

EMPIRICAL PAPER

Climate Financing and Low-Carbon Transition: A Systematic Review on the Role of International Development Banks

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Abstract

Purpose: This study investigates the role of international development banks (IDBs) in financing climate initiatives and supporting the transition to low-carbon economies. It examines the strategies they employ, the effectiveness of these strategies, and the challenges they encounter in expanding climate finance. The study also explores how IDBs collaborate with other financial entities to enhance climate-financing outcomes.

Methodology: The study was structured according to the PRISMA methodology, which entailed a comprehensive review of scholarly literature sourced from reputable academic databases, including Google Scholar, Elsevier's ScienceDirect, and SpringerLink, covering the timeframe of 2015 to 2024. Through this process, the review identified 35 scholarly articles that were deemed relevant to the objectives of this research.

Result: The review highlights the strategies employed by International Development Banks to promote climate financing, including the deployment of green bonds, the establishment of climate funds, the use of carbon-pricing mechanisms, and the formation of strategic partnerships with other financial institutions. Additionally, the findings identify the major obstacles hindering the expansion of climate finance and recommend potential solutions for addressing these challenges.

Novelty and contribution: The study provides a synthesised perspective on how IDBs integrate institutional capacity, innovation, and policy coordination to advance climate finance. It offers a clearer understanding of their strategic role in accelerating the global transition to a low-carbon economy.

Practical and social implications: The findings guide policymakers and development financiers on improving institutional frameworks and partnerships for climate finance. Strengthened coordination can enhance green investment flows, promote sustainable growth, and support social and environmental resilience.

Keywords: climate financing, international development bank, low-carbon economy, carbon pricing mechanisms, climate change

1 Introduction

According to the Intergovernmental Panel on Climate Change (IPCC, 2018), the global average temperature has increased by approximately 1°C, and projections suggest that it is likely to reach the 1.5°C threshold between 2030

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and 2052, depending on the current trajectory of climatic alterations (Masson-Delmotte et al., 2018). In recent decades, the global average temperature has been rising at an approximate rate of 0.2°C per decade. This trend underscores the urgent need for decisive and large-scale measures to reduce greenhouse gas emissions, ensuring that the rate of temperature increase slashes sufficiently to keep global warming below the 1.5°C threshold. As emphasised in the most recent IPCC report (2022), the urgency of decarbonisation has become increasingly evident. While the ramifications of climate change are becoming more conspicuous, the temporal window for achieving a temperature increase of 1.5–2°C is diminishing. Achieving net-zero emissions by the year 2050 will require an annual reduction of 3%–5% in global greenhouse gas emissions. This benchmark was achieved only during the COVID-19 pandemic, illustrating the magnitude of the transformative changes required to facilitate decarbonisation (Daumas, 2024).

The principal strategies for climate protection encompass mitigation and adaptation. The UN Intergovernmental Panel on Climate Change (IPCC) defines climate mitigation as "an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases." Conversely, climate adaptation refers to the capacity of a system to adjust in response to climate change, including climate variability and extremes, to mitigate potential harm, capitalise on opportunities, or manage the consequences. The IPCC defines climate adaptation as the "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities" (UNFCCC, 2018). Between the two primary climate response strategies — mitigation and adaptation — mitigation has received predominant focus, whereas adaptation has been comparatively underexplored (Chiroli et al., 2023). Within the broader discourse on climate protection, a central and pressing issue is that of climate finance. Climate finance forms a component of environmental finance and partially intersects with green finance.

Climate finance pertains to the financial resources mobilised to support climate change mitigation, adaptation, and resilience-building initiatives (Panda, 2023). It encompasses funding from diverse sources — including public finances, private investments, and international mechanisms — aimed at reducing greenhouse gas emissions, enhancing climate resilience, and fostering sustainable development (Pauw et al., 2021). Climate finance may enhance both the effectiveness and equity of the global response to climate change, particularly since adaptation funding can support the most vulnerable nations, and mitigation funding can support developing countries in transitioning to low-carbon economies (Pickering et al., 2017). The transition to a low-carbon economy is a complex and multifaceted process that encompasses both economic and societal dimensions. Economically, it involves measures such as halting new fossil fuel extraction projects (SEI et al., 2021). Socially, it entails the implementation of climate policies, the creation of new institutional frameworks, and potentially profound lifestyle shifts toward greater sustainability and sufficiency (IPCC, 2022).

The institutional framework governing climate finance is inherently intricate and spans a wide range of participants (Nakhouda et al. 2013). The contributors to this framework primarily consist of developed donor nations, the European Union, and certain subnational entities. These actors establish specialised climate finance mechanisms and initiatives while also forming bilateral and multilateral organisations, including multilateral development banks (MDBs). Bilateral organizations typically collaborate with implementing agencies to facilitate the execution of their respective projects. In contrast, multilateral organisations employ both market-driven and non-market-driven approaches to achieve their climate objectives. Market-driven approaches — established under the Kyoto Protocol — include International Emissions Trading, the Clean Development Mechanism, and Joint Implementation (Varadarajan & Chitrah, 2021). Non-market approaches encompass a diverse array of approaches, which may include any initiative that is not predicated on market principles, such as collaborative efforts in climate policy, fiscal strategies like carbon pricing, or tax mechanisms aimed at reducing emissions. The beneficiaries of these initiatives are predominantly developing nations, which typically engage with regional and national implementing agencies and funding sources.

In the preceding decade, there has been a marked escalation in climate finance flows directed towards developing nations, indicative of an increasing global acknowledgment of the imperative to assist vulnerable states in their efforts to mitigate and adapt to climate change. According to the Climate Policy Initiative, global climate finance flows reached approximately USD 579 billion in 2019, with a considerable fraction allocated to developing nations. This financial influx comprises both public and private investments, alongside contributions from international climate financing entities such as the Green Climate Fund (GCF) and the Global Environment Facility (GEF) (Cui et al., 2020). Although the overall climate finance inflow to developing nations has surged, notable regional inequities persist in the

distribution of funds. Countries situated in Africa, Asia, and Small Island Developing States (SIDS) frequently receive a disproportionately lower share of climate finance in comparison to other regions, despite their heightened vulnerability to the ramifications of climate change. This inequality accentuates the necessity for focused initiatives aimed at addressing the distinct adaptation and mitigation requisites of these regions, which includes investments in resilient infrastructure, disaster risk management, and ecosystem rehabilitation (Chiroli et al., 2023).

Multilateral climate funding bodies such as the Green Climate Fund (GCF) and the Adaptation Fund are pivotal in directing climate finance towards developing nations. These funds employ a variety of distribution frameworks and criteria for resource allocation, which incorporate country eligibility requirements, project selection parameters, and funding modalities. For instance, the GCF emphasises funding for projects that align with the objectives of the Paris Agreement, bolster climate resilience, and promote gender equality and social inclusivity (Puno, 2021). Furthermore, the GCF facilitates direct access to financial resources for national and sub-national organisations in developing nations, empowering them to conceive and implement climate initiatives that are customised to their unique requirements and priorities (Digitemie & Ekemezie, 2024).

Additionally, the geographic distribution of projects under the Clean Development Mechanism (CDM), an international market tool established by the Kyoto Protocol, reveals where the most efficient mitigation efforts are concentrated. As of May 2020, 75.2% of the emission credits (certified emission reductions, CERs) anticipated by the end of 2020 were tied to projects in just three countries: China, India, and Brazil (UNEP, 2020). Donors are facing growing pressure to prioritise poorer recipient nations in their development cooperation, as outlined by commitments to "good donorship" principles, such as those in the Paris Declaration, which are tracked by various donor rankings (Michaelowa et al., 2020). Some donors may lack awareness of the differences between different types of aid and apply the same standards across all, while others may struggle to explain these distinctions to the public, succumbing to pressure even when misguided. As a result, many bilateral aid agencies face challenges in adopting efficiency-based criteria for climate change mitigation (Castro et al., 2020).

