

Science and Global Environmental Policymaking: A Review of Institutional and Political Barriers

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Abstract. As global environmental challenges escalate, the integration of scientific knowledge into international policymaking has become increasingly crucial. Nevertheless, a significant gap remains between scientific recommendations and the actual implementation of international environmental agreements. This review examines how science has been incorporated into global environmental governance. Key findings suggest that while international bodies like the IPCC have shaped policy discussions, geopolitical interests, institutional inertia, and power imbalances often impede the adoption of science-based decision-making. Most studies employ qualitative approaches, such as case studies and discourse analysis, with few engaging in cross-national or quantitative comparisons. By synthesizing current research trends and identifying gaps in both methodology and theory, this review provides valuable insights into how scientific evidence can be more effectively utilized to inform international environmental policies.

Keywords: Scientific knowledge, international policymaking, international environmental policies, policy discussions, geopolitical interests, institutional inertia.

1. Introduction

Environmental issues such as climate change, biodiversity loss, and pollution have emerged as urgent global concerns [1]. While many countries have undertaken individual efforts to address these challenges, the overall effectiveness of unilateral actions remains limited [2]. These problems span national borders and require collective, coordinated solutions [3]. Consequently, international cooperation has been increasingly recognized as crucial [4]. Prominent institutions like the Intergovernmental Panel on Climate Change (IPCC) [5]. and the United Nations Framework Convention on Climate Change (UNFCCC) [6] serve as major global initiatives that provide scientific assessments and guide international policymaking. However, despite various international agreements—such as the Kyoto Protocol and the Paris Agreement [7] — global environmental challenges persist. This paradox highlights a significant disconnect between scientific consensus and political action [8]. Although scientific bodies regularly produce thorough assessments and recommendations, the translation of these findings into actionable, enforceable international policies remains inconsistent and politically charged [9]. Geopolitical interests [10], institutional complexity, and power imbalances among nations continue to hinder the implementation of science-based solutions. This study aims to synthesize existing research on the relationship between international policymaking and environmental science, focusing on the barriers to integrating scientific evidence into international agreements. By reviewing recent literature on the science-policy interface, this paper seeks to contribute to a deeper understanding of how scientific knowledge can be more effectively incorporated into global environmental governance.

2. Literature review

A growing body of literature has examined how international organizations influence environmental governance, reflecting a heightened scholarly interest in the mechanisms through which global institutions shape policy outcomes. Studies have consistently highlighted the pivotal role of entities such as the United Nations Environment Programme (UNEP) and the Intergovernmental Panel on Climate Change (IPCC) in promoting science-based policymaking at the

international level. For instance, the IPCC's periodic assessment reports are not only foundational documents within scientific communities but are also frequently cited as key references during the negotiation and formulation of major climate agreements, such as the Paris Agreement. These institutions function as critical nodes in the global knowledge-policy interface, offering authoritative scientific assessments that inform state actors and negotiators.

In parallel, scholars have extensively analyzed frameworks such as Global Environmental Politics (GEP), which elucidate how environmental issues are governed through the dynamic interplay between national governments, international organizations, the scientific community, civil society actors, and market forces. The GEP framework underscores that environmental governance does not occur in a vacuum but is instead shaped by the interaction of multiple stakeholders operating across different scales and motivated by diverse interests.

While the existing literature provides rich insights into the development of environmental treaties, the deployment of policy instruments, and the evolution of institutional dynamics, there remains a notable gap in systematically examining the intricate interplay between international politics and environmental science. In particular, limited attention has been paid to how geopolitical interests, structural power asymmetries, and the strategic considerations underlying diplomatic negotiations affect the uptake, translation, and implementation of science-based environmental recommendations. This gap suggests that science-policy integration is not merely a technical or normative challenge but is deeply embedded within broader political processes.

To better understand how prior studies have addressed these complexities, this review analyzes the methodologies employed across several key publications. A substantial portion of the literature adopts case study approaches, often combining semi-structured interviews with document analysis to investigate implementation challenges at the national level. For example, studies on Pakistan's climate adaptation strategies illustrate how domestic political economies, institutional capacities, and international aid dynamics shape the local application of global climate science. Similarly, comparative analyses of negotiation behaviors within the UNFCCC processes have shed light on how factors such as geopolitical alliances, issue-framing strategies, and institutional path dependencies influence the degree of alignment between scientific recommendations and negotiated outcomes.

