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A Review of Global Policy Mechanisms Designed for Tropical Forests Conservation and Climate Risks Management

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Deforestation and forest degradation of tropical forests are major global concerns due to their ecological, social, and economic roles. In the wake of climate change and its diverse global effects, fragmentation and degradation of tropical forests have jeopardized their ability to support livelihoods and regenerate climate regulating services. Concerted efforts by local, national, and international players, which are primarily scientific, technological, or economic, have borne minimal results in safeguarding these forests from destruction, necessitating a more integrated and inclusive approach. The Rio Earth Summit (1992) brought together world leaders to set targets and priorities on the global sustainability agenda and laid a strong foundation for international policy cooperation in the future. This study employed a systematic review of articles published between 1992 and 2020 to establish how various policy mechanisms have been developed and evolved to bridge forests and climate change discourse in tropical forests while highlighting their strengths and weaknesses. The initial search of peer-reviewed publications and gray literature yielded 2622 records, which were subjected to inclusion and exclusion criteria based on The Preferred Reporting Items for Systematic Review and Meta Analyses guidelines, resulting in a final list of 65 records for in-depth qualitative analysis. The study establishes that the mechanisms in place have contributed mainly to more coordination and incentives to manage climate risks, primarily through tropical forests conservation. However, hurdles such as inadequate participation and involvement of the local and indigenous people, insufficient national and local policy frameworks and bureaucracies around emissions monitoring, measuring, reporting, and verification processes continue to slow tropical forest conservation. Thus, there is a need for more integrated, multilevel, and diverse stakeholder engagement to achieve the set global targets effectively.

Keywords: climate change, deforestation and forest degradation, people and livelihoods, policies, systematic review, tropical forests

INTRODUCTION

The 2020 state of the world forests report establishes an alarming rate of deforestation and forests degradation globally. The 2015-2020 period witnessed deforestation at an annual rate of 10 million hectares annually (FAO and UNEP, 2020). Among the factors behind massive tropical forest loss include conversion to other land uses, invasive species, fires, pests, and diseases (FAO and UNEP, 2020). A study by Sasaki et al. (2016) estimates that 13 million ha of tropical forests are lost annually due to deforestation, while about 500 million ha forests are degraded annually. Further, The International Tropical Timber Organization – ITTO (2020) suggests that 930 million hectares of tropical forests have been degraded or modified, which agrees with a study by Brancalion et al. (2020) that estimates potential restorable tropical forests at 863 million hectares. D'Amato et al. (2017) further confirm that deforestation is the second-largest source of carbon dioxide emission after fossil fuel combustion. Tropical forests degradation releases between 2.2 and 5.39 gigatons of carbon dioxide emissions (GtCO2e) into the atmosphere, or around 6–14% of global carbon dioxide emissions (International Sustainability Unit, 2015). Tropical forests are the most essential forest types supporting over 50% of global biodiversity and playing a significant role in climate regulation surface (Reed et al., 2020). Described by Lewis (2006) as the 'biodiversity epicenters,' 'lungs of the planet,' and 'climate change modulators,' the tropical forests remain by far and large the most intact forests compared to boreal, temperate, subtropical, and polar forests (FAO and UNEP, 2020). However, the 'carbon sink' role is declining, with the Amazon tropical rainforests (largely the Southeast parts) transiting from net carbon sink to source because of land-use changes, deforestation, climate change, and increased fire incidences (Gatti et al., 2021; Saatchi et al., 2021). Efforts at the local, national, and global scales to address deforestation and forests degradation as part of the mitigation measures to curb the climate change effects have taken different shapes and approaches. While these efforts are primarily technical and economic/financial, this study will focus on the policy processes designed to curb the trends. Most of the policy interventions have evolved from the 1992's Rio Earth Summit, which is viewed as one of the historical landmarks in promoting global cooperation on environment and development (Sánchez and Croal, 2012).

There are three pathways through which deforestation contributes to climate change: (a) deforestation emits carbon immediately from the forests, (b) deforestation reduces the overall carbon stocks in the forests, and (c) the exposed land and subsequent land use act as carbon sources (Buizer et al., 2014; Gaveau et al., 2014; Lawrence and Vandecar, 2015; Nunes et al., 2020; Viana, 2020). Some evidence of these changes globally includes varying precipitation patterns and rising global temperatures (Marengo et al., 2018). Three Rio Conventions that set ambitious targets on forestry and climate change are United Nations Framework Convention on Climate Change-UNFCCC, The Convention on Biological Diversity-CBD, and United Nations Convention to Combat Desertification-UNCCD. UNFCCC is a multilateral environmental treaty that came to force in 1994 with a target to stabilize greenhouse gases concentration through curbing human influences that are dangerous to climate systems (Bernauer, 2013). The annual Conference of Parties (COP) to the UNFCCC has since 1995 yielded and ratified different policy mechanisms for climate change mitigation and adaptation. The UNCCD was established in 1994 as a legally binding international agreement on sustainable land management that links development and the environment. It fosters North and South collaborations to reduce or prevent land degradation, which is crucial in averting tropical deforestation and forest degradation. The COP to the UNCCD which is the supreme decision-making organ has since 2001 met biennially to review country-level commitment to land degradation neutrality and pass recommendations (United Nations Convention to Combat Desertification, 2021). The CBD is a legally binding treaty that aims to promote biodiversity conservation, use and equitable benefits sharing (The Convention on Biological Diversity (CBD), 2021). In relation to the tropical forests, the CBD is intended to play a crucial role in restoring forest landscapes and protecting their degradation for sustainable forest biodiversity use and conservation nationally. Despite the ambitious national targets and clear pathways for international collaboration presented by these agreements, deforestation, forest degradation, and climate change remain a global concern. This study reviews the policy mechanisms anchored on these conventions to understand how they have shaped the forestry and climate change agenda since 1992.

BRIEF BACKGROUND ON TROPICAL FORESTS CONSERVATION AND CLIMATE RISKS MANAGEMENT

Tropical forests play a crucial role in climate risks management. They form the most diverse and productive ecosystem on earth (Cuni-Sanchez et al., 2021), which stores 40–50% of terrestrial vegetation carbon (Blundo et al., 2021). They also provide climate such as carbon sequestration and sinking, which have contributed to reducing carbon from the atmosphere, consequently mitigating the effects of climate change, enhancing community adaptation and ecosystems resilience. However, the current trends in tropical deforestation and forests degradation have jeopardized the global efforts to curb climate change and its adverse effects on ecosystems and livelihoods. Studies such as Muthee et al. (2018, 2021) note anthropogenic and natural factors, such as ecosystems conversion to support livelihoods, unsustainable natural resources extraction, and wildfires, as some of the key drivers behind tropical deforestation and forest degradation.