International development banks (IDBs) are central to funding climate initiatives, with a focus on both mitigation and adaptation strategies. They raise funds through financial tools like green bonds to support projects that lower greenhouse gas emissions and boost climate resilience (Varadarajan & Chitrah, 2022; Attridge & Gouett, 2021). The World Bank (WB), the largest global IDB, sets a precedent for regional development banks like the African (AfDB), the Asian (ADB), the Inter-American (IDB), the European Bank for Reconstruction and Development (EBRD), and the European Investment Bank (EIB). While these institutions are key players in global climate finance, they can only partially meet development demands. Their role is vital, as they collaborate with other public and private financial bodies to maximise resource mobilisation through opportunity and risk sharing. Additionally, they are influential in developing and spreading norms (Chiroli et al., 2023).

The Paris Agreement's vision of aligning financial flows with low-carbon, climate-resilient development is a major driver in the work of multilateral development banks, which committed at COP 24 in December 2018 to align their actions with the goals of the agreement (Varadarajan & Chitrah, 2022). IDBs provide access to climate finance through concessional loans, grants, guarantees, and risk mitigation instruments to support mitigation and adaptation efforts in developing nations. They also track and report on their contributions to climate change following international agreements like the Paris Accord to ensure transparency and accountability (Xie et al., 2023). Additionally, IDBs act as knowledge hubs, facilitating knowledge sharing, capacity building, and peer learning among stakeholders to drive climate action (Manahan & Kumar, 2021). This review aims to explore the role of IDBs in financing climate change initiatives and transitioning to low-carbon economies.

1.1 The Paris Agreement

The 2015 Paris Agreement marks the first universal climate accord that assigns policy responsibilities to all participating nations. It establishes a hybrid governance model that combines both bottom-up and top-down approaches to global climate action (Bodansky, 2011). As a legally binding international treaty, it aims to address climate change and was endorsed by 196 countries during the United Nations Climate Change Conference (COP21) in Paris, France, on December 12, 2015. The agreement came into force on November 4, 2016. Operating on a *laissez-faire* principle, it allows countries to design their own domestic climate policies while obligating them under international law to plan, implement, and continually enhance their climate commitments (Dimitrov, 2024).

The central goal of the Paris Agreement is to limit the rise in global average temperature to well below 2°C above pre-industrial levels, with efforts aimed at constraining the increase to 1.5°C (UN, 2015). Under the agreement, the UN member states must submit nationally determined contributions (NDCs) that outline their projected greenhouse gas (GHG) emissions for 2025 and 2030. These NDCs are to be updated every five years, guided by the results of periodic global stocktakes that assess progress toward long-term climate goals (Kuh, 2018). Through the effective implementation of NDCs, global emissions are expected to decline relative to previous trajectories (UN, 2016). The agreement also emphasises strengthening countries' adaptive capacities to cope with the impacts of climate change (UNFCCC, 2018).

Widely recognised as a cornerstone of international climate governance, the Paris Agreement provides a critical framework for emission reduction and resilience-building. However, despite its ambitions, projections suggest that even full implementation of current NDCs will not achieve the 2°C target. This shortfall underscores the need for more robust carbon pricing systems and economic transformations to further reduce emissions. While the agreement fosters collective global action, it also exposes the persistent challenges of ensuring fairness, balancing economic trade-offs, and maintaining equitable participation among nations (Liu et al., 2019).

1.2 Study Rationale

To mitigate the most severe consequences of climate change, projections show that annual climate finance inflows amounting to US\$5.2 trillion will be required by the year 2030 (Boehm et al. 2022). Despite a marked increase in climate finance inflows over the preceding decade, only approximately \$600 billion was accessible in 2020, with the prevailing rate of augmentation proving inadequate to achieve the 1.5°C global warming threshold (Naran et al. 2022). Furthermore, a mere subset of the climate finance inflows is allocated to developing nations, where governmental budgets and capacities are notably constrained; consequently, the demand for supplementary investments continues to escalate, particularly in the wake of the pandemic. Public financing alone cannot sufficiently address the climate investment deficit, which encompasses resources provided by governmental entities, bilateral development finance institutions (DFIs), and multilateral development banks. Private investors possess assets totalling \$210 trillion — approximately twice the gross domestic product (GDP) of the global economy (Georgieva & Adrian 2022) — and there is a surge to channel a substantial fraction of this capital towards climate mitigation and adaptation initiatives. There is a pressing need for international development banks to enhance collaboration with private sector entities, financial institutions, governmental bodies, and other relevant stakeholders to mitigate climate risk through adequate financial provisions. This review aims to examine the role of international development banks in climate financing and in supporting the transition toward low-carbon economies. The investigation is guided by the following research questions;

- i. What strategies have international development banks adopted to facilitate climate financing for the transition to low-carbon economies?
- ii. How effective are these banks in mobilising and deploying climate finance to support low-carbon development?
- iii. What barriers do development banks commonly face in scaling up climate financing, and what measures can be taken to overcome them?
- iv. In what ways do international development banks collaborate with other financial institutions and governments to strengthen climate financing outcomes?

2 Methodology

This systematic review was conducted under the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines to ensure a thorough and structured approach to data collection and analysis (Bamiro et al., 2024). The review process started with the creation of a review protocol, which involved clearly defining the inclusion and exclusion criteria, along with developing a search strategy. Only studies published from 2015 onwards were included in the review.

2.1 Identification Phase

During the identification phase, relevant articles for this systematic review were retrieved from reputable academic databases, including Google Scholar, ScienceDirect, and SpringerLink. These platforms were chosen for their academic credibility and significant influence in scholarly research. The article search employed a combination of keywords and Boolean operators ("AND" and "OR"), using search strings such as "Climate Financing," "Low-Carbon Transition AND International Development Banks," "Climate Funding AND Multilateral Development Banks," and "Transition to Low-Carbon Economies AND International Financial Institutions." Table 1 below presents the keywords used in the study's search process.

Table 1 Search Keywords

Database	Key words
Google scholar	"Climate Funding" and "Multilateral Development Banks"
Springerlink	"Transition to Low Carbon Economies" and "International Financial Institutions"
ScienceDirect	"Climate Financing, Low Carbon Transition and International Development Bank"

2.2 Inclusion Phase

In the inclusion phase, all identified research publications were carefully assessed to determine their relevance to the study's objectives. The inclusion criteria (as summarized in Table 2) required that only peer-reviewed, English-language articles be considered, without restrictions based on the authors' nationality, reflecting the global scope of the research. Furthermore, the review targeted studies published between 2015 and 2024 to ensure the incorporation of recent and up-to-date findings.

2.3 Exclusion Phase

During the exclusion phase, the titles and abstracts of all retrieved articles were screened to assess their alignment with the study's criteria. Only those that fully met the inclusion requirements were advanced to the next stage of analysis. Publications such as book series, book chapters, reports, conference proceedings, and non-English papers were excluded. After applying these criteria, 35 studies were deemed eligible and included in the systematic review (see Table 2).

Table 2 Inclusion and Exclusion Criteria

Criterion	Included	Excluded
Types of literature	Research articles	Conference proceedings, reports, book chapters
Language choice	English Language	Articles not in English
Country	Global	-
pan of years	2015-2024	2015 and earlier

2.4 Data Extraction

This section summarises the reviewed literature that aligns with the objectives of this study. A detailed analysis of the gathered data is conducted, focusing on key elements such as author names, country of origin, study titles, publication years, methodologies, findings, and the journals where the studies were published.

