need to expand their role in providing scientific data that is easily accessible and understandable to policymakers and economic actors. Harmonization between law, economics, and environmental science

must be directed towards building multi-level and multi-stakeholder governance that is transparent, inclusive, and based on justice. Thus, the principles of justice and sustainability are not only normative discourse, but are truly realized in the practice of global resource management, to achieve human welfare and the sustainability of the earth in a balanced manner.

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