

	Science, Education and Innovations in the Context of Modern Problems Issue 9, Vol. 8, 2025
	TITLE OF THE RESEARCH ARTICLE  Carbon Trade in International Law between the Kyoto Protocol and the Paris Agreement: Toward a Coherent Global Legal Framework
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Issue web link	https://imcra-az.org/archive/383-science-education-and-innovations-in-the-context-of-modern-problems-issue-9-vol-8-2025.html
Keywords	Carbon trade – Kyoto Protocol – Paris Agreement – Climate justice – Carbon pricing.
Abstract This article analyses the legal evolution of carbon trading between the Kyoto Protocol (1997) and the Paris Agreement (2015) in light of the shift from binding obligations to a voluntary, cooperative approach. While Kyoto established flexible mechanisms such as the Clean Development Mechanism and international credit trading, the Paris Agreement focused on nationally determined contributions as the primary instrument of climate commitment. However, the absence of a unified international legal framework for carbon pricing, along with the multiplicity of regional systems, has led to fragmented carbon markets and weakened transparency and accountability. The study also highlights the disparity in climate burdens between industrialised and developing countries, which has limited the effectiveness of the "polluter pays" principle. The article concludes with an international agreement complementary to the Paris Accord, incorporating binding rules for carbon pricing, establishing a unified global registry for credit exchange under United Nations supervision, and strengthening the capacities of developing countries to achieve a fairer and more effective global carbon market.	
Citation. Menzer A; Draze S. (2025). Carbon Trade in International Law between the Kyoto Protocol and the Paris Agreement: Toward a Coherent Global Legal Framework. <i>Science, Education and Innovations in the Context of Modern Problems</i>, 8(9), 1303–1324. https://doi.org/10.56334/sei/8.9.107	
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Received: 02.03.2025	Accepted: 10.08.2025 Publishing time: 05.10.2025

Introduction

1303 – www.imcra-az.org, | Issue 9, Vol. 8, 2025

Carbon Trade in International Law between the Kyoto Protocol and the Paris Agreement: Toward a Coherent Global Legal Framework

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Carbon trading is one of the most innovative mechanisms developed through international efforts to address climate change. The Kyoto Protocol of 1997 represented the actual starting point for building a global market for the trading of emission rights within the framework of what became known as the Clean Development Mechanism and the flexible implementation of environmental obligations. However, the rapid evolution of climatic and economic conditions, together with the profound disparities between developed and developing countries, has revealed the limitations of this system in terms of environmental justice and its effectiveness in achieving tangible reductions in greenhouse gases, foremost carbon dioxide.

With the entry into force of the Paris Agreement in 2016, the international community reconsidered the philosophy of carbon trading from a more comprehensive and realistic perspective. The carbon market was no longer merely an economic tool for reducing emissions; it became a cornerstone of the “global climate balance” approach, which seeks to reconcile economic development with environmental commitments through new mechanisms, such as Article 6 of the Agreement, which redefined voluntary cooperation and the exchange of carbon credits among nations.

Nevertheless, this transformation, despite its ambition, raises complex legal and political challenges regarding the effectiveness of the international legislative framework governing carbon trade and its alignment with the principles of climate justice and common but differentiated responsibility. It also prompts questions about the need to develop existing international instruments and to introduce amendments that ensure clarity in market rules, transparency in accountability, and fairness in the distribution of burdens among states.

Hence, the central problem of this article arises: to what extent has the carbon trade mechanism between the requirements of the Kyoto Protocol and the provisions of the Paris Agreement succeeded in achieving a balance between the demands of development and the commitment to reducing greenhouse gases, and what legal reforms are necessary to enhance its effectiveness and fairness?

To address this problem, the study is divided into two main parts. The first examines the legal development of carbon trading between the Kyoto Protocol and the Paris Agreement, whereas the second analyses the reform of the international legal framework of carbon trade in light of the requirements of justice and effectiveness.

Section One: The Legal Evolution of Carbon Trading between the Kyoto Protocol and the Paris Agreement

The Kyoto Protocol (1997) represents the first international experience that established the concept of carbon trading as a legal and economic mechanism for reducing greenhouse gas emissions by integrating market-based instruments into the framework of climate obligations. However, despite its pioneering nature, this experience was characterised by limited implementation and an imbalance in the interests of developed and developing countries. With the entry into force of the Paris Agreement in 2015, the climate regime underwent a

fundamental transformation from the logic of strict obligations to the principle of voluntary cooperation among states through more flexible mechanisms, including nationally determined contributions and the exchange of carbon credits under Article 6 of the Agreement. This development holds particular significance in redefining the legal dimension of carbon pricing as a tool that combines economic regulation and shared environmental responsibility, thereby raising questions about the effectiveness of this shift in achieving global climate objectives.

First: The Normative Foundation of Carbon Trading under the Kyoto Protocol

The Kyoto Protocol constitutes the foundational framework for the legal regulation of carbon trading at the international level, as it established for the first time a legal system for emission trading on the basis of the principles of economic efficiency and shared responsibility. This Protocol marked the starting point for understanding how market mechanisms could be employed to fulfil climate obligations. Nevertheless, its limited scope and uneven implementation between industrialised and developing countries revealed the need for more comprehensive and equitable rules, an issue that the Paris Agreement later sought to address.

1. The Legal Nature of Developed States' Obligations under the Kyoto Protocol (Article 3)

The Kyoto Protocol of 1997¹ constituted a decisive turning point in the development of international environmental law. The international community transitioned from the stage of nonbinding general rules, as outlined in the 1992 United Nations Framework Convention on Climate Change, to a stage of clear legal obligations imposed upon the industrialised states listed in Annexe A of the Protocol. These obligations are codified and quantitatively defined and are imposed primarily on developed countries, the principal historical contributors to greenhouse gas emissions responsible for global warming.