Tropical forests have a high potential to contribute toward managing climate risks based on their distribution and density compared to other land and forest types across the tropics (FAO and UNEP, 2020). There is, therefore, the need for increased collaboration between the public and private sectors in developing scalable and replicable interventions to conserve tropical forests. Some of the existing agreements and mechanisms that have the potential to enhance tropical forests conservation

and climate risks management if well implemented include Reducing emissions from deforestation and forest degradation, and fostering conservation, sustainable management of forests, and enhancement of carbon stocks (REDD+) under the Paris Agreement, Clean Development Mechanism (CDM) under Kyoto Protocol, and Sustainable Land Management (SLM) as a mechanism to achieve Land Degradation Neutrality Targets (LDN). In the later sections, these policy mechanisms will be discussed in detail based on the existing literature to establish their links in synergizing tropical forests conservation and climate risks management.

Besides the policy mechanisms, other supporting frameworks are essential to promote synergies and reduce tradeoffs related to tropical forests and climate risks management. Key among these include active recognition, involvement, and capacity building of the local and indigenous populations, which is a significant gap in localization of the most international agreements (Rae et al., 2011). Notably, the local communities are the primary beneficiaries and stewards of the local resources; hence integrating them in the management process can yield high levels of success. Failure to involve locals and indigenous communities is a significant barrier to effectively rolling out different international policy and practice mechanisms at local and national levels (Muthee et al., 2017; Špirić, 2018; Wainaina et al., 2021). Increasing collaboration between state and non-state actors (including international organizations, research bodies and academia) is crucial to simultaneously conserve tropical forests and reduce climate risks through adaptation and mitigation practices (Rae et al., 2011), noting that most of the government processes are bureaucratic as opposed to those of non-government actors (Biesbroek et al., 2018). The second agenda that should be addressed for effective tropical forest and climate change synergy is developing a strong policy and institutional framework at the local and national levels. Studies such as Fay et al. (2012) and Hasrat (2018) concur that nations with strong local mechanisms have a higher possibility of achieving the internationally agreed targets, not just within tropical forests conservation and climate risks management, but also cutting across other internationally agreed goals.

Geopolitical Complexities in Tropical Forests Conservation and Climate Risks Management

The key driver of the global politics around tropical forests conservation and climate risks management is climate finances, with Koh et al. (2021) suggesting that tropical forests conservation can yield about 1.8 ($\pm$1.1) $GtCO_2e$ annually of investible carbon with a return-on-investment worth $46.0 billion per annum in net present value. Since the 1980s, climate science has progressively become more accessible to the public and decision-makers, making most decisions and policies evidence-based. Keohane (2015) establishes that framing tropical forests conservation and climate risks management without any form of incentives has yielded little or no course of action in the past. Various policy mechanisms have set up shared or individual funding mechanisms to support the developing countries financially and technically in achieving tropical forests conservation and climate risks management. Between 2001 and 2018, the CDM mechanism under Kyoto Protocol attracted an investment of over USD 304 billion through over 8,000 projects and programs related to climate change adaptation and mitigation in 111 countries (UNFCCC, 2018). The Paris Agreement reaffirmed the commitment by the developed countries to support developing countries with climate finance of at least USD 100 billion annually by 2020 as per the COP 16 accord (Cancun Agreement) (Roberts et al., 2021). Complexities around geopolitics and power, both within and outside the global North and South, have affected the development, implementation, and outcomes of different policies, as Nightingale (2017) notes. An example of these complexities is the withdrawal of the U.S from the Paris Agreement in 2017, citing economic undermining and disadvantages posed by the agreement (Zhang H. et al., 2017), a move that posed a challenge to international cooperation in meeting global climate goals (Zhang Y. et al., 2017).

The transaction costs involved in implementing various policies related to tropical forests conservation and climate risks management is uncertain, mainly due to the lack of a common framework and methodology for costs assessment (Nantongo and Vatn, 2019). Even in instances where the policies are clear and well designed, the implementation costs in different geographical locations differ and may affect the overall effectiveness of the policy at local and national levels. Rendón-Thompson et al. (2013) estimate the average cost of setting up, executing, and monitoring six REDD + projects in Peruvian Amazon at US$0.73 ha-1 yearly, with an annual range of between US$0.16 to 1.44 ha-1 per project. An analysis of 60 studies by Rakatama et al. (2017) estimates the total REDD + cost at $24.87/$tCO_2e$, a figure that is 2.23 times higher compared to the opportunity cost. Cases of geopolitical consensus and compromises are also common in international negotiation when developing policy mechanisms and crafting climate finances to promote the buying-in of all involved stakeholders. Fehl (2011) cites a case of geopolitical consensus and compromises, where the European Union had to accommodate the U.S. demands for softer emission targets with related environmental costs and potential business competitive disadvantages for the Kyoto Protocol to sail through.

In a complex web of international policy and institutional systems, it is becoming more apparent that policies don't succeed or fail on their own merits, rather by the extent to which they are and nationally domesticated (Hudson et al., 2019). Unfortunately, much of the national level interventions only revolve around policy announcements and ratification of agreements, with minimal tracking mechanisms related to tropical forests conservation and climate risks management (Purdon, 2015). In terms of national ratification, Paris Agreement is among the widely ratified international protocol, with 193 parties already setting their emissions reduction targets through submitting their first Nationally Determined Contributions (NDCs) and 13 parties already submitting their second NDCs (UNFCCC, 2021a). The complexities and divide around global north-global south commitments to tropical forests conservation and climate risks management continue to widen. Questions

around the political and legal obligations to different policy mechanisms, who pays for what through which means, resources transfer from North to South, and accountability mechanisms remain largely unanswered. Further, global North-South funding for tropical forests conservation and climate risks management evolution from willingness (voluntary) by the involved stakeholders to a binding and legal contract through Paris Agreement has also created new political challenges and opportunities. Retraction from the global North's initial commitments to the global south has changed the perception of climate change risks and tropical forests conservation as a western problem, primarily driven by politics and economics instead of meeting global emissions reduction targets (Gupta, 2009). This study looks at how some policy mechanisms have contributed to tropical forests conservation and climate risks management.