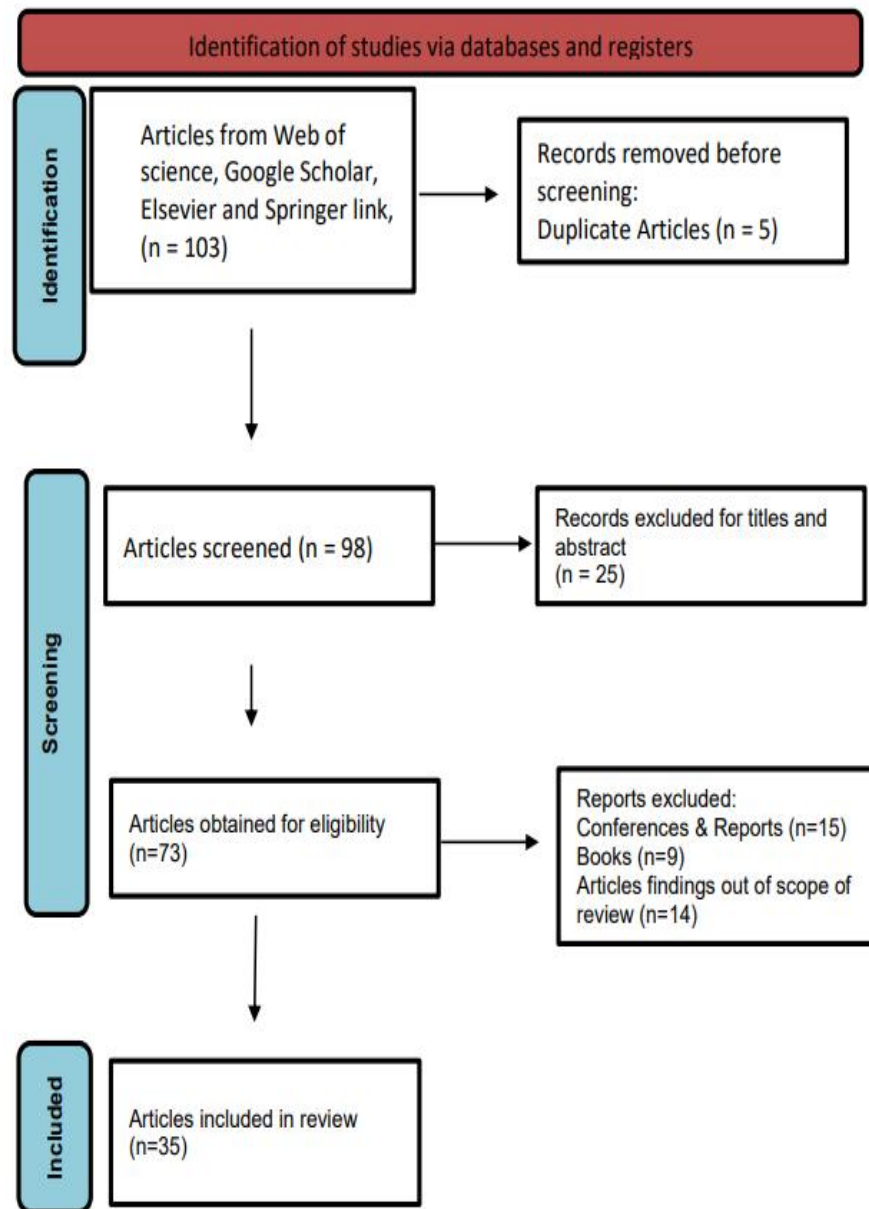


Figure 1 PRISMA flow diagram illustrating the search and selection process

Table 3 Complete List of the Reviewed Selected Papers

S/N	Authors & Year	Method	Findings	Country	Journal
1.	Omukuti (2020)	Qualitative	The paper explored the influence of multi-stakeholder engagement on climate funds. The paper found that the climate adaptation fund should be perceived as a country ownership principle.	United Kingdom	Geoforum journal (Elsevier)
2.	Timilsina (2021)	Qualitative	The study provides an overview of existing international provisions on climate finance for adaptation	USA	Sustainability
3.	Digitemie and Ekemezie (2024)	Qualitative	The paper examined the allocation and distribution of climate finance, analysing trends, disparities, and challenges in accessing and utilising funds among developing nations.	Nigeria	Finance & Accounting Research Journal
4.	Li (2024)	Qualitative	The paper explored the challenges faced by financial institutions in the global transition to a low-carbon economy. It also examined the mechanisms through which financial institutions can contribute to the transition towards low-carbon economies.	China	International Journal of Social Sciences and Public Administration
5.	Dasandara et al. (2022)	Qualitative	The paper examined barriers to climate financing in Sri Lanka and proposes strategies to address them.	Australia	Journal of Financial Management of Property and Construction
6.	Green (2021)	Qualitative	The study revealed that carbon pricing has a limited impact on emissions	Canada	Environmental Research Letters Journal
7.	Panda (2023)	Qualitative	The paper studied the transformative finance for climate resilient development	Japan	Current Opinion in Environmental Sustainability
8.	Adhikari and Safae Chalkasra (2023)	Qualitative	The paper analysed barriers that commonly inhibit private sector investment in climate adaptation action	Canada	Journal of Sustainable Finance & Investment
9.	Zhang (2020)	Qualitative	The study revealed	Hong Kong	Journal of Sustainable Finance & Investment
10.	Sangiorgi and Schopohl (2021)	Qualitative	The paper analysed	United Kingdom	International Review of Financial Analysis
11.	Nguyen et al. (2023)	Qualitative	The paper highlighted barriers, opportunities, and regulatory difficulties, and expected growth for the development of the green bond market	Vietnam	The European Journal of Development Research

12.	Deschryver and de Mariz (2020).	Qualitative	The paper identified barriers explaining the lack of scalability of the green bond market	USA	Journal of Risk and Financial Management
13.	Banga (2019)	Qualitative	This paper examined the potential of green bonds in mobilising adaptation and mitigation finance for developing countries	France	Journal of Sustainable Finance & Investment
14.	Azhgaliyeva et al. (2020)	Qualitative	This paper provided a review of green bond issuance and green bond policies in ASEAN.	Singapore UK	Journal of Sustainable Finance & Investment
15.	Freeburn and Ramsay (2020)	Qualitative	The study identified the features of green bonds, green bond markets and challenges regarding the issuance of green bonds by development banks	Australia	Capital Markets Law Journal (Elsevier)
16	Versal and Sholoiko (2022)	Quantitative	The paper identified the features of green bond issues and implemented green projects by the World Bank (the WB) and the European Bank for Reconstruction and Development (the EBRD)	Ukraine	Investment Management and Financial Innovations
17	Mendez and Houghton (2019)	Qualitative	The study explored the role of multilateral development banks (MDBs) in originating norms of sustainable banking	Spain US	Sustainability
18	Ameli et al. (2020)	Quantitative	The paper provided an understanding of the conditions under which new actions and policies have to be taken to ensure long-term sustainable investing	UK	Climate change (Springerlink)
19	Ameli et al. (2021)	Qualitative	This study showed how modelled decarbonisation pathways for developing economies are disproportionately impacted by different weighted average cost of capital (WACC) assumptions	UK	Nature communications
20	Bolton et al. (2022)	Qualitative	The paper found that price-earnings discount has been linked to corporate carbon emissions	UK	Journal of Applied Corporate Finance
21	Gurara et al. (2020)	Qualitative	The results showed that MDBs' participation is associated with higher borrowing costs and longer maturities, signaling a greater willingness by MDBs to finance risky projects that may not be financed by the private sector.	US	Journal of International Money and Finance
22	Chowdhury and Jomo (2022)	Qualitative	This article examined the state of play of climate finance and offers some suggestions to unblock the impasse.	Australia	Development
23	Spencer et al. (2018)	Qualitative	The paper surveyed the political economy of coal sector transition in the	France, China	Climate Policy