Article 3 of the Kyoto Protocol provides that the parties included in Annexe A commit to reducing their overall emissions of greenhouse gases by at least 5 percent below 1990 levels during the first commitment period (2008–2012). This represents a legally binding obligation precisely defined in both scope and duration, fundamentally distinct from the voluntary commitments that had characterised earlier conventions. Accordingly, the obligations under Kyoto are, in legal terms, obligations of results, which do not merely express an intention but compel the state to achieve a specified level of emission reduction.²

¹ Signed on 16 March 1998 by 159 states, the Kyoto Protocol was set to enter into force 90 days after ratification by 55 countries, including developed states responsible for 55 per cent of total global carbon emissions. After the United States withdrew in March 2001, the Protocol's entry into force became dependent on ratification by 188 parties to the Climate Change Convention and 127 parties to the Protocol, representing 44.2 per cent of emissions. Negotiations with Russia on several conditions for ratification concluded in October 2004, and the Prot

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The legal nature of these obligations is also characterised by differentiation among states, in accordance with the principle of "common but differentiated responsibilities" outlined in Article 3, paragraph 1 of the United Nations Framework Convention on Climate Change and Article 10 of the Protocol. While developed countries are subject to strict quantitative obligations, developing countries are required only to engage voluntarily in emission–reduction cooperation. This differentiation has sparked scholarly debate over its compatibility with the principle of sovereign equality among states; however, the historical and economic justifications for such disparity remain valid.³

The binding nature of these obligations is further underscored by the compliance mechanisms established under Article 18 of the Protocol, which provide corrective measures against noncompliant states, including the suspension of their participation in three flexibility mechanisms: emissions trading, the Clean Development Mechanism, and joint implementation. This supervisory framework grants the obligations a quasijudicial character, as a noncompliant state is deemed to be in breach of a specific international environmental obligation.⁴

Accordingly, the legal nature of the obligations under the Kyoto Protocol consists of mandatory international commitments of a quantitative nature, exercised within a framework of international oversight and supported by flexible mechanisms. This made Kyoto a unique experiment in the evolution of international regulation of greenhouse gases, despite the limited practical outcomes that followed.

2. Three Flexibility Mechanisms: Legal Frameworks and Implementation Modalities

The flexibility mechanisms are supplementary instruments introduced in the Kyoto Protocol to facilitate the implementation of state obligations to reduce greenhouse gas emissions. Through these mechanisms, parties seek to achieve the Protocol's objectives in a flexible and efficient manner. These mechanisms include the following:

a. Emissions Trading System

The emissions trading system constitutes an effective mechanism for reducing greenhouse gas emissions and represents the core of the concept of carbon trading in an economic sense. It serves as an incentive for entities to undertake emission-reduction measures to avoid heavy fines for exceeding established emission limits. Furthermore, it enhances companies' environmental efficiency and increases their competitiveness in international markets.

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³ Alan Boyle and Catherine Redgwell, *International Law and the Environment* (Oxford: Oxford University Press, 2021), 14.

⁴ Daniel Bodansky, *The Art and Craft of International Environmental Law* (Cambridge, MA: Harvard University Press, 2010).

This system operates by issuing units known as allowances or certificates, each representing a specified quantity of permitted emissions. The primary objective of the emissions trading system is to encourage companies and industries to achieve these limits at the lowest possible cost by employing clean technologies, improving energy efficiency, or utilising renewable energy sources, among other available options. In doing so, the system helps achieve globally defined targets for reducing greenhouse gas emissions.

This compromise solution reached in Kyoto stemmed from the diverse positions of the State Parties to the Convention. Consequently, Article 17 of the Kyoto Protocol³ included only a limited number of fundamental rules concerning emissions trading, in addition to paragraphs 10 and 11 of Article 3 of the Protocol.⁶ These two latter paragraphs define the main features of the emissions trading system, stipulating that any emission reduction units or portions of an assigned amount acquired by one party from another shall be added to the assigned amount of the acquiring party and deducted from the assigned amount of the transferring party.

Notably, emissions trading is restricted to developed countries, which are permitted to purchase emission reduction units from one another. The purchase is made by the Party, whose emissions exceed its allowed emission limit, from the Party, whose emissions fall below its assigned quota. This system renders carbon trading an international contractual legal mechanism that combines the principles of public international law with the economic rules of the market.⁷

b. Clean development mechanism (CDM)

The Clean Development Mechanism is one of the most prominent flexibility mechanisms established under the Kyoto Protocol, pursuant to Article 12. It aims to enable the developed countries listed in Annexe I to fulfil part of their obligations to reduce greenhouse gases by financing projects in developing countries that contribute to sustainable development and achieve actual reductions in emissions.⁸ These projects include renewable energy, energy efficiency, waste management, and sustainable agriculture.

According to Article 12(3), the state or entity investing in such projects receives certified emission reductions (CERs), which are tradable in the international carbon market. This system allows developing countries to benefit from the transfer of clean technologies and the improvement of their environmental infrastructure while

³ Article 17 of the Kyoto Protocol provides that “a state may reduce emissions not subject to mandatory reduction and then sell a certificate of such reduction to another industrialised country to be used in meeting its commitments.” Ibid.

⁶ Article 3, paragraph 7 of the Kyoto Protocol stipulates that, during the first commitment period (2008–2012), the assigned amount for each Party listed in Annexe I shall be equivalent to the percentage inscribed for it in Annexe B, of its aggregate anthropogenic carbon dioxide equivalent emissions of the greenhouse gases listed in Annexe A in 1990, multiplied by five. Ibid.

⁷ Farhana Yamin and Joanna Depledge, *The International Climate Change Regime: A Guide to Rules, Institutions and Procedures* (Cambridge: Cambridge University Press, 2004), 227.