Other strands of research employ legal text analysis and discourse analysis to explore the normative and ideological barriers that hinder the incorporation of scientific models into policy frameworks. For instance, investigations into the governance of solar geoengineering highlight how contestations over technological risk, ethical considerations, and North-South equity concerns complicate the science-policy interface. Despite the richness of these approaches, the majority of studies remain predominantly qualitative, often focusing on individual cases or specific issue areas, with relatively few efforts aimed at building cross-national, comparative, or quantitative generalizations.

These methodological trends underscore an urgent need for more integrated research designs that combine qualitative depth with comparative breadth, and that are capable of systematically mapping the political determinants of science uptake across different environmental regimes. Addressing these gaps would not only enhance theoretical understanding but also offer practical insights into how international environmental governance can more effectively incorporate scientific knowledge in a politically contested world.

3. Methodology

This study employs a qualitative systematic review methodology to synthesize existing scholarship on the interaction between international environmental policymaking and scientific knowledge. The objective is to examine how previous studies have addressed the integration of scientific evidence into global environmental agreements and institutions. By analyzing peer-reviewed journal articles, institutional reports, and policy analyses, this research identifies major themes, prevailing research methods, and key limitations in the literature.

To ensure relevance and academic rigor, documents were selected based on the following criteria:

- 1) Published in English between 2010 and 2024.
- 2) Explicitly address the relationship between science and international environmental policy.
- 3) Include empirical or theoretical analysis of policymaking, international governance, or institutional dynamics.
- 4) Appear in peer-reviewed journals or reputable policy-oriented institutions (e.g., United Nations, OECD).

Data were collected through systematic searches in major academic databases such as Web of Science, Scopus, and Google Scholar. Keywords and phrases used in various combinations included: “international environmental policy,” “science-policy interface,” “IPCC,” “UNFCCC,” “climate governance,” and “environmental treaty implementation.” Approximately 45 documents were selected based on thematic relevance, methodological clarity, and contribution to the science-policy nexus.

4. Results

Each selected document was coded for the following variables: research methodology, key themes, geographic focus, institutional actors, and integration of scientific input into policy frameworks. A coding matrix was developed to facilitate comparison and thematic grouping across studies.

The coded data were analyzed through thematic synthesis, identifying recurrent patterns and methodological trends. Key findings include:

Case study methodologies were prevalent in analyses of national-level barriers to science-informed policy (e.g., Pakistan’s climate adaptation policies).

Comparative institutional analysis was used to assess the engagement of developing countries in global climate negotiations.

Legal and policy discourse analysis featured prominently in studies exploring international environmental law implementation.

Constructivist and critical theoretical frameworks were applied in literature examining the political reframing of scientific recommendations, such as in the context of solar geoengineering.

The review also revealed methodological limitations in the existing literature, particularly the underutilization of large-scale, cross-country empirical studies and the general lack of quantitative validation.

5. Conclusion

This review has examined the existing literature on the interface between international environmental policymaking and scientific knowledge. By analyzing a selection of peer-reviewed articles, policy reports, and institutional studies published between 2010 and 2024, the study applied a systematic qualitative methodology to identify common themes, research approaches, and knowledge gaps. The documents were coded based on variables such as methodology, geographic and institutional focus, and the extent of science-policy integration, which allowed for a structured comparison across studies. The findings reveal that while case studies and discourse-based analyses dominate the field, there is a notable lack of comparative, cross-national research and quantitative assessments. Existing literature demonstrates the crucial role of institutions like the IPCC and UNFCCC in shaping science-informed governance, yet persistent barriers—including political asymmetries, institutional inertia, and selective use of science—limit the effective integration of knowledge into policy frameworks. To enhance the impact of scientific knowledge on global environmental decision-making, future research should prioritize interdisciplinary approaches, increase empirical scope, and explore mechanisms that facilitate science-policy alignment under diverse geopolitical conditions. Policymakers and scholars alike must work toward creating institutional designs and negotiation processes that not only recognize but structurally incorporate

scientific input into international agreements. Only through such integration can evidence-based environmental governance be effectively realized at the global scale.

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