			requirements of ambitious climate mitigation scenarios to limit warming to 1.5°C		
24	Fries (2023)	Qualitative	The paper found that MDBs help lower barriers to low-carbon investments in emerging markets and developing economies.	United Kingdom	Policy Brief
25	Ogbo et al. (2024)	Qualitative	The paper revealed that technical barriers like inadequate infrastructure and limited expertise, economic constraints due to high costs, and regulatory issues from the lack of a comprehensive legal framework lead to carbon capture and storage challenges in Nigeria	Nigeria	British Journal of Multidisciplinary and Advanced Studies,
26	Wang et al. (2021)	Qualitative	The review examined breakthroughs and advancements across both established and emerging CCS/CCU systems with different Technology Readiness Levels (TRLs) in various industrial sectors.	Austria	Frontiers Energy Resources
27	Boisson de Chazournes (2015)	Qualitative	The paper explored the complex web of financial assistance mechanisms in the climate change sector.	Switzerland	Laws
28	Ahamer (2021)	Qualitative	The paper explored how international financial institutions contribute to climate protection.	Austria	Project Finance: Theory and Practice
29	Simpa et al. (2024)	Qualitative	This study critically evaluated the strategic implications of carbon pricing mechanisms on global environmental sustainability and economic development.	UK, US	International Journal of Advanced Economics
30	Onwuka and Adu (2024)	Qualitative	The paper explored the mechanisms and comparative advantages of offshore carbon sequestration.	Nigeria	Engineering Science & Technology Journal
31	Choi et al. (2020)	Quantitative	The study investigated the actors and the relationship between the actors by stage and year. As a result, the study visualised the network of PPPs in P4G, revealing that the partnerships were evolving as the participants' relationships became stronger each year.	South Korea	Sustainability
32	Ugwu et al. (2024)	Qualitative	The paper investigated the role of PPPs in building clean energy infrastructure in the United States and Nigeria.	USA	International Journal of Management & Entrepreneurship Research
33	Narassimhan et al. (2018)	Qualitative	The study reviewed emission trading systems in eight jurisdictions. It clarified the practices of implementing the system.	USA	Climate policy

34	Florini and Pauli (2018)	Qualitative	This paper explored how and why sector collaborations are evolving, and what steps can or should be taken to ensure that partnerships create public and private value.	Singapore	Asia Pacific Policy Studies
35	Nyikos and Kondor (2022)	Mixed method	The paper assessed the compliance of European national development banks with sustainability requirements by exploring their strategic objectives and investment activities.	Hungary	The Central European Journal of Regional Development and Tourism

3 Results

3.1 Study Features

The study features include the publication year of the articles, the authors' affiliations, and the methodologies explored in each paper.

3.2 Classification by Publication Year

Figure 2 presents the distribution of the reviewed studies from 2015 to 2024. The year 2020 recorded the highest number of publications, with eight papers. Both 2021 and 2024 contributed six publications each, followed by 2022 with five papers. In 2023 and 2018, four and three papers were reviewed, respectively. There were only two publications in 2019, and just one paper from 2015. No papers were reviewed in the years 2016 and 2017.

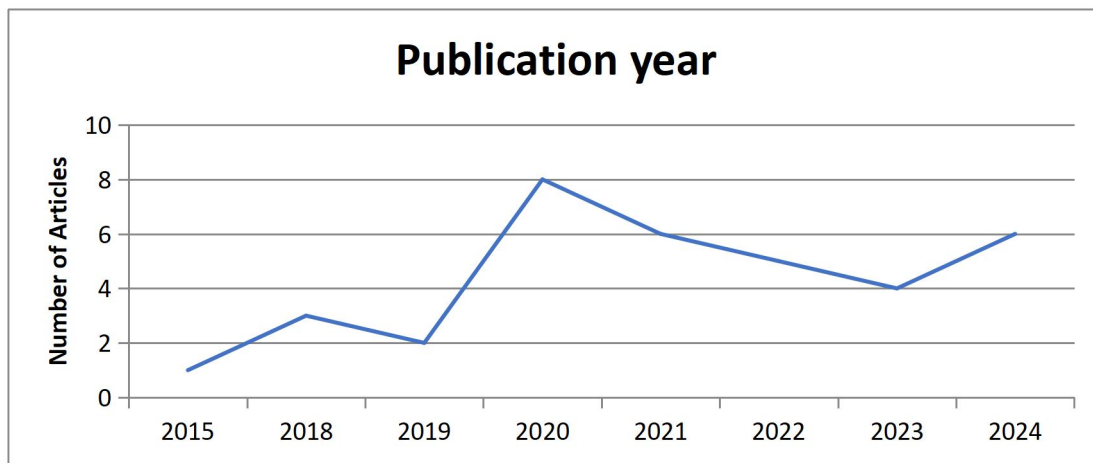
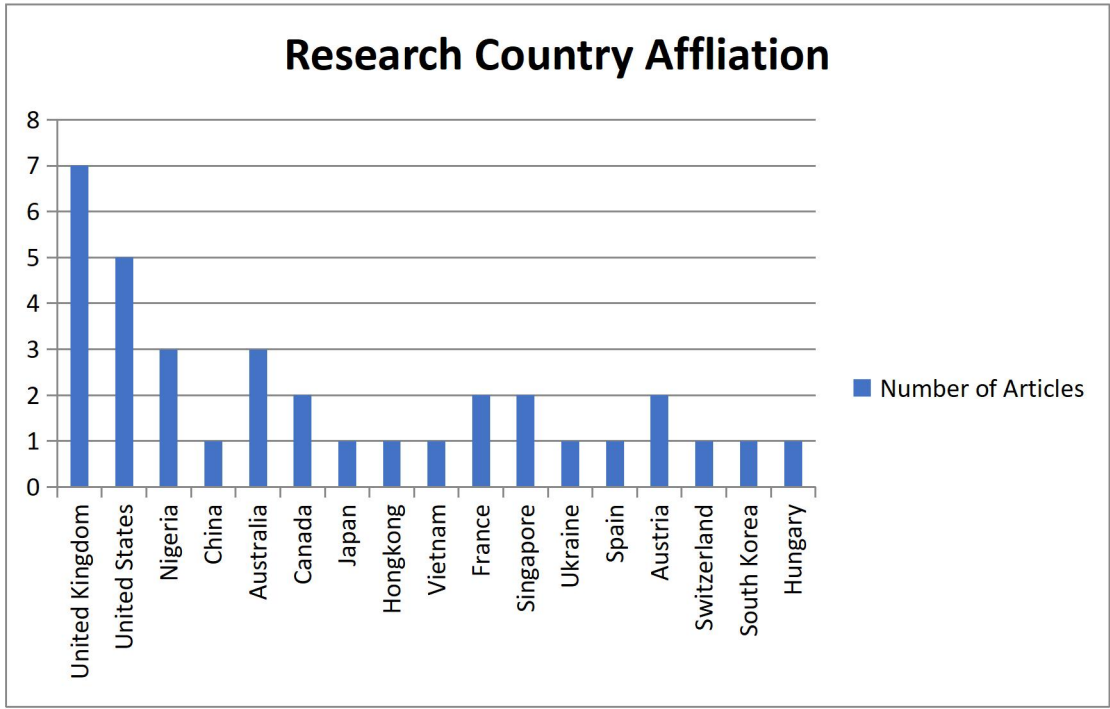


Figure 2 Years of Publication of the Reviewed Papers

3.3 Geographical Distribution of Research Publications

Table 4 shows the regional distribution of articles used in this study. The UK led with seven articles, demonstrating a strong contribution from that region. The United States followed closely with five authors, highlighting its significant involvement. Nigeria and Australia each contributed three studies, while Canada, France, Singapore, and Austria each provided two studies. Additionally, China, Japan, Hong Kong, Vietnam, Ukraine, Spain, Switzerland, South Korea, and Hungary each contributed one study, showcasing a diverse range of geographical participation. The table also highlights collaborative research efforts across multiple countries, emphasising a rich mix of international research activity that reflects both local and global engagement in the field.