⁸ Christophe Böhringer and Lasten Völget, “Economic and Environmental Impacts of the Kyoto Protocol,” *Canadian Journal of Economics* 36, no. 2 (May 2003): 479.

enabling developed countries to meet their commitments at the lowest possible cost.⁹ The implementation of these projects is supervised by the CDM Executive Board, which ensures the verification of "environmental additionality" and approves projects in accordance with specific standards for validation, measurement, and transparency.

Despite the relative success of this mechanism in strengthening North–South cooperation, its practical application has revealed several legal and economic challenges. Most projects have been concentrated in emerging economies such as China, India, and Brazil, whereas African countries have remained weakly involved due to fragile institutional frameworks and limited financing. Moreover, the mechanism has faced criticism for inadequate environmental oversight of specific projects and for having been transformed into a purely investment-oriented tool rather than a means of achieving climate justice.

Nevertheless, the Clean Development Mechanism helped consolidate the concept of legal flexibility within climate obligations. This paved the way for the emergence of "carbon markets" as global economic and legal institutions. Therefore, evaluating this experience constitutes a fundamental step toward understanding the subsequent transformation introduced by the Paris Agreement of 2015, which sought to redesign this mechanism within a broader, fairer, and more transparent framework for managing emissions.

c. Joint Implementation Mechanism

The joint implementation mechanism is based on the concept of cooperation among different states to achieve emission-reduction objectives at the lowest possible cost by implementing projects that reduce emissions in other countries. It was established under Article 3 of the Kyoto Protocol and operates through the transfer of "emission reduction units resulting from projects," in accordance with the conditions specified in Article 6 of the Protocol. These units are generated in the host country and transferred to the states participating in joint implementation.

An important aspect of this mechanism lies in the determination of the conditions required for participation. These include, for example, ensuring that the project complies with the obligations of the participating states under the Protocol, is evaluated through reliable and transparent mechanisms, and aligns with the needs and objectives of the states engaged in joint implementation.¹⁰

⁹ Steven Guilmeaut and Jean-Guy Vaillancourt, "Les changements climatiques et le rôle des ONGs," in *D.D. et participation publique*, ed. Corinne Gendron and Jean-Guy Vaillancourt (Montréal: Presses de l'Université de Montréal, 2003), 157–171, at 163.

¹⁰ Sebastian Oberthür and Hermann E. Ott, *The Kyoto Protocol: International Climate Policy for the Twenty-First Century* (Berlin Heidelberg: Springer-Verlag, 1999), 151.

From a positive standpoint, this mechanism enables emission reductions at the lowest possible cost and strengthens international cooperation in combating climate change. It also promotes sustainable development in the host countries of the projects. On the negative side, however, it has been criticised for its reliance on emissions trading and for reducing the incentive for developed countries to achieve emission reductions within their own national boundaries.¹¹

A review of the evolution of the Joint Implementation Mechanism reveals that since its adoption in the Kyoto Protocol in 1997, views among contracting parties have differed regarding its effectiveness. Developing countries have expressed concern about the potential negative impact of this mechanism on international equity and sustainable development, as they perceive that industrialised nations continue to bear responsibility for excessive energy consumption and large-scale emissions. Nevertheless, the concept of joint implementation remains an important tool for addressing the challenges of climate change and achieving sustainable development, a notion reaffirmed later in the Paris Agreement of 2015.

The issues of verification, reporting, and institutionalisation of joint implementation remain among the most critical matters requiring further discussion and negotiation. These include determining appropriate standards and procedures to ensure the accurate and effective implementation of commitments, as well as preparing suitable reports to assess progress toward achieving the objectives of the Convention or the Protocol. Achieving consensus among contracting states on these sensitive issues requires continuous cooperation and dialogue.

Although these three mechanisms enhanced the effectiveness of the Kyoto Protocol by creating an international emissions market, practical implementation revealed legal and structural limitations. The absence of a mandatory compliance mechanism and the lack of transparency in specific projects deprived the system, in some cases, of its environmental substance. Moreover, the United States's withdrawal from the Protocol in 2001 reduced demand in the carbon market, thereby affecting the price of emission units.

3. Legal Shortcomings of the Kyoto Protocol in Regulating Developing Countries' Emissions and the Limited Effectiveness of Market Mechanisms

Although the Kyoto Protocol represented a qualitative leap in international environmental law by establishing contractual mechanisms to reduce greenhouse gas emissions, its legal structure contained fundamental imbalances that adversely affected the effectiveness of the global carbon market. The Protocol relied on the principle of "common but differentiated responsibilities," as outlined in Article 3 of the United Nations Framework Convention on Climate Change (UNFCCC), which granted developing countries an almost

¹¹ Mohamed Adel Askar, *Le droit international de l'environnement: Changement climatique - défis et confrontation* (Analytical and comparative study of the UNFCCC and the Kyoto Protocol), previously cited, 365.

complete exemption from quantitative emission-reduction obligations on the basis of their limited historical contribution to global warming.

However, this legal exemption, originally intended to be temporary and proportionate to developmental capacities, has in practice widened the environmental responsibility gap between the Global North and the Global South, creating a stark disparity in climate burdens.¹² Moreover, the Protocol failed to establish any binding monitoring mechanisms or an effective system of sanctions applicable to developing countries, thereby weakening their voluntary adherence to emission-reduction programmes and rendering most climate efforts dependent on political will rather than on legally binding commitments.

On the other hand, the three market mechanisms established under the Protocol suffered from structural deficiencies that undermined their economic and environmental effectiveness. They focused primarily on transferring obligations from developed countries to low-cost projects in the Global South without addressing the root causes of domestic emissions in the North.¹³ Moreover, the voluntary nature of the Clean Development Mechanism encouraged speculative practices in the carbon credit market and created an unequal system dominated by multinational corporations.

In addition, the Protocol lacked a transparent monitoring and verification system applicable to developing countries, which led to a steady increase in their emissions since 2005, surpassing, by 2015, the emissions of some industrialised nations themselves.¹⁴ Hence, excluding developing countries from measurable, verifiable legal commitments was among the key factors limiting the Kyoto Protocol's actual effectiveness in achieving its principal objective: reducing the global temperature rise to within 2 degrees Celsius.