METHODOLOGY

Policy Mechanisms Under Different Rio Conventions Included in the Review

Different policy mechanisms have been developed under each convention under various decisions and resolutions. Their nature is multisectoral - cutting across the social, economic and politics – though this paper will limit itself to the political gaps and implications of tropical forests conservation. **Table 1** below summarizes some of the policy mechanisms established within the three main frameworks under UNCED selected in this study for review due to their link to tropical forests conservation.

Survey of Literature and Inclusion/Exclusion Criteria

The study adopted a combination of case study and systematic review approaches to understand how policy mechanisms have shaped the tropical forests conservation and climate risks management agenda in the 1992–2020 period. The systematic review process used the primary search conducted on Scopus, described by Schotten et al. (2017) as the most extensive database for abstracts and citation of scientific literature, while the secondary search was conducted on Crossref for additional references limited to 200 per record as of 7th April 2021. The systematic review approach was used to generate reliable research with minimal bias for further analysis (Malkamäki et al., 2018). The Preferred Reporting Items for Systematic Review and Meta Analyses (PRISMA)[1] guidelines, an evidence-based approach for critical appraisal and reporting system reviews and meta-analysis, collated related data from various sources. **Figure 1** summarizes the studies included and excluded for analysis at different levels using the PRISMA flow diagram guidelines. The study used the Publish or Perish[2] (Version 7.30.3245), a software designed to retrieve and analyze academic literature using a wide range of databases (Harzing, 2007) to search for different phrases as summarized in **Table 2** below, after which the number

[1] PRISMA (prisma-statement.org).

[2] Publish or Perish on Microsoft Windows (harzing.com).

TABLE 1 | Different policy mechanisms under the UNFCCC, UNCCD, and UN-CBD.

Convention	Policy mechanisms	Link to the tropical forest conservation
UNFCCC	Paris Agreement and Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+)	Paris Agreement is a legally binding international treaty aimed to limit global warming to well below 2°C, preferably to 1.5°C, compared to pre-industrial levels. Its implementation period is between 2020 and 2030. REDD+ is one of the measures introduced to achieve the targets of the Paris Agreement. It is a results-based payment mechanism designed to motivate activities that mitigate forest-based contributions to climate change (White et al., 2011).
	Bonn challenge	This is a voluntary and flexible mechanism setting a global goal to bring 150 and 350 million ha of degraded and deforested landscapes under restoration by 2020 and 2030 respectively. It uses the Forest Landscape Restoration (FLR) approach, bridging both CBD and UNFCCC on forests restoration within and outside tropical forests (Temperton et al., 2019). In 2020, the New York Declaration on Forests (NYDF) incorporated the Bonn Challenge targets.
	Kyoto Protocol and Clean Development Mechanism (CDM)	Kyoto Protocol is an international agreement to reduce carbon dioxide emissions, mainly through reducing emissions from the industrialized nations. Its implementation period was between 2008 and 2020. CDM is one of the three flexible mechanisms under Kyoto Protocol. Through CDM, developed countries are allowed to undertake emissions reduction projects in developing countries to counter their emissions.
UN-CBD	Aichi Biodiversity Targets	A set of 20 global targets grouped under five strategic goals under the Strategic Plan for Biodiversity 2011–2020. Targets 5 and 7 aim to reduce natural habitat loss, including forests, and promote sustainable biodiversity conservation.
	Cartagena Protocol on Biosafety	An international treaty governing the movements of living modified organisms (LMOs) resulting from modern biotechnology from one country to another. Its strategic objective includes enhanced safeguarding of ecosystems, species and genetic diversity, and enhanced benefits sharing, which closely relates to tropical forest conservation
	Nagoya Protocol on Access and Benefit-sharing	An international agreement aims to share the benefits arising from the utilization of genetic resources fairly and equitably. This protocol gives a broad guideline of how the different parties can access and share benefits related to the use and transfer of these materials (Jonas et al., 2010)

(Continued)

TABLE 1 | (Continued)

Convention	Policy mechanisms	Link to the tropical forest conservation
	National Biodiversity Strategy and Action Plan	These are the main policy frameworks (vehicles) of national implementation of the Convention on Biological Diversity – including compliance to legislations and regulations and benefits sharing for traditional knowledge, practices, and innovations
UNCCD	National Action Programmes (NAP)	The conceptual and legal framework to identify the factors contributing to desertification and the practical measures necessary to combat desertification at the national level. Forest conservation (through avoided deforestation and forest degradation) is a crucial feature in most of the NAPs in countries with tropical forests
	Sustainable Land Management (SLM)	SLM is a holistic mechanism that combines biophysical, economic, and sociocultural to address land degradation and deforestation to achieve carbon neutrality. Concerning tropical forests conservation, SLM entails sustainable use and restoration of forests and their associated goods and services meet the current and future generation needs (Liniger et al., 2011).
	Land Degradation Neutrality (LDN)	LDN are policy mechanisms developed to aid countries in balancing land use (degradation), rehabilitation and management from political, social, and economic perspectives. Among others, it creates a framework for national-level adoption to reverse land cover changes associated with deforestation and forests degradation, in addition to increasing forest cover (IUCN, 2015).

of studies generated was summarized in **Figure 1** for further analysis. The search incorporated all studies (review, articles, conference papers, book chapters, and surveys), with restrictions on timelines between 1992 and 2020. The study area is the tropical forests and articles only in the English language.

The initial search generated 22 and 2,600 records from the primary and secondary search, respectively. However, most of the records, especially those drawn from the secondary search, did not meet the inclusion and exclusion criteria; thus, they were eliminated from the study. **Figure 1** below summarizes the identification to inclusion process. The initial search yielded a total of 2622 records, which were screened further to establish duplicated and incomplete records, generating 979 records for further processing. The next step entailed a review of the study topics and abstracts to establish their relevance to the study questions, which yielded a total of 220 studies for full-text articles assessment, after which a final list of 65 records was selected for qualitative synthesis. The final screened database was selected based on its completeness, accessibility, and reliability of the source (Annex 1: **Supplementary Material**). Notably, Bonn Challenge, National Biodiversity Strategy and Action Plan, and National Action Programmes (NAP) were dropped from further analysis since their corresponding references failed to meet the set inclusion and exclusion criteria. The main discussion question was how literature framed the strength and weaknesses of different policy mechanisms in tropical forests conservation and climate risks management. **Figure 1** presents a graphical presentation of the inclusion and exclusion criteria based on PRISMA guidelines, while **Table 2** summarizes the distribution of the 65 publications reviewed on policy mechanisms.