3.4 Classification of Research Methods Used

Figure 3 illustrates the research methodologies employed in the reviewed articles. Of these, 31 studies used qualitative analysis, three employed quantitative methods, and one adopted a mixed-methods approach. This distribution highlights the prevalence of qualitative research, which typically emphasises narrative reviews, case studies, and thorough examinations. In contrast, quantitative studies focus on data-driven statistical analyses to provide empirical evidence. The mixed-methods approach integrates both qualitative and quantitative techniques, combining detailed insights with empirical data, thus providing a more comprehensive and robust understanding of the findings.

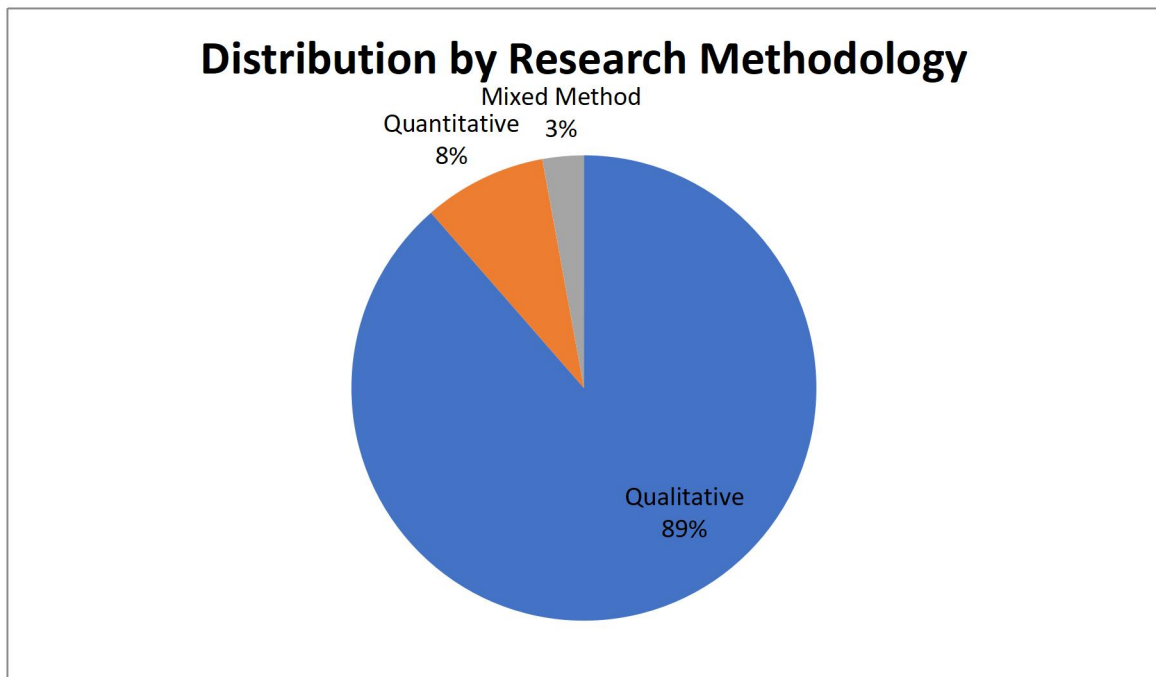


Figure 3 Distribution by Research Methodology

4 Discussion

4.1 What Strategies Have International Development Banks Employed to Facilitate Climate Financing for Low-Carbon Economies?

International Development Banks support climate financing for low-carbon economies through mechanisms such as green bonds, climate funds, carbon pricing, and partnerships with other institutions. These methods offer innovative ways of directing finance toward climate-related projects. For instance, green bonds allow investors to fund environmentally sustainable projects, while climate insurance products provide financial protection against climate risks and disasters (Rossitto, 2021; Digitemie & Ekemezie, 2024). Additionally, carbon pricing tools, such as carbon taxes and emissions trading systems, encourage emission reductions while generating revenue for climate finance.

4.1.1 Green Bonds

Green and climate bonds have acquired significant attention in recent years as essential tools for funding the transition to a low-carbon economy. Initially a niche market in 2007, it has since expanded, attracting a broader range of investors and issuers (Deschryver & de Mariz, 2020). Multilateral development banks have led the way in issuing green bonds to support their environmental and development goals, while corporations and municipalities have also begun participation (Nguyen et al., 2022). The European Investment Bank (EIB) was the first to issue a climate-awareness bond in 2007, worth USD 1 billion. The World Bank followed in 2008 with its first green bond, funding climate mitigation and adaptation projects in its regions. Since then, municipalities, commercial banks, and major corporations have followed suit. By 2017, the green bond market had grown from USD 1 billion in 2007 to USD 895 billion, with USD 674 billion being self-labeled green bonds and USD 221 billion being certified labeled green bonds, according to the Climate Bonds Initiative (Banga, 2019).

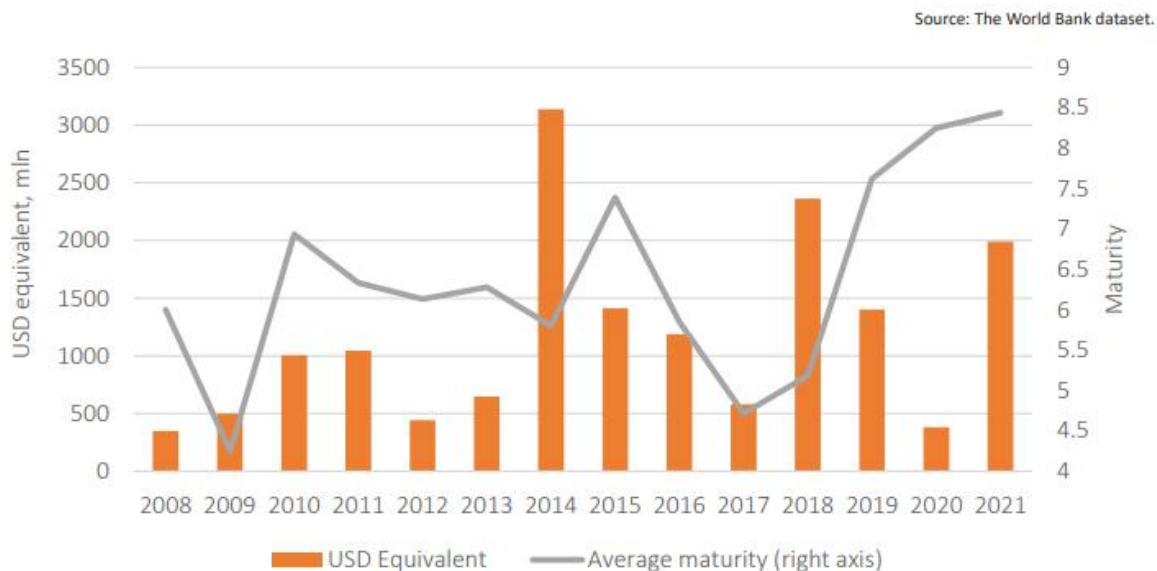


Figure 4 Green bond issues by the WB and average maturity of issues, 2008 – November 30, 2021 (Versal & Sholoiko, 2022)

Green bonds are fixed-income securities issued to raise capital for financing or refinancing projects to improve the natural environment. Essentially, they support the development of a low-carbon, climate-resilient economy. According to Azhgaliyeva et al. (2020) and Sangiorgi & Schopohl (2021), green bonds attract investors prioritizing sustainability and environmental protection over pure economic returns. Zhang (2020) noted a growing demand for green bonds among both individual and institutional investors, driven by increasing awareness of environmental issues and climate

change. As a result, green bonds offer a valuable avenue for attracting investment committed to reducing emissions and addressing climate change, leading to lower financing costs for environmentally friendly projects.