Second: From Binding Obligations to Voluntary Cooperation—The Legal Transformation of the Paris Agreement

The conclusion of the Paris Agreement posed a significant challenge for the parties to the Framework Convention on Climate Change. Negotiations for the Agreement took years of intensive dialogue and multilateral discussions aimed at achieving a global consensus that accommodates the varying needs and demands of states at different levels of development while balancing environmental preservation with sustainable development.

¹² Patricia Galvão Ferreira, "Differentiation in International Environmental Law: Has Pragmatism Displaced Considerations of Justice?" in *Global Environmental Change and Innovation in International Law* (Cambridge: Cambridge University Press, 2018), 32.

¹³ Michael Grubb, Christiaan Vrolijk, and Duncan Brack, *The Kyoto Protocol: A Guide and Assessment* (London: Taylor & Francis, 1999), 210.

¹⁴ International Energy Agency (IEA), *CO₂ Emissions from Fuel Combustion* (Paris: IEA, 2016), 45.

The Paris Agreement of 2015 represents a fundamental turning point in the evolution of the international legal regime for combating climate change. It marked a shift from the logic of strict, top-down obligations characteristic of the Kyoto Protocol to a more flexible and cooperative approach grounded in national will. This transformation was not merely technical but also amounted to a redefinition of climate responsibility in accordance with the principles of justice and voluntary participation. This change is most clearly reflected in Article 6 of the Agreement, which established a new legal foundation for carbon trading within a framework of transparency and multilevel cooperation.

1. An Analytical Reading of Article 6 of the Paris Agreement as a New Legal Basis for Carbon Trading

Article 6 of the Paris Agreement of 2015 is among the most complex and significant provisions of the accord, as it establishes a new legal framework that restructures the concept of carbon trading within an international framework grounded in voluntary cooperation among parties. This article addresses the limitations of the flexibility mechanisms established under the Kyoto Protocol by creating new legal instruments to increase environmental efficiency and establish a transparent global carbon market that accounts for disparities in national capacity.

Article 6(1) of the Agreement provides that parties “recognise that some parties choose to pursue voluntary cooperative approaches” when implementing their nationally determined contributions (NDCs). This enshrines the principle of legal flexibility without undermining each state’s national responsibility for its emissions. Furthermore, Articles 6(2) and 6(3) establish a legal mechanism for trading internationally transferred mitigation outcomes (ITMOs), subject to a unified accounting framework designed to avoid the double counting of reductions, thereby distinguishing it from the “emissions trading” system that prevailed under Kyoto.

Paragraph 6(4) introduces a new mechanism, the sustainable development mechanism (SDM), intended to encourage emission-reduction projects in developing countries while ensuring sustainable development and technology transfer. This represents a more advanced continuation of the Clean Development Mechanism established by the Kyoto Protocol. However, paragraph 6(5) emphasises that such projects must be additional and possess high environmental integrity, meaning that they must contribute effectively to global emission reductions rather than merely redistribute them.¹⁵

According to Bodansky, Article 6 embodies a fundamental shift from the logic of “state obligations” to that of “interstate cooperation,” reflecting a new legal philosophy based on flexibility, shared accountability, and the integration of legal and market instruments.¹⁶ Moreover, the relatively ambiguous drafting of the article was

¹⁵ United Nations, *Paris Agreement* (New York: United Nations, 2015), art. [specific article].

¹⁶ Daniel Bodansky, “The Legal Character of the Paris Agreement,” *Review of European, Comparative & International Environmental Law* 25, no. 2 (2016): 149.

intended to facilitate broader state participation in voluntary exchange mechanisms without imposing rigid legal constraints.¹⁷

In applying this framework, several countries, including the United Kingdom, Canada, and South Korea, have begun adapting their national systems to comply with Article 6 requirements by introducing domestic carbon-pricing instruments that can be linked to international markets. This approach represents a practical step toward establishing a flexible global carbon-trading system on the basis of mutual recognition of climate credits and the harmonisation of international accounting standards.

In light of these findings, it may be concluded that Article 6 of the Paris Agreement not only redefined the legal framework of carbon trading but also rearticulated the relationship between the right to development and the duty of climate protection. It did so through a participatory approach that transcends traditional, unilateral obligations in favour of a multilateral climate governance model integrating legal rules with market instruments to achieve the Agreement's central objective, limiting global warming to below two degrees Celsius.

1. Nationally Determined Contributions (NDCs) and the Redefinition of Climate Responsibility among States

Nationally determined contributions constitute one of the most significant legal innovations introduced by the Paris Agreement of 2015. They marked a paradigm shift in the system of climate obligations from the quantitative, uniform commitments established under the Kyoto Protocol to a model of nationally programmed voluntary pledges. Pursuant to Article 4 of the Agreement, each Party undertakes to "prepare, communicate and maintain successive nationally determined contributions" and to "pursue domestic mitigation measures" aimed at achieving them, with periodic reviews every five years to increase ambition.¹⁸

This transformation embodies a new legal logic that acknowledges differentiated capacities and responsibilities while situating them within a framework of international accountability and transparency. In other words, the paradigm has shifted from "externally imposed obligations" to "self-determined commitments," granting states greater regulatory sovereignty in selecting their instruments while simultaneously subjecting them to regular disclosure and accountability before the international community.¹⁹

From a legal standpoint, NDCs do not constitute obligations of result, as under the Kyoto Protocol; instead, they are obligations of conduct and endeavour. In other words, a state is not held accountable for achieving a specific quantitative reduction but for exerting its maximum possible effort to attain its nationally defined

¹⁷ Christina Voigt and Felipe Ferreira, "Dynamic Differentiation: The Principles of CBDR-RC, Progression and Highest Possible Ambition in the Paris Agreement," *Transnational Environmental Law* 5, no. 2 (2016): 54.