RESULTS AND DISCUSSION

Kyoto Protocol and the Clean Development Mechanism of Kyoto Protocol

Kyoto Protocol (K.P) is the main framework that operationalizes UNFCCC through the annex-based structure, where Annex 1 countries (industrial and economies-in-transition countries) committed to reduce GHG emissions per their individual targets. Studies such as Kim et al. (2020) suggest that K.P has created an essential framework that has contributed to carbon emissions reduction, however, with a potential negative impact on the GDPs of participating countries in the long run unless more incentives are introduced. Logan-Hines et al. (2012) look deeper into the contributions of tropical forests toward meeting K.P targets at different scales, noting that its flexibility mechanisms allow countries to set the emission targets based on their local contexts. In addition, the bottom-up approach where the countries account and report on the emission targets at the UNFCCC level has aided the countries in meeting and surpassing their set targets. Rosen (2015) notes the flexible mechanism in the K.P design since different countries are at various levels of emission, risks and vulnerably, and potentiality to address climate change effects. Hence, designing local solutions could have achieved more significant impacts at the global levels. One of the greatest undoing to the K.P and global emission reduction targets is the high rates of tropical deforestation and forest degradation, especially in Brazil and Indonesia. Santilli et al. (2005) suggest that these rates could go up to four-fifth of the annual emission reductions gained through K.P. in its first implementation phase, which can only be reduced through incentivizing tropical forests conservation. The high imbalances between emissions reduction targets and annual emissions resulting from anthropogenic factors have jeopardized the ability to meet the global emissions reduction targets. Setting large-scale incentive programs to reduce tropical forests destruction and leveraging the K.P. emission targets at national and regional levels can bridge this gap.

The national policy and institutional configuration highly determine effectiveness in the implementation of multilateral agreements. Henry and Sundstrom (2010) establish that Russia is among the countries that have successfully ratified the protocol in 2004, following the consensus that the protocol met the national policy, political, institutional, economic, and social interests from both state and non-state actors. In Norway, models developed

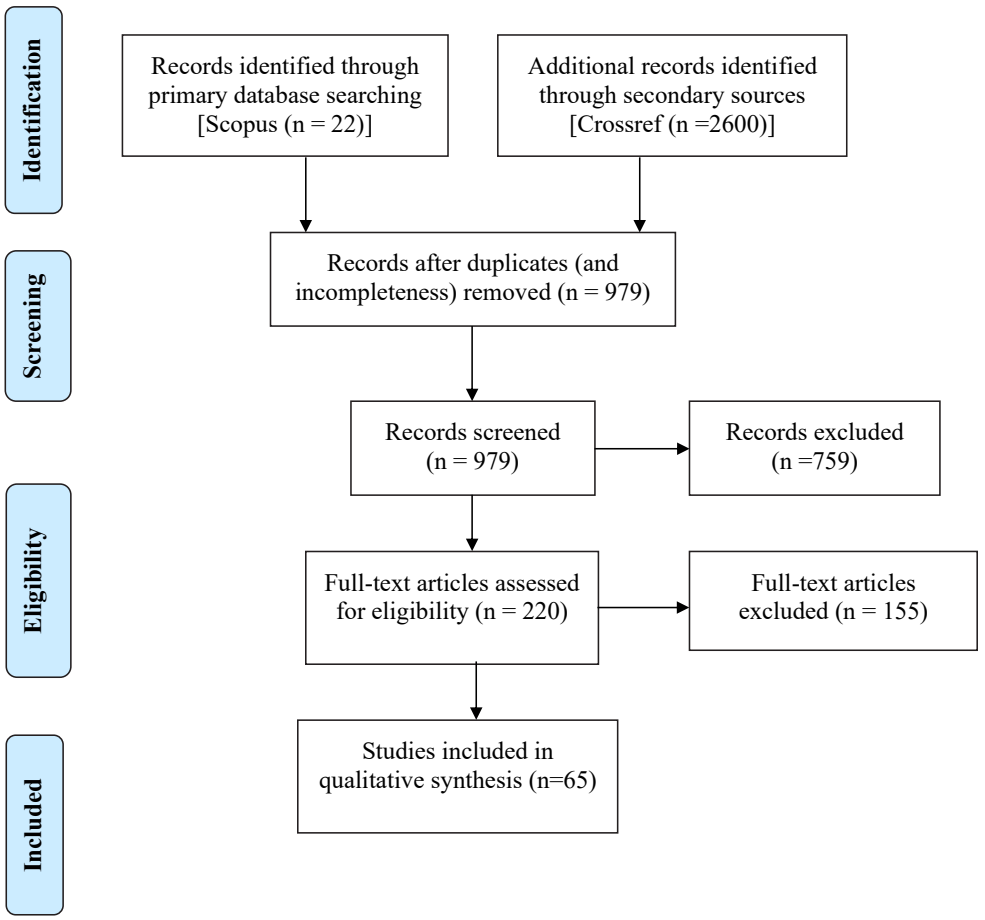

FIGURE 1 | Summary of studies inclusion and exclusion based on PRISMA guidelines. Adapted from Moher et al. (2009).

by Sjølie et al. (2014) indicate that the K.P. policy scenario increases carbon offsets and, consequently, mitigates climate change levels compared to the no policy scenario. However, more incentives and removal of forest carbon credit caps are needed in the long run for sustainable investment in forestry restoration. Policy mechanisms that are not supplemented by robust national policy and institutional frameworks in the host country can never meet global targets. Barnsley (2006) notes that some of the significant challenges post-ratification process include weak national-level policy and institutional framework to support the implementation of the protocol, bureaucracies involved in the ratification and domestication processes. In addition, criticism around the countries obliged to cut GHG emissions is primarily limited to developed countries. This scenario fails to appreciate that other developing and in-transit economies that are not adequately obliged to reduce their emissions, such as China, India, and South Africa, are also potential contributors of GHG gases. This calls for the need for a more balanced spread of countries committing to K.P. and emissions reduction targets (Gunawansa, 2009). Geopolitical complexities and interests also pose a significant hurdle facing practical commitment to GHG reduction under K.P, with some countries, such as the United States, rejecting the legally binding models of GHG reduction (Metz, 2013). This situation further exposes developing nations to the adverse effects of climate change and the population to higher vulnerabilities; thus, necessitating more flexibility in meeting the national emission reduction targets and enshrining them in the national policy framework.