However, Mendez & Houghton (2020) pointed out that multilateral development banks (MDBs) face significant challenges when issuing green bonds, particularly around project bankability, transparency, and market standards. The uncertain viability of green projects can deter investors due to perceived risks. Additionally, a lack of transparency in tracking the flow of sustainable capital complicates the evaluation of the true environmental impact of green bonds, raising concerns about 'greenwashing' (Deschryver & de Mariz, 2020). The absence of a universal mechanism to align green investment supply with demand further creates market inefficiencies (Versal & Sholoiko, 2022). MDBs are also under pressure to relax green bond standards to meet high demand, which risks undermining the credibility of the green bond market (Freeburn & Ramsay, 2020). Together, these factors limit the scalability and effectiveness of development banks in issuing green bonds for climate financing.

4.1.2 Carbon Pricing Mechanism

The 2015 Paris Agreement has motivated governments to adopt stronger policies aimed at achieving decarbonisation. One of the most economically efficient approaches to reducing greenhouse gas (GHG) emissions is through carbon pricing policy instruments. These mechanisms fall into three main types: cap-and-trade systems (or emissions trading systems, ETS), carbon taxes, and hybrid mechanisms that combine aspects of both (Narassimhan et al., 2018). Development banks utilise carbon pricing mechanisms to support climate financing by integrating standardised carbon pricing frameworks, which generate significant public revenues for climate initiatives (Simpa et al., 2024).

Liu et al. (2022) explored the links between deep decarbonisation and air pollution reduction in China, revealing how carbon reduction strategies can also improve environmental quality. Their research emphasises the transport sector's potential for significant carbon reductions, as well as the importance of energy intensity and structural changes in lowering emissions. It demonstrates that carbon pricing can effectively reduce air pollutants, although the impacts vary across different sectors and types of pollutants. Additionally, carbon pricing fosters economic development by encouraging green technology innovation and investment. The shift to a low-carbon economy, driven by carbon pricing, has the potential to stimulate economic growth, improve energy security, and drive structural changes towards more sustainable industries and supply chains (Onwuka & Adu, 2024). Moreover, carbon pricing can help finance critical infrastructure, supporting sustainable socio-economic development while bridging gaps in access to essential services. By combining carbon pricing with green bonds, immediate investments in low-carbon transitions are encouraged, ensuring that the financial responsibility for current climate mitigation efforts is shared by future generations (Deschryver & de Mariz, 2020). Development banks can also adopt flexible carbon pricing strategies to promote global cooperation and incentivise emissions reductions, contributing to a broader green transformation.

4.1.3 Partnership and Co-financing with Other Financial Institutions

Leveraged co-financing from public and private sources has become a key policy focus for international development agencies in achieving environmental and development objectives. Partnerships between development banks and other financial institutions offer significant benefits for climate financing. Anbumozhi et al. (2020) found that these collaborations help mobilise private capital, which is essential to bridging the substantial investment gap in sustainable infrastructure projects, especially in renewable energy sectors that may initially seem unattractive to private investors. Ahamer (2021) noted that by using blended finance strategies, international development banks can reduce the risk of investments, attract commercial equity, and enable access to local-currency lending for projects like off-grid solar electricity. Co-financing arrangements also expand the scale and impact of climate initiatives, as shown by the Global Environment Facility's approach to pooling resources from multiple stakeholders. This collaborative approach not only fosters innovative financial tools but also aligns investment strategies with the urgent need for low-carbon transitions, contributing to global climate goals (Li, 2024).

Choi et al. (2020) conducted a study on public-private partnership (PPP) networks using social network analysis to examine the relationships between stakeholders. Focusing on the Partnership for Green Growth and Global Goals 2030 (P4G), the research explored various actors and their connections across different stages and years. The study found that over 50 PPP initiatives in developing countries have received financial support. By analysing the partnerships within P4G, the authors could track the evolution of these PPPs over time and by development stage,

providing insights into how future PPPs could be implemented. Their visualisation of the P4G network showed that these partnerships have become more interconnected and defined over time, with each actor's role becoming clearer at each stage of development. The study offers practical recommendations for practitioners aiming to enhance international development cooperation through PPPs in future projects.

4.2 How Effective Are International Development Banks in Employing the Facilitation of Climate Financing for Low-Carbon Economies?

In their climate strategies, international development banks have pledged to enhance financing for climate projects and support policies aimed at mitigating climate change across key sectors (Fries, 2023). Multilateral development banks leverage capabilities to create synergies between public and private sector operations. These efforts, which encompass technical assistance and financial support, aim to enhance policy frameworks and cultivate business environments conducive to low-carbon investments, thereby mitigating investment risks and amplifying returns. If effectively executed, these strategies have the potential to expand investment avenues and stimulate low-carbon investments in developing nations.

To improve the business climate for low-carbon investments, implementing carbon pricing and abolishing fossil fuel subsidies is imperative. Such policy reforms are crucial for emerging markets and developing economies (Bolton et al., 2022). Nevertheless, a more urgent challenge for these nations is the swift deployment of competitively priced low-carbon technologies, including renewable energy and energy-efficient systems. Obstacles to technology adoption frequently arise from non-price factors such as energy policies and inadequate infrastructure (Ameli et al., 2020). Addressing these challenges requires an organised business environment and the execution of energy reforms.

Although policy reforms can enhance investment prospects, financing from development banks is vital for sustained investments in developing economies. Involvement of development banks in projects provides advantages, including specialised knowledge of local conditions, particularly in areas with limited private financing access. As debt and minority equity stakeholders, development banks play a role in risk allocation and mitigation (Gurara et al., 2020). Furthermore, their substantial involvement aids in aligning investment initiatives with sector-specific reforms.

Innovative climate finance mechanisms, such as the blended finance model utilised by multilateral development banks, efficiently mobilise concessional funds to facilitate necessary financing and investments (Fries, 2023). For instance, subsidies for private low-carbon investments can target sectors and nations at the forefront of the transition, thereby reducing future investment costs (Spencer et al., 2018). Such cost reductions may arise from economies of scale, experiential learning, and network effects as energy systems transition from conventional to low-carbon technologies (Ameli et al., 2021).