¹⁸ United Nations, *Paris Agreement* (New York: United Nations, 2015), arts. 4 and 13.

¹⁹ Lavanya Rajamani, "Ambition and Differentiation in the 2015 Paris Agreement: Interpretative Possibilities and Underlying Politics," *International and Comparative Law Quarterly* 65, no. 2 (2016): 347.

objectives. Daniel Bodansky noted that this development reflects the international community's desire to adopt a more flexible and inclusive system capable of encompassing all parties without reproducing the division between "Annexe B" and "developing" countries that characterised the Kyoto regime.²⁰

However, this legal flexibility has raised several issues concerning the verifiability and comparability of national contributions, particularly in the absence of standardised criteria for establishing baselines or measuring methodologies. This could lead to significant disparities in climate efforts among states. For this reason, the transparency framework established under Article 13 was introduced to complement the NDC system by imposing an obligation to submit harmonised national reports subject to an international technical review mechanism.

In practice, there has been a clear divergence in the implementation of Nationally Determined Contributions:

- Compared with 1990 levels, the European Union has committed to reducing its emissions by 55 percent by 2030, a target enshrined in binding domestic legislation.²¹
- India and Brazil, by contrast, have adopted flexible targets based on improving carbon intensity relative to GDP rather than setting an absolute emissions cap.
- The United States, after its withdrawal from the Agreement in 2017 and its re-entry in 2021, set its renewed contribution at a reduction of 50–52 percent by 2030.²²

Notably, the voluntary legal character of these contributions has not prevented a positive competitive dynamic among states in terms of increasing their climate ambitions. This has been described as a form of "soft obligation producing hard results," as it relies more on international political and moral pressure than on traditional legal sanctions.

Overall, the NDCs have redrawn the boundaries of climate responsibility among states. Responsibility is no longer measured solely by the status of the "historical polluter," as under Kyoto does, but rather by each country's level of contribution to the collective objective of the Paris Agreement. Thus, climate responsibility has evolved from a fixed, centralised concept to a relative, dynamic concept that is renewed with each review cycle.

4. Assessing the Shift from a System of Binding Obligations to a Cooperative Approach and Its Effects on Carbon Market Transparency

²⁰ Daniel Bodansky, *The Art and Craft of International Environmental Law* (Oxford: Oxford University Press, 2017), 293.

²¹ European Union, *Regulation (EU) 2021/1119 – European Climate Law* (Brussels: European Union, 2021), art. 2.

²² United States, *Nationally Determined Contribution under the Paris Agreement* (Washington, DC, 2021).

The Paris Agreement of 2015 represents one of the most significant turning points in the development of international climate law. It marked a transition from the system of binding legal obligations enshrined in the Kyoto Protocol of 1997 to a flexible, cooperative approach centred on nationally determined contributions. This transformation was not merely a modification of implementation mechanisms; it fundamentally affected the legal philosophy underpinning climate commitments. Compliance was no longer imposed from the top down but stemmed from the sovereign will of states, in line with their national capacities and developmental priorities.²³

This shift expanded the scope of international participation in climate efforts, as the Kyoto system had been limited to the developed countries listed in Annex A. However, the voluntary nature of the contributions made it challenging to regulate the level of climate ambition or impose stringent accountability mechanisms, thereby affecting the transparency of carbon markets. In the absence of a sanctioning system or an international supervisory body, the verification of emission reductions depends on national monitoring mechanisms and voluntary reports submitted by states.²⁴

Although the Paris Agreement, in Article 13, established an enhanced transparency framework designed to harmonise reporting and review procedures, practical implementation revealed wide disparities in data quality and accounting methodologies among states. This increased the risk of double-counting or inflating carbon-reduction figures to improve international standing. Moreover, the voluntary nature of contributions weakens adherence to long-term commitments, causing the carbon market to lack the stability and legal confidence necessary to attract sustainable green investment.²⁵

Nevertheless, it must be acknowledged that the Agreement strengthened the logic of international cooperation by allowing voluntary mechanisms for exchanging mitigation outcomes and implementing joint projects between states under Article 6. This may gradually help build a more flexible and interactive system grounded in mutual transparency. However, the success of this approach remains contingent on states' ability to harmonise measurement, reporting, and verification (MRV) standards and establish clear legal rules governing the exchange of carbon credits, ensuring both nonduplication and environmental integrity.²⁶

In conclusion, the analysis demonstrates that the transition from the system of binding obligations under the Kyoto Protocol to the cooperative approach of the Paris Agreement was not merely a technical development in the tools used to combat climate change; rather, it constituted a structural transformation in international

²³ United Nations Framework Convention on Climate Change (UNFCCC), *Paris Agreement*, adopted at the 21st Conference of the Parties (COP21), Paris, 12 December 2015, art. 4.

²⁴ Daniel Bodansky, "The Legal Character of the Paris Agreement," *Review of European, Comparative & International Environmental Law* 25, no. 2 (2016): 142-150.

²⁵ Lavanya Rajamani and Jacob Werksman, "The Legal Character and Operational Relevance of the Paris Agreement's Temperature Goal," *Philosophical Transactions of the Royal Society A* (2016): 4.

²⁶ Lambert Schneider et al., "Double Counting and the Paris Agreement Rulebook," *Nature Climate Change* 9 (2019): 182.

environmental legal thought. Whereas Kyoto established the logic of “obligation in exchange for emission” in accordance with the *polluter-pays* principle, the Paris Agreement reflected a shift toward the principle of differentiated common responsibility, leaving broader space for national policy discretion. This granted greater flexibility in participation but, conversely, weakened the binding and supervisory character of the carbon market regime.

Both experiences revealed a profound paradox: the greater the flexibility and participation are, the weaker the capacity for enforcement and accountability, and vice versa. Thus, achieving a precise balance between voluntary participation and the necessity of legal enforceability remains the greatest challenge to the evolution of international carbon governance. This, in turn, paves the way for examining the second section of this study, which addresses the challenges and prospects of establishing a unified global carbon market, as well as the legal and institutional reforms required to ensure transparency and coherence between regional and national systems.