The failure of countries to meet the set K.P targets is also attributed to a poor institutional design of the policy from the start (Rosen, 2015). Specifically, its short time frame for action, binding targets, emission reduction measures, and provision for future commitment periods have resulted in short-sighted behavior by member states and path-dependent structures that failed to manage the climate risks (Rosen, 2015). Issues around human rights and equitable benefits sharing are inadequately addressed in the K.P. as Cullet and Robinson (2009) establish. Notably, tropical forests conservation and climate risks management are discussed along environmental and economic lines, with minimal consideration of the human rights of the local communities who depend on their immediate environment for their sustenance. Specific community vulnerability assessments to climate change effects resulting from changes in tropical forests need to be addressed and incorporated in mechanisms such

TABLE 2 | Summary of search phrase and areas of restriction between 1992 and 2020.

Main policy instrument	Search phrase	Number of hits	Number of documents reviewed
Bonn Challenge	'Bonn challenge' AND 'Tropical forests' AND 'climate change'	200	0
	'LULUCF' AND 'Tropical forests' AND 'climate change'	201	2
Kyoto protocol and Clean Development Mechanism	'Kyoto Protocol' AND 'Tropical forests' AND 'climate change'	204	11
	'Clean Development Mechanism' AND 'Tropical forests' AND 'climate change'	201	17
The Paris agreement and REDD+	'Paris Agreement' AND 'Tropical forests' AND	200	3
	'climate change' 'REDD+' AND 'Tropical forests' AND 'climate change'	216	17
Aichi Biodiversity Targets	'Aichi Biodiversity Targets' AND 'Tropical forests' AND 'climate change'	200	1
Cartagena Protocol on Biosafety	'Cartagena Protocol on Biosafety' AND 'Tropical forests' AND 'climate change'	200	3
Nagoya Protocol on Access and Benefit-sharing	'Nagoya Protocol on Access and Benefit-sharing' AND 'Tropical forests' AND 'climate change'	200	7
National Biodiversity Strategy and Action Plan	'National Biodiversity Strategy and Action Plan' AND 'Tropical forests' AND 'climate change'	200	0
National Action Programmes	'National Action Programmes' AND 'Tropical forests' AND 'climate change'	200	0
Sustainable Land Management	'Sustainable Land Management' AND 'Tropical forests' AND 'climate change'	200	3
Land Degradation Neutrality Target'	'Land Degradation Neutrality Target' AND 'Tropical forests' AND 'climate change'	200	1
Total		**2622**	**65**

as K.P. to promote equitable benefits sharing and ecosystems restoration. A summary of challenges and strengths related to K.P. development and implementation is presented in **Table 3**.

As part of meeting the emission-reduction targets under Kyoto Protocol, the CDM creates a platform through which greenhouse gas mitigation projects in developing countries can earn Certified Emissions Reduction (CERs) credits (that are equivalent to one ton of carbon dioxide emissions) that can be sold and utilized by industrialized countries in emissions reduction. Developing countries reducing GHG gases beyond the 'baseline level' receive funds to support the emissions offsetting initiatives (Huang et al., 2012). In the context of tropical forests conservation and climate risks management, the development of CDM has received mixed reactions on its effectiveness based on different case studies. One of the strengths of CDM is its ability to link developed and developing countries in emissions reduction and de-risking developing countries from adverse effects of climate change, thus having a more global outlook (Mathy et al., 2001; Voigt, 2008). Countries with well-developed tropical forests and strong national policies and institutional frameworks have the potential to earn more benefits and incentives related to emissions reduction through CERs in activities related to afforestation and reforesting (A/R) programs (Gupta, 2009). Effective CDM interventions have also generated numerous benefits associated with sustainable development and emissions reductions, with co-benefits such as employment creation and improved air quality in the project area (Sutter and Parreño, 2007). This is, however, limited by the complexities related to regulations and methodologies employed to assess CDM projects. In essence, some well-designed tropical forests conservation strategies may fail to yield optimum benefits. Inadequacy in monitoring modalities and verification procedures of co-benefits is also cited as a significant gap in most CDM. Complexities in assessment procedures, design, low awareness, and related bureaucracies have consistently halted the success of the CDM interventions and inclusion of the co-benefits in Brazil (Fernández et al., 2012) and Argentina (Blanco et al., 2016), and Indonesia (Mafira, 2013), calling for improved design protocol to achieve co-benefit goals.

The development of adequate policy and institutional framework is essential for the success of CDM projects. Duan (2015) establishes that China CDM projects have realized significant benefits due to robust policy and institutional frameworks, capacity development and awareness mechanisms, incentives, and enhanced technical/technological capacity in the private sector. Contextualization is a concern since different countries rank differently from governance and socioeconomic development perspectives. It is essential to consider the critical determinant of the project success, including the human development index, policy and institutional framework, multi-stakeholder involvement, and other non-economic factors that vary with countries and regions (Fay et al., 2012). Kreibich et al. (2014) point to the challenges related to collapse in compliance markets and low demand for CERs as a contributor to the insufficient development of CDM in the least developed countries, especially in the African context. Additionally, Okubo and Michaelowa (2010) establish the inadequate design of the subsidies related to CDM projects development, noting that the subsidies available are limited to particular aspects, such as institutional capacity building. Blanco et al. (2016) indicated that CDM only contributed 45% to technology transfer with limited capacity building support on operation and maintenance in Argentina's case. This has limited the

TABLE 3 | Key strengths and weaknesses related to the development of the Kyoto protocol.

Strengths/benefits	References
The clarity in the set national emission reduction targets and flexibility with the national policy mechanisms	Henry and Sundstrom, 2010; Logan-Hines et al., 2012; Sjølie et al., 2014; Rosen, 2015
Weaknesses/challenges	References
High carbon emissions from deforestation and forests degradation, neutralizing K.P. efforts	Santilli et al., 2005
Weak national policy/legal framework	Barnsley, 2006
International bureaucracies	Barnsley, 2006
Insufficient human rights considerations and vulnerability assessment of the local people	Cullet and Robinson, 2009
Unbalanced geopolitical complexities and interests	Gunawansa, 2009; Metz, 2013
Poor institutional design from the start	Rosen, 2015

TABLE 4 | Key strengths and weaknesses related to CDM.