Table5. Climate-Related Financing Goals and Mitigation Operations of Multilateral Development Banks

Multilateral development bank	Climate-related financing goals	Policy analysis And lending	Sector priorities for low-carbon and energy efficiency investment
		Country strategy	Sector reform
		Energy	Agriculture and land use
		Cities and buildings	Transport and Manufacturing
Africa Development Bank	40% share of annual financing by 2020 and align operations with the Paris Agreement goals by 2025		
Asian Development Bank	\$80 billion in cumulative climate-related finance from 2019 to 2020		
Asian Infrastructure Investment Bank	50% share of annual financing by 2025 and align operations with the Paris Agreement goals by mid-2023		
World Bank Group	35% share of total financing from 2021 to 2025		

European Bank 50% share of annual reconstruction financing by 2025 and development operations align with the Paris Agreement goals

European Investment Bank Exceed 50% share of its annual financing by 2025 and align operations with the Paris Agreement goals

Islamic Development Bank 35% share of its annual lending by 2025

Inter-American Development Bank 30% share of its annual financing from 2020 to 2023

New Development Bank 40% share of its total financing from 2022 to 2026

Note: Climate-related financing goals include both climate change mitigation and adaptation. The operational priorities for energy-related sectors are for climate change mitigation. Source: Fries, S. (2023)

4.3 What Are the Common Barriers Faced in Scaling up Climate Financing by Development Banks and How Can They be Addressed?

Climate finance is a pivotal element in supporting nations as they endeavour to mitigate and adapt to the ramifications of climate change (Omukuti, 2020). Notwithstanding the growing recognition of their significance, development banks continue to encounter substantial impediments in augmenting financial resources. This section examines the main barriers that constrain the enhancement of climate finance through development banks, as well as the strategies employed to overcome these challenges.

A principal obstacle is the restricted availability of financial resources, particularly for adaptation initiatives in developing nations (Timilsina, 2021). Despite commitments made by developed countries to provide financial assistance, the actual funding frequently falls short of the projected needs, thereby inhibiting numerous nations from securing the requisite resources for climate-related projects. Another critical challenge pertains to policy unpredictability and the regulatory risks that accompany it. Robust regulatory frameworks and incentives are essential for guiding investment choices within carbon markets and ensuring investor confidence. However, uncertainties surrounding governmental policies, including alterations in energy subsidies, tax incentives, and carbon pricing, can engender volatility that discourages investors. Discrepancies in policies and regulatory risks compromise long-term investments in efforts aimed at carbon reduction, thereby impeding decarbonisation initiatives (Digitemie & Ekemezie, 2024).

Li (2024) posits that shifts in governmental leadership and political priorities may lead to variations in energy and climate policies, which in turn generates uncertainty for investors and businesses. Inconsistencies within policy frameworks, such as modifications to renewable energy subsidies or carbon pricing mechanisms, have the potential to disrupt investment strategies and diminish investor confidence. The absence of enduring policy stability ultimately undermines the scalability and reliability of renewable energy projects and carbon reduction initiatives, potentially deterring private-sector participation and decelerating the broader transition towards clean energy.

The intricacy of climate finance mechanisms, encompassing diverse funding sources, modalities, and criteria, poses additional challenges for development banks in accessing and navigating funding avenues. The disjointed nature of climate finance governance, coupled with inadequate coordination among donors and financing entities, exacerbates these challenges, resulting in inefficiencies and delays in the mobilisation and allocation of resources (Chowdhury & Jomo, 2022). Furthermore, protracted fund disbursement can defer the implementation of essential climate projects.

Numerous developing nations are deficient in the institutional capacity and technical expertise requisite for the effective management and utilisation of climate finance, resulting in delays and inefficiencies in project execution. Ogbo et al. (2024) emphasise that the development and deployment of carbon capture and storage (CCS) technologies face significant technical and economic constraints, which limit their scalability and reduce their effectiveness in mitigating emissions from industries that remain heavily dependent on fossil fuel. CCS technologies are crucial for alleviating emissions in carbon-intensive sectors such as power generation, manufacturing, and heavy industry. Nonetheless, they face challenges associated with exorbitant costs, energy penalties, and the availability of suitable storage sites. Public acceptance and regulatory uncertainties concerning CCS implementation, along with apprehensions regarding leakage and long-term liability, further hinder widespread adoption (Wang et al., 2024).

To address these technological and infrastructural challenges, collaborative initiatives among policymakers, industry stakeholders, and research institutions are imperative to foster innovation, curtail costs, and dismantle deployment barriers. Cooperation between the public and private sectors, academia, and civil society is vital to propel technological advancement, bolster infrastructure resilience, and facilitate the transition towards a sustainable, low-carbon energy future.

Strengthening institutional capacity and enhancing coordination among stakeholders are imperative for the effective mitigation of these obstacles and the augmentation of climate finance. Green bonds, which represent debt instruments specifically designed to finance projects pertinent to climate change, such as initiatives for renewable energy, enhancements in energy efficiency, and sustainable infrastructure development, constitute a component of the overall solution. Climate funds, including the Green Climate Fund (GCF) and the Climate Investment Funds (CIFs), provide essential financial assistance for climate-related initiatives in developing nations, leveraging investments from both the public and private sectors to amplify climate finance. These financial instruments present opportunities for

the mobilisation of additional resources directed towards climate action while concurrently fostering sustainable development.

International development banks can proactively engage with policymakers, regulatory bodies, and governmental agencies to advocate for favourable policy frameworks and incentives that stimulate investments in renewable energy and the establishment of carbon pricing mechanisms. By contributing to the development of energy and climate policies, financial institutions can influence regulatory environments that promote the deployment of clean energy technologies, mitigate investment risks, and encourage market incentives for initiatives aimed at carbon reduction.

Climate insurance and risk-sharing mechanisms function as financial protections against climate-induced risks and disasters, thereby assisting in the alleviation of the economic and social repercussions of extreme weather events on vulnerable communities and economies. These mechanisms, which encompass weather index insurance, catastrophe bonds, and risk pooling arrangements, help transfer the financial risks associated with climate hazards from susceptible populations to insurers, governmental entities, and international financial institutions, providing a safety net for those disproportionately affected by climate change.

Carbon pricing mechanisms, including carbon taxes and emissions trading systems, incentivize the reduction of emissions while simultaneously generating revenue for climate finance initiatives (Green, 2021). By imposing a cost on carbon emissions, these mechanisms internalise the social and environmental repercussions of climate change, thereby motivating polluters to transition towards cleaner, low-carbon technologies and practices. The implementation of carbon pricing can mobilise significant financial resources for climate action, establishing a stable and predictable funding source for both mitigation and adaptation endeavours.

Impact investing concentrates on financing projects, enterprises, and funds that aim to generate positive social and environmental outcomes alongside financial returns. Impact investors place a premium on initiatives that confront climate change, advocate for sustainable development, and bolster resilience against climate-related risks. By aligning financial objectives with environmental and social priorities, impact investing has the potential to mobilise capital for climate finance initiatives and facilitate the transition towards a low-carbon and climate-resilient economy (Dasandara et al., 2022).

In conclusion, the scaling up of climate finance through development banks mandates collaborative efforts among governmental entities, international organizations, financial institutions, and civil society to surmount barriers, mobilise additional resources, and promote innovative financing mechanisms. By identifying opportunities for resource mobilisation — such as green bonds, climate funds, climate insurance, risk-sharing mechanisms, and innovative financing tools — policymakers, practitioners, and stakeholders can expedite climate action, enhance resilience to the impacts of climate change, and realise sustainable development objectives.

4.4 How Do International Development Banks Collaborate With Other Financial Institutions and Governments to Enhance Climate Financing Outcomes?