Section Two: Reforming the International Legal Framework for Carbon Trading between the Requirements of Justice and Effectiveness

The pursuit of a unified global carbon market transcending the limits of regional systems and bilateral agreements constitutes one of the most significant legal challenges in the post-Paris era. The current diversity of carbon pricing mechanisms, ranging from national emission trading systems to carbon tax regimes, has generated substantial discrepancies in standards and in the mutual recognition of credit. This fragmentation has weakened market efficiency and raised issues of transparency and double-counting. The absence of a coherent international legal framework governing measurement, reporting, and verification (MRV) and preventing double counting renders international coordination both a legal necessity and an economic necessity. Accordingly, this study seeks to outline the contours of a proposed legal framework for an integrated global carbon market by analysing its institutional foundations and identifying the requirements of environmental governance that can guarantee both distributive justice and effective compliance under the emerging global climate regime.

First: Legal and Institutional Challenges to the Effectiveness of Carbon Market Mechanisms

Global carbon markets have faced profound challenges that go beyond technical considerations to touch upon the very core of their legal and institutional architecture. The fragmentation of national and regional carbon-pricing systems, coupled with the absence of a unified international legal framework, has made achieving integration and transparency a structural challenge, threatening the effectiveness of these mechanisms. Furthermore, the weakness of international verification and monitoring systems (MRVs), together with the lack of adequate legal safeguards for transactional transparency, has created regulatory loopholes that are exploited to inflate or double-count credits. In addition, the imbalance in the distribution of climate burdens between the

industrial North and the developing South undermines the principle of climate justice and deprives the *polluter-pays* rule of its practical substance.

1. Fragmentation of National and Regional Carbon-Pricing Systems and the Absence of a Unified International Legal Framework

The absence of a coherent international legal framework for carbon pricing represents one of the principal obstacles limiting the effectiveness of market mechanisms in combating climate change. This fragmentation has resulted in a mosaic of heterogeneous systems, varying in standards and mechanisms, ranging from emission-trading schemes (ETSs), such as the European Union, to carbon-tax regimes adopted in certain Scandinavian countries and Canada to hybrid models in regions such as China and South Korea. While this diversity reflects the flexibility of national policy approaches, it has also led to substantial price disparities among markets, resulting in uneven competitiveness and difficulties in linking different pricing systems.²⁷

For example, the price of one tonne of carbon ranges from less than €5 to more than € 20 in some developing economies and in the European Union Emissions Trading System (EU ETS). This disparity reflects the absence of internationally coordinated rules that could ensure economic fairness and equal opportunity among states³⁵. Moreover, the lack of an international regulatory authority responsible for harmonising measurement, reporting, and verification (MRV) standards has made it difficult to guarantee the credibility of carbon-reduction claims, as each country or regional bloc relies on its own internal mechanisms for estimating emissions and determining prices.²⁸

Previous climate negotiations, particularly those conducted within the framework of the Conferences of the Parties (COPs), have failed to establish a “global carbon market” governed by a unified legal framework owing to conflicting interests between industrialised countries seeking to protect their economic competitiveness and developing nations fearing that strict carbon pricing might hinder their economic growth. Furthermore, although the Paris Agreement recognises the diversity of national approaches, it does not introduce a binding mechanism to coordinate prices or standardise benchmarks; instead, it limits itself to encouraging voluntary cooperation under Article 6.²⁹

Accordingly, the fragmentation of legal systems governing carbon pricing represents not only a technical or administrative challenge but also an institutional problem that strikes at the very core of international climate

²⁷ World Bank, *State and Trends of Carbon Pricing 2023* (Washington, DC: World Bank, 2023).

²⁸ Ariane de Dominicis, “Les fonds d’investissement dans les actifs CO₂: état des lieux,” *Revue d’économie financière* 8 (2006): 47.

²⁹ Mostafa Hashem et al., *Negotiations of Arab States under the United Nations Framework Convention on Climate Change* (Amman: Friedrich Ebert Foundation, May 2022), 22.

governance. This limits the possibility of establishing a coherent, transparent global market capable of simultaneously achieving both climate and economic justice.

2. Limitations of International Monitoring, Reporting, and Verification (MRV) Mechanisms and the Weakness of Legal Safeguards for Transparency

The system of measurement, reporting, and verification (MRV) serves as the reference mechanism for ensuring the credibility of the carbon-trading regime, as it is the technical and legal tool enabling the monitoring of states' compliance with their climate commitments and the assessment of the authenticity of exchanged emission credits. Although the Paris Agreement, in Article 13, established the "enhanced transparency framework," its practical implementation has revealed substantial institutional fragility and insufficient legal safeguards. This is primarily due to the lack of unified standards for measurement and reporting methodologies, as well as to each country's reliance on its own national mechanisms, in the absence of an international oversight body with executive authority.³⁰

This situation has resulted in significant disparities in the quality of published climate data, leading to difficulties in verifying the validity of traded carbon credits and increasing the likelihood of double counting of emission reductions, a practice incompatible with the environmental integrity requirement affirmed in paragraph 2 of Article 6 of the Paris Agreement³⁹. Moreover, the lack of a clear legal obligation to subject national reports to independent review mechanisms has undermined the effectiveness of international transparency, as states remain free to determine their own accounting methodologies and data sources.³¹

In light of the above, it becomes evident that the shortcomings of MRV mechanisms, from a legal perspective, are not confined to technical deficiencies but extend to the absence of a binding norm in international climate law requiring parties to submit accurate and verifiable data. The current system relies on voluntary participation and political accountability rather than judicial enforceability, making it difficult to operationalise the principle of "mutual trust" as the foundation for the exchange of carbon credits.