Strengths/benefits	References
Linking developing and developed countries on the emissions reduction	Mathy et al., 2001; Voigt, 2008; Gupta, 2009
Strong domestic policy and procedures, and institutional framework	Duan, 2015; Blanco et al., 2016
Multiple co-benefits such as generation of employment, income, and improved air quality	Sutter and Parreño, 2007
Weaknesses/challenges	References
Complexity in regulations, compliance, and procedures	Mafira, 2013; Kreibich et al., 2014; Blanco et al., 2016
Inadequacy in structural flaws, design, assessment and monitoring to meet CDM project goals	Fernández et al., 2012; Condon, 2016
Insufficient flexibility to local and national contexts	Fay et al., 2012
Gaps in subsidies design, especially in CDM projects design in developing countries	Mathy et al., 2001; Okubo and Michaelowa, 2010; Blanco et al., 2016
Inadequate national policy and institutional capacity	Condon, 2016
Uneven geographical and sectoral distribution (low development dividend)	Voigt, 2008; Disch, 2010

participation of the developing countries in CDM interventions and associated benefits. In its final design, CDM in most developing countries serves more as a sustainable development tool than a carbon emissions mitigation tool in developed countries. In agreement, Voigt (2008) and Condon (2016) argue that the CDM design cannot meet both emission reduction and sustainable development, citing institutional, leadership, capital investment, uneven sectoral and geographical distribution, structural flaws, conflicting national interests, among other gaps. Uneven geographical and sectoral distribution has jeopardized the achievement of 'development dividend' across different regions (Disch, 2010), which is the core mandate of CDM. There is also a need to invest more in capacity development and technological transfer to meet the case-specific requirements (Condon, 2016) and CDM redesigning and flexibility to ease its domestication, alignment with the national strategies and attraction of investment capacity (Mathy et al., 2001). A summary of the strengths (benefits) and weaknesses (challenges) related to the CDM are summarized in **Table 4** below.

Paris Agreement and Reducing Emissions From Deforestation and Forest Degradation and the Role of Conservation, Sustainable Management of Forests and Enhancement of Forest Carbon Stocks in Developing Countries (REDD+)

The governance and diplomacy faults in K.P necessitated developing a more inclusive framework that was achieved through the Paris Agreement (P.A). According to Pauw et al. (2019), P.A employed a bottom–up approach that required all global countries to contribute to emissions reduction through developing Nationally Determined Contributions (NDCs), unlike K.P, which only obligated developed countries. Further, P.A promoted more climate diplomacy, unlike K.P, calling upon actions and responsibility toward emissions reductions at the national level. From a scientific perspective, climate models have demonstrated the likelihood of temperature rise to 4.5°C by 2100 in a no-action scenario, 3.5°C if Paris pledges are implemented, and no further progress is made, and an ambitious plan to keep the temperature within 1.5°C – 2°C above pre-industrial levels if Paris Agreement is fully adopted and implemented at national levels (IPCC, 2018). However, the IPCC (2021) report demonstrates that the global surface temperature will continue to increase under all emission scenarios unless there are deep GHG emissions reductions in the coming decades. This is likely to pose unmanageable and irreversible climate change effects to people and ecosystems, increase food and water scarcity, and lead to global economic losses. It lays out global climate action plans and has been approved by 191 countries. Its design allows for more international and intergenerational climate justice, in that developing (poor) economies are cushioned against the diverse impacts of climate change through emission reductions and financial support by the developed economies, with a financial target of mobilizing USD 100 billion annually (Roberts et al., 2021). The funding is to aid the developing countries in pursuing poverty eradication, human development, and investment in renewable energy goals set at the national levels.

Despite the ambitions set by the P.A., few critical gaps are likely to slow the envisaged achievement of the set emissions targets. Some significant flaws include mainstreaming and coordinating the negotiation, decision, policies, and actions process. Even when countries ratify the protocol, domesticating and executing it at the national level remains a challenge (Geden, 2016). To illustrate, most NDCs from developing countries have set conditional commitments to emissions reduction that can only be achieved through financial and technical support

(UNFCCC, 2021b). The technological mechanism involved in the review and setting climate stabilization targets is also a significant gap, as established by Geden (2016). This necessitates evidence-based mechanisms where national policy decisions are made in a more coordinated effort from local to international levels, based on the scientific and research evidence coupled with political goodwill at national levels. Yu and Zhu (2015) note that international negotiations around emissions reduction and climate financing are faced by diplomatic complications and inequalities, coupled with mistrusts between countries such as China and United States, overall affecting the implementation process. This calls for more climate-political diplomacy in the process of negotiation, decisions making, policies and national level actions. A summary of the strengths (benefits) and weaknesses (challenges) related to the Paris Agreement mechanisms are summarized in **Table 5** below.

REDD+ is proposed as one of the interventions under the Paris Agreement that can bridge tropical forests conservation and climate risks management strategies through result-based payment (Plugge et al., 2013). A study by Ken et al. (2020) establishes that implementation of REDD+ projects in Cambodia increased the physical, human, financial and social local livelihood assets with an average impact factor of 0.33. However, the natural livelihood assets declined by an average impact factor of 1.24, mainly because of illegal logging. Other diverse challenges in rolling out REDD+ cited by other studies include inequality in benefit and cost-sharing, conflicts related to the usage of forests, especially those within the REDD+ program and political influences. Implementing REDD+ requires several interventions based on the local contexts. In Mexico, for example, Špirić (2018) looks at the contrasting view between two groups, the supporters, mainly the government and international NGOs who perceive REDD+ to be a legitimate process, while the locals and indigenous groups feel unrepresented in the Mexico REDD+ process, viewing it as a detractor. The issue of unbalanced representation and interests, especially from local and indigenous communities, is also highlighted as a significant challenge in the development of REDD+ mechanisms in countries such as Malaysia (Rae et al., 2011), Nigeria (Nuesiri, 2017), Tanzania (Lord, 2018), and Brazil (May et al., 2011), consequently raising issues around legitimacy and inclusivity in REDD+ projects development and implementation. In the development of Nigeria-REDD+, Nuesiri (2017) attributes unbalanced participation to 'godfather politics' and 'lack of political commitment,' which ultimately contributed to subversion of Nigeria's local democracy and interests as required in developing such as essential national strategy.

Effective REDD+ needs clear contextualization of the cultural and social needs of the population, especially the indigenous people in countries like Brazil who depend on the Brazilian Amazon for their sustenance and culture (May et al., 2011). Lord (2018) establishes that undermining the local people and authorities' representation in the REDD+ programs designing

TABLE 5 | Key strengths and weaknesses related to the Paris Agreement.