Ahamer (2021) analysed the role of international financial institutions in climate protection. Findings indicated that international development banks (IDBs) improve climate financing by collaborating strategically with other financial entities and governments. They employ blending tools effectively to support climate initiatives and amalgamate funds from diverse donors, including the Green Climate Fund and the World Bank. Digitemie & Ekemezie (2024) highlighted the importance of public funds in financing climate change mitigation and adaptation activities, such as renewable energy initiatives, ecosystem restoration, and disaster risk reduction efforts.

Boisson de Chazournes (2015) emphasised the private sector's significant contribution to climate finance and the growing presence of financial mechanisms facilitated by international organisations, like the World Bank. Private investments are critical for enhancing climate finance and mobilising additional resources for climate initiatives (Adhikari and Safaee Chalkasra, 2023). Engagement from the private sector in climate finance includes diverse activities, encompassing investments in renewable energy, energy efficiency, clean technology, and sustainable infrastructure projects. Various entities, including institutional investors, commercial banks, venture capital firms, and impact investors, contribute to climate finance through mechanisms such as green bonds, carbon markets, climate funds, and public-private partnerships (PPPs). Harnessing private investments is vital for addressing the climate finance gap and promoting transformative changes towards a low-carbon, climate-resilient economy (Panda, 2023). Ugwu et al. (2024) supported that PPPs can expedite the transition to a low-carbon future while fostering economic

growth and enhancing energy security by integrating public resources with private sector innovation and efficiency. Nyikos & Kondor (2022) evaluated the adherence of European national development banks to sustainability requirements by analysing their strategic objectives and investment activities. The study found that government dedication to sustainable development substantially affects national development banks' involvement in sustainable finance, ensuring alignment with policy objectives and effectively addressing market failures.

Governments are crucial in this context by providing political backing and strengthening the operational frameworks that direct development banks, ensuring their financing strategies foster long-term macro-fiscal stability and a just transition to climate neutrality (Florini & Pauli, 2018). Additionally, the synchronisation of policies and procedures, as highlighted in the Paris Declaration, is vital for enhancing aid effectiveness and ensuring that development efforts cater to local needs. In conclusion, international development banks must collaborate with climate stakeholders, including the private sector, as this cooperative approach not only optimises funding processes but also improves the efficacy of climate projects through coordinated stakeholder efforts.

5 Conclusions

This study underscores the crucial function of international development banks in financing climate-related initiatives and promoting transitions towards low-carbon economies. By employing a variety of financial instruments, including green bonds and carbon pricing mechanisms, these institutions enhance projects designed to mitigate greenhouse gas emissions and improve climate resilience. The review articulates the methodologies employed by international development banks to facilitate climate financing, encompassing green bonds, climate funds, and collaborations with financial institutions. The effectiveness of these methodologies depends on the operational efficiency of the development banks.

Despite the promise of international development banks, challenges emerge in the scaling of climate finance for low-carbon economies, which include funding constraints, the necessity for policy stability, fragmented governance, reluctance from private investors, and political prioritisation. These challenges must be addressed for climate financing to be scaled effectively. Moreover, international development banks should actively engage with policymakers and regulators to advocate for conducive policy frameworks, incentives, and regulations that bolster climate financing and renewable energy investments. By contributing to the evolution of energy and climate policy, financial institutions can shape regulatory conditions that facilitate clean energy technologies, diminish investment risks, and encourage carbon reduction initiatives.

The study further accentuates the need for collaboration between international development banks and diverse stakeholders, such as governmental entities, private sectors, non-governmental organisations, and civil societies. Such collaborations enhance the outcomes of climate finance and accelerate the transition to a low-carbon economy while promoting economic growth. Alongside an analysis of their strengths and weaknesses, additional empirical research is essential to comprehend thoroughly the role of international development banks in low-carbon transitions.

Social and Practical Implications

The findings of this study reveal that international development banks (IDBs) play a crucial role in advancing climate finance and facilitating the global transition to low-carbon economies. By promoting inclusive and equitable access to financial resources, IDBs can enhance adaptation and resilience in climate-vulnerable regions such as Sub-Saharan Africa, Small Island Developing States (SIDS), and South Asia. Enhancing IDB support for adaptation projects not only contributes to environmental sustainability but also reduces socio-economic disparities and promotes community wellbeing.

From a policy standpoint, the research underscores the criticality of establishing stable and coherent regulatory frameworks that incentivise investments in low-carbon technologies. Policymakers ought to formulate targeted fiscal and financial incentives, such as tax credits, concessional loans, and guarantees, to stimulate private sector engagement in renewable energy and climate adaptation endeavours. Furthermore, alignment between national climate policies and the strategic imperatives of IDBs can cultivate coherence, enhance policy credibility, and yield sustainable outcomes over the long term. The study also emphasises the need for consistent governance frameworks and clear financing methods to ensure the effective allocation of climate funds. Strengthened collaboration among

governments, IDBs, and private sector entities can expedite the transition toward sustainable, low-carbon economies. The implementation of digital technologies — such as blockchain and artificial intelligence — can further enhance accountability, monitoring, and traceability of climate finance flows.

Practically, the findings provide guidance for development practitioners and financial managers in the formulation of innovative funding models, including green bonds and blended finance instruments, aimed at mobilising private capital for climate initiatives. Empowering local institutions through capacity-building efforts and participatory governance can also ensure that climate finance effectively addresses both mitigation and adaptation priorities.

Implication for Theory Development

The study contributes to theoretical discourse by extending institutional and sustainability finance frameworks to explain the evolving role of IDBs in climate governance. It underscores how institutional legitimacy, stakeholder collaboration, and policy alignment jointly influence the effectiveness of climate finance systems. The synthesis also supports the development of a multidimensional model linking financial innovation, governance quality, and sustainable development outcomes.

Future theoretical work could explore how transnational partnerships reshape the institutional landscape of climate finance. Such research would deepen scholarly understanding of climate finance as both an economic mechanism and an institutional driver of sustainable transformation.

Limitations and Future Research Directions

This study presents a comprehensive synthesis of the contributions of international development banks (IDBs) to climate finance and the transitions to low-carbon economies; however, several constraints warrant acknowledgement. The research is grounded in a systematic literature review (SLR), which inherently depends on the scope and quality of available secondary data. While the review follows the PRISMA framework to uphold methodological rigor, the analysis was limited to peer-reviewed articles published between 2015 and 2024, potentially excluding valuable insights derived from grey literature and institutional reports. Subsequent investigations might employ mixed-methods or bibliometric methodologies to yield more data-driven and comparative examinations of trends in climate finance. Additionally, the global perspective adopted limits the differentiation of regional and institutional contexts, potentially obscuring the distinct characteristics of development banks such as the AfDB, ADB, EBRD, and World Bank. Conducting comparative regional studies is recommended to illuminate context-specific drivers and impediments that influence the effectiveness of IDB interventions in climate finance.

Furthermore, most of the reviewed literature prioritises mitigation-oriented instruments — such as green bonds and carbon pricing while the financing of adaptation initiatives remains inadequately explored. Additional empirical research should examine adaptation mechanisms, including resilience bonds and climate insurance, particularly in vulnerable regions such as Sub-Saharan Africa, Small Island Developing States (SIDS), and South Asia. Finally, as emergent technologies such as artificial intelligence (AI), blockchain, and digital finance platforms acquire traction, future research should explore their potential to enhance the traceability, monitoring, and impact assessment of climate finance flows. Integrating digital tools into climate finance frameworks could significantly improve transparency and accountability while enabling real-time evaluations of low-carbon investments. Addressing these limitations through interdisciplinary and context-sensitive research will fortify the comprehension of the intricate interactions between international development finance, climate policy, and sustainability transitions, providing a more robust empirical foundation for evidence-based policymaking.

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Conflict of Interest

The authors declare no conflicts of interest.

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