Additionally, the lack of coordination among United Nations bodies dealing with climate matters, such as the CDM Executive Board and the Subsidiary Body for Implementation, has led to overlaps in their functions and delays in approving standard measurement methodologies. Achieving genuine transparency in carbon markets, therefore, necessitates legal reform that goes beyond mere technical reporting. It requires establishing an independent international authority responsible for verification and oversight, vested with the legal powers of

³⁰ UNFCCC, *Modalities, Procedures and Guidelines for the Transparency Framework for Action and Support*, FCCC/PA/CMA/2018/3/Add.2 (Bonn: UNFCCC, 2018), 18.

³¹ Secretariat of the United Nations Framework Convention on Climate Change, *Technical Paper Submitted by the Adaptation Committee*, accessed 19 October 2024, 10:00 a.m., https://unfccc.int/sites/default/files/resource/ME_TP_Final_ForDesign_1309%20-%20Arabic_2023.pdf

review and accountability, akin to international financial regulatory bodies. Such a reform would enhance confidence among states and ensure the credibility of global climate markets.

3. The Imbalance in the Distribution of Climate Burdens between Industrialised and Developing Countries and the Understanding of the “Polluter-Pays” Principle

The *polluter-pays* principle is one of the fundamental pillars of international environmental law, assigning responsibility for the costs arising from environmental harm – whether financial, technical, or regulatory – to the entity causing the pollution. However, the practical application of this principle within the framework of climate justice has revealed a structural paradox between the legal obligations imposed on industrialised nations and those borne by developing countries. This has produced a clear imbalance in the distribution of climate burdens and weakened the effectiveness of carbon market mechanisms as instruments for achieving environmental justice.³²

Historically, developed countries have been the primary sources of greenhouse gas emissions since the Industrial Revolution. However, they continue to maintain high emission margins within their economic policies. Moreover, developing countries, whose contribution to global pollution remains relatively limited, are compelled to shoulder the same compliance burdens and climate standards without adequate financial or technological support. This situation has undermined the core of the principle of "common but differentiated responsibilities," enshrined in Article 3 of the United Nations Framework Convention on Climate Change. It has widened the trust gap between the Global North and the Global South.³³

In the context of carbon market mechanisms, this imbalance manifests itself in disparities in access to green finance and clean technology. Multinational corporations based in North dominate the largest share of certified carbon credits, whereas developing countries face regulatory and technical barriers that hinder their effective participation. Moreover, insufficient climate compensation and the absence of equitable carbon pricing further exacerbate this inequity, as developing economies bear the costs of the energy transition without enjoying the corresponding benefits implied by the *polluter-pays* principle.³⁴

From a legal standpoint, the current structure of the global climate regime continues to lean towards an economic rather than a justice-oriented approach. Carbon is treated as a tradable commodity, with little regard for the historical imbalance in environmental responsibility. Consequently, the *polluter-pays* principle is stripped of its moral and legal substance, which is reduced to a purely economic mechanism that enables

³² Organisation for Economic Cooperation and Development (OECD), *The Polluter-Pays Principle* (Paris: OECD Publishing, 2012), 18.

³³ United Nations, *United Nations Framework Convention on Climate Change* (New York: United Nations, 1992).

³⁴ Lambert Schneider and Sonja La Hoz Theuer, “Environmental Integrity of International Carbon Market Mechanisms under the Paris Agreement,” *Climate Policy* 19, no. 3 (2019): 386–400, at 391.

wealthy nations to purchase carbon credits to offset their emissions without undertaking substantive changes to their production patterns.

Restoring the true meaning of this principle requires a fundamental reform of the international legal framework, one that redefines climate obligations in light of historical justice and economic capacity while simultaneously strengthening mechanisms for climate finance and technology transfer. Only through such reform can equilibrium be restored to the carbon-pricing system, making the market an effective instrument for achieving climate justice grounded in responsibility and equity rather than in economic bargaining.

Second: Toward a Coherent International Legal Framework for the Regulation of Carbon Trading

The transition toward a coherent international legal framework governing carbon trading constitutes a decisive step in the evolution of global climate governance. Previous studies have demonstrated the limitations of a system on the basis of voluntary understanding and the lack of harmonisation among market mechanisms. The challenge now lies not only in reducing emissions but also in regulating such reductions under unified rules that ensure transparency, credibility, and equality of obligations. Consequently, there is a pressing need to develop new legal instruments that complement the Paris Agreement, frame carbon pricing and trading processes, and establish a fair global monitoring system that takes into account the specific circumstances of developing countries while ensuring an equitable distribution of climate burdens.

1. Towards an International Agreement Complementary to the Paris Accord

One of the most prominent proposals to have emerged in recent years in international discussions on climate governance is the adoption of an international agreement complementary to the Paris Accord, aimed at regulating carbon pricing and carbon credit exchanges. Despite the relative success of the Paris Agreement (2015) in broadening the base of climate commitments, it still lacks a unified legal framework capable of accurately regulating carbon pricing and the mechanisms of credit exchange between states and economic actors.

The voluntary nature of nationally determined contributions (NDCs) and the absence of a binding system for carbon pricing have rendered carbon markets inherently unequal, characterised by varying prices and mechanisms across regions. This situation undermines the principle of climate justice and weakens the overall effectiveness of international efforts to curb greenhouse gas emissions.³⁵

³⁵ World Trade Organisation (WTO), *World Trade Report 2022* (Geneva: WTO, 2022), 85–86, https://www.wto.org/english/res_e/booksp_e/wtr22_e/wtr22_ch4_e.pdf

The need for an agreement complementary to the Paris Accord arises from the current system's inability to ensure legislative coherence among the various national and regional carbon-pricing mechanisms, such as the European Union Emissions Trading System (EU ETS) and the Canadian, Chinese, and United States (California Cap-and-Trade) schemes. Each of these systems operates according to distinct approaches to establishing carbon caps, auction methods, and verification procedures, without any international legal reference points to coordinate their functioning or guarantee the mutual recognition of exchanged carbon credits.³⁶

Accordingly, a new binding international agreement has been proposed to establish unified global standards for carbon pricing, define progressive emission ceilings, and establish a dedicated dispute-resolution mechanism for carbon trading under the supervision of an independent United Nations authority.