Strengths/benefits	References
Promotion of international and intergenerational climate justice	Moellendorf, 2009
Global inclusivity of all nations toward emissions reduction	Pauw et al., 2019
Enhanced emissions reduction reporting and review	Pauw et al., 2019
Promoted more climate diplomacy, unlike its predecessor (KP)	Pauw et al., 2019
Weaknesses/challenges	References
Unclarity in review mechanisms, political rationale and climate stabilization targets	Geden, 2016
Gaps in mainstreaming negotiations, decisions, policies and actions from multilateral to national levels	Geden, 2016
International diplomacy and geopolitics hurdles	Yu and Zhu, 2015

TABLE 6 | Strengths and weaknesses associated with REDD+ development.

Strength/benefits	References
Reduced (slowed down) carbon emissions compared to the baseline scenario.	Nzunda and Mahuve, 2011
Increased funding for sustainable forests conservation and reducing agriculture, forestry, and other land-use sector emissions	Nzunda and Mahuve, 2011; Plugge et al., 2013
Promoting biodiversity habitats conservation	Nzunda and Mahuve, 2011
Poverty reduction for the locals and indigenous communities	Nzunda and Mahuve, 2011
Weaknesses/challenges	References
Lack of adequate frameworks for carbon emissions monitoring, measurement, reporting, and verification	Lord, 2018; Špirić, 2018
Unbalanced representation (mainly local and indigenous people) and human rights breach	Hall, 2011; Larson and Petkova, 2011; May et al., 2011; Rae et al., 2011; Kebec, 2013; Venuti, 2014; Nuesiri, 2017; Lord, 2018; Špirić, 2018
The legitimacy of the REDD+ development process	Špirić, 2018
Domestication of international and multilateral agreements at local and national levels	Rae et al., 2011
Weak political support and governance structures (including insufficient policy and institutional frameworks at national and local levels)	Hall, 2011; Pavageau and Tiani, 2014
Weak monitoring, reporting and verification mechanisms at local and national levels	Ochieng et al., 2018
Inequality in benefits sharing	Larson and Petkova, 2011; May et al., 2011
Transaction and implementation costs in the monitoring, reporting and verification process may exempt some countries	Olsen and Bishop, 2009; Köhl et al., 2020

in Tanzania will likely yield land tenure and ownership conflicts in the program sites. Including local and indigenous groups in Latin America's Amazonia Basin REDD+ programs development negotiation can increase multiple benefits related to their human rights, improved socioeconomic status, management of the protected areas and other natural resources (Hall, 2011). According to Massarella et al. (2018), REDD+ in Tanzania yielded a lot of high hopes and hype during the piloting phase but later became hard to implement full-scale REDD+ projects primarily due to financial constraints, resulting in projects stalling and discontinuation. Notably, project piloting was largely dependent on donor funding and carbon financing, which marked the end of the project activities upon ending. The critical lesson learnt from the Tanzania case study is the need to design a continuity plan for REDD+ projects beyond their piloting phase, failure to which they may become a disincentive to the local beneficiaries once the financial support is withdrawn.

REDD+ can improve the conservation of traditional forests such as Ojibwe in Canada and the United States if well designed considering the needs and interests of the local and indigenous people (Kebec, 2013). Venuti (2014) adds that some countries such as Papua New Guinea have sacrificed the equitability of benefit sharing and participation of local and indigenous communities within the project areas due to the political, social, and economic interests of the 'outsiders.' Apart from the economic and financial benefits attached to such programs, there is a crucial need to consider the traditional and cultural needs of the indigenous and local people to achieve cross-cutting benefits. This study supports multi-stakeholder fora to take care of diverse interests and community buying in for the success of the REDD+ interventions at different scales, primarily so when related to forests conservation. For example, Rae et al. (2011) establish that non-state actors and mechanisms are the main drivers of tropical forests conservation at different scales; thus, the need to include them in the design process. Such an approach would address the limitations of implementing multilateral agreements related to tropical forests conservation and climate risks management at the national and local levels. Larson and Petkova (2011) also highlights the human rights violation and lack of clear benefits sharing mechanisms due to conservation efforts related to REDD+ projects and recommends establishing binding agreements to protect the rights and benefits of the local and indigenous communities.

Developing robust forest Monitoring, Measurement, Reporting, and Verification (MMRV) strategies at national levels is crucial in tracking the success of the intervention. Different countries have institutionalized MMRV strategies at different levels. Ochieng et al. (2018) compare the national levels of REDD + legislation integration in Tanzania, Peru, and Indonesia, noting that the countries are at 'intermediate-deep,' 'shallow-intermediate,' and 'deep' levels of policy institutionalization. The finding calls for more political goodwill, especially in the developing countries, to develop better MRV mechanisms that can track and report the changes attributed to national REDD+ programs. A study by Hall (2011) in Latin America's Amazon basin highlights the weakness in the local and national governance structures and laws as a significant impediment in implementing the REDD+ projects. Most conservation policies are market-oriented instead of conservation-oriented, thus putting the locals, the main drivers of conservation, at a disadvantage. This necessitates more involvement of the locals in the decision-making process and considering their interests. However, studies have also pointed to high transaction and implementation costs in the MMRV process, which may be a cost trap exempting some countries (Olsen and Bishop, 2009; Köhl et al., 2020). These costs can be reduced significantly through economies of scale by engaging in large scale projects (Olsen and Bishop, 2009). There are three proposed pathways under REDD+, including setting the reference levels for forest carbon, multiscale administration and funding through REDD+ (Tufano, 2012). Despite the massive potential to capitalize on the REDD+ funding to address deforestation and forests degradation and increase carbon stock, areas such as Congo River Basin remain relatively behind in terms of programs benefiting from this fund. Pavageau and Tiani (2014) point out several challenges, including inadequate political support from the host countries and disinterest from political circles to support local and national development of related programs. Some of the potential areas for REDD+ development and implementation include local and national training, capacity building and knowledge transfer to the national and local state actors for effective implementation, monitoring, measurement, reporting, and verification of different interventions to promote sustainable forest conservation. A summary of the strengths (benefits) and weaknesses (challenges) related to the development of REDD+ mechanisms are summarized in **Table 6** below.