Such an agreement would help bridge the legal gap between states' commitments and the practical realities of implementation. It could incorporate mandatory international rules on accountability and transparency (MRV) and oblige states to adopt national mechanisms consistent with international reporting standards. Moreover, it would extend the scope of climate justice by integrating the *polluter-pays* principle more effectively through the adoption of harmonised minimum carbon prices to prevent developing countries from becoming "carbon havens" due to legislative disparities.³⁷

On the basis of the preceding analysis, the conclusion of an international agreement complementary to the Paris Accord constitutes both a legal and strategic necessity for unifying the regulatory framework of the global carbon market. However, the success of such an endeavour depends on the adoption of a gradual and consensual approach that takes into account the differing economic and technological capacities of states. Hence, the proposed Agreement would not merely serve as a formal extension of the Paris Accord but rather as a decisive step toward the establishment of a global legal order for carbon trading, one characterised by transparency, equity, and integration that links climate objectives with the imperatives of sustainable development.

2. Establishing a Unified Global Registry for Carbon Transactions Under the Supervision of an Independent United Nations Authority

Establishing a unified global registry to track carbon transactions is a pivotal step toward transparency and consistency in the management of the international carbon market. Previous experiences, whether under the Kyoto Protocol or within regional frameworks such as the European Union Emissions Trading System (EU ETS), have demonstrated that the absence of a centralised database has led to the doubling of credits and discrepancies between national emission records, thereby undermining legal confidence in carbon markets⁴⁷.

³⁶ World Bank, *State and Trends of Carbon Pricing 2023* (Washington, DC: World Bank, 2023), 57.

³⁷ Michael A. Mehling, Gilbert E. Metcalf, and Robert N. Stavins, "Linking Climate Policies to Advance Global Mitigation," *Science* 356, no. 6339 (2017): 997.

Creating an international registry under the supervision of an independent United Nations authority would ensure the standardisation of registration procedures, the verification of issued credits, and the prevention of fraud or manipulation in carbon-accounting records. Such a registry should be designed in accordance with rigorous technological and security standards, enabling linkages between national and regional databases within a secure digital network based on blockchain technology to guarantee transparency and real-time traceability of all transactions.

This unified system would enhance the legal reliability of carbon transactions, making them eligible for cross-border trading without infringing on each state's sovereign oversight rights. This would pave the way for the establishment of an integrated global carbon market and strengthen the capacity of UN bodies to monitor state compliance with climate commitments pursuant to Article 13 of the Paris Agreement on enhanced transparency.

3. Strengthening Legal and Institutional Support Mechanisms for Developing Countries to Ensure Equitable Participation in Carbon Markets

Enhancing the legal and institutional support mechanisms available to developing countries is a fundamental step toward ensuring fair and balanced participation in carbon markets. Past studies have shown that these countries have often encountered technical and legislative challenges in effectively accessing international market mechanisms because of limited human and institutional capacity and insufficient climate financing. The absence of appropriate legal frameworks and the lack of measurement, reporting, and verification (MRV) infrastructure have forced many of them to rely heavily on external assistance, thereby reducing their autonomy in making climate-related decisions⁴⁸.

In this context, there is a pressing need to establish a United Nations mechanism for legal and technical support that would complement the Green Climate Fund (GCF). This body would assist in drafting national legislation and in training experts in carbon governance, environmental litigation, and climate-impact assessment for projects. Furthermore, developing South-South partnership programs to exchange expertise in managing local and regional carbon markets, thereby fostering sustainable capacity building in developing nations, is proposed.

Empowering developing countries with practical legal and institutional tools is not merely a matter of climate equity but also a structural prerequisite for the success of the global carbon-pricing system. The absence of institutional fairness leads to imbalances in the environmental credibility of the market and perpetuates the divide between the Global North and the Global South. Hence, integrating this dimension into future agreements is essential for achieving equitable and inclusive climate governance.

Conclusion

An analysis of the evolution of carbon trading from the Kyoto Protocol to the Paris Agreement reveals that the international community has shifted from a system of strict legal obligations to a flexible, cooperative approach based on voluntary national contributions. This transformation expanded the scope of participation but simultaneously weakened enforcement and transparency mechanisms. Experience has further shown that the fragmentation of national and regional carbon-pricing systems and the absence of a unified global registry have generated structural deficiencies in the credibility of carbon markets, resulting in limited legal and investment confidence.

On the basis of these findings, the study proposes several pathways to strengthen the global legal framework, notably:

1. The conclusion of an international agreement complements the Paris Accord, incorporating unified and binding rules for carbon pricing and credit exchange.
2. The establishment of a global carbon registry under the supervision of an independent United Nations authority to ensure transparency and prevent double-counting of reductions.
3. The activation of legal and institutional support mechanisms for developing countries to promote climate justice and equitable participation in carbon markets.
4. Harmonise measurement, reporting, and verification (MRV) standards to establish a transparent foundation for international trust.

Accordingly, the construction of a fair and coherent global carbon market requires a transition from voluntary governance to a comprehensive international legal system that balances the imperatives of climate justice with economic efficiency and ensures the long-term sustainability of global efforts to combat climate change.

Ethical Considerations

Only publicly available comments were analysed. Usernames and identifiable information were not recorded. The study followed digital ethics guidelines to protect individuals from harm and ensure data confidentiality.

Acknowledgement

The researcher extends gratitude to Faculty of Law and Political Science, University of Algiers and University of batna 1 for academic support and guidance.

Funding. This research received no external funding.

Conflict of Interest. The author declares no conflict of interest.

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