Land Use Land-Use Change and Forestry, Sustainable Land Management, and Land Degradation Neutrality Target

Land Use, Land-Use Change and Forestry (LULUCF) is concerned with removing greenhouse gases related to land-use activities, including settlements and commercial purposes, land-use changes, and forestry-related activities (Bloomfield and Pearson, 2000). Notably, most of the carbon emissions that contribute to climate change and its diverse effects are related to land use activities such as agriculture, accounting for about 30% of total emissions. Three pathways through which LULUCF contributes to mitigation targets include emissions reduction (through reduced deforestation and forests degradation), increasing carbon sinks, and enhanced carbon substitution through, among others, alternative energy sources (Grassi, 2010). However, inadequacy in the accounting frameworks and procedures, unclarity in the accounting rules (especially those around voluntary reporting), and the definition of forest lands and management in different contexts continue to halt the effectiveness of LULUCF (Macintosh, 2011). Streck (2009) further argues that vagueness in accounting and reporting mechanisms has led to an insignificant reduction in the emissions associated with LULUCF. Improving the transparency, accuracy, and completeness of the LULUCF processes is among the most significant opportunity for its improvement. For example, a transparent mechanism to assign

value to the standing tropical forests, clear marketing/financing mechanisms and incentives framework, complemented by clear policies on forestry governance, can improve the effectiveness of LULUCF mechanisms. Developing a straightforward LULUCF classification mechanism within minimal policy, economic, biophysics, and environmental complexities may address the accounting and reporting challenges at the local and national levels (Michetti, 2012). Further, Michetti (2012) argues for comprehensive and expanded datasets on global land use to capture diverse attributes of LULUCF in different landscapes. **Table 7** summarizes some of the challenges related to LULUCF development and their corresponding references.

On the other hand, Sustainable Land Management (SLM) entails developing and using land resources to meet human and environmental needs with minimal tradeoffs (Sanz et al., 2017). World Overview of Conservation Approaches and Technologies (2019) expounds on the definition of SLM to include the use of land and its resources (including water, soil, fauna, and flora) in producing goods and services for human use and environmental functioning. It is part of the UNCCD's goal and commitment to combat droughts, desertification, and land degradation as part of the broader climate change mitigation and adaptation. Mainstreaming the SLM goals at the national level can play a crucial role in reducing tropical deforestation and forest degradation. However, most SLM strategies are largely uni-sectoral with minimal implementation span resulting in an overall tradeoff effect at the landscapes level, as Schmidt et al. (2017) note. Using Ethiopia as the case study, the authors suggest the need for long-term investment, markets and value-chains development, and inclusion of incentives at landscapes level for SLM to be effective, both in terms of profitability and productivity in the long run. In agreement, Kaihura and Schlingloff (2016) recommend a holistic and multisectoral approach in SLM, including catchment management, training and capacity building, policy and institutional framework enhancement, and land management exercises. An SLM intervention in Rwanda, Uganda, Burundi, and Tanzania through the Kagera TAMP project revealed that SLM interventions could promote integrated livelihoods and ecosystem benefits. These include crop productivity, ecological regeneration and health, improved carbon sequestration from both soils and forests, and improved household income. The successes of the TAMP project reveal that SLM activities, if well-executed, can enhance tropical forests conservation and climate risks management exercises, with cross-cutting ecological and livelihood benefits. In Northeast Thailand, Salaisook et al. (2020) note that SLM is a promising strategy toward farm production diversification and income generation in the wake of agrarian changes from the unprofitable small-scale rainfed rice production. The approach is applicable in other Asian countries to diversify farm-level productivity and enhance the conservation of tropical forests, which continuously face degradation resulting from farm expansions.

Land Degradation Neutrality Target (LDN) is part of SDG (15.3) and UNCCD, with over 120 countries setting their voluntary targets and pathways for implementation, including (1) setting national LDN baseline, (2) setting national voluntary LDN measures and targets, and (3) setting platform for knowledge sharing and management (Wunder et al., 2018). Desertification and land degradation threaten the lives of over 1 billion people in over 100 countries, with an economic loss estimated at 490 billion USD annually (Annette et al., 2018). Since the Rio+ 20 summit in 2012, land has received recognition as an integral part of the sustainable development agenda in the U.N. discourse. Tropical forests conservation is at the heart of the shift toward LDN, noting that forests and trees are significant carbon sinks that can reverse climate change effects. However, the rate at which tropical deforestation and forest degradation are taking place poses a major challenge toward meeting the LDN targets, calling for more commitments and actions to reverse the same. An overview by Gnacadja and Wiese (2016) establishes that Sub-Saharan Africa is one of the potential areas for restoration to meet the global LDN targets with over 60% of the global uncultivated land and a third of degraded lands. However, issues related to policy gaps, inadequate institutional framework, and insufficient coordination from international to national levels are cited as significant gaps toward the effective meeting of the set LDN targets.

TABLE 7 | Key challenges related to LULUCF development.

Strengths/benefits	References
Enhanced emissions reduction and increased carbon sinks	Grassi, 2010
Enhanced carbon substitution	Grassi, 2010
Weaknesses/challenges	References
Inadequate carbon accounting and reporting framework	Macintosh, 2011
Inadequate incentive framework	Streck, 2009
Complexities in accounting and reporting process	Michetti, 2012

Aichi Biodiversity Targets, Nagoya Protocol on Access and Benefit Sharing and Cartagena Protocol on Biosafety

The Aichi Biodiversity Targets are part of the 2011–2020 Biodiversity Strategic Plan adopted in 2010 during the 10th Conference of Parties (COP) to the Convention on Biological Diversity members. They are comprised of 20 targets divided broadly into five sections (A-E). Carr et al. (2020) establish some of the broad targets of Aichi Biodiversity Targets, aiming to promote, protect, and conserve global biodiversity. Whereas there are criticisms around meeting the set targets and accountability at the national levels, there are few notable achievements, especially within the tourism sector. According to Avilés-Polanco et al. (2019), there are numerous benefits associated with improved biodiversity science quality and enhanced productivity due to international collaboration of research and funding around biodiversity conservation, promoting the development of the tourism sector. Further, promoting biodiversity and genetic resources conservation is essential in tropical forest conservation (Hasrat, 2018). However, this needs more resources allocation and review mechanisms

for the commitments set at national levels to have a global impact within the tropical forest conservation and climate risks management domains.

One of the indicators of Aichi biodiversity targets is the Nagoya Protocol on Access and Benefit. It came to effect in 2014 to promote fair and equitable benefit sharing from genetic resource use, ultimately incentivizing conservation and sustainability in biodiversity use (Avilés-Polanco et al., 2019). It aims to give commercial benefits to the bioresources providers, which can play a crucial role in promoting the conservation of tropical forests and climate risk management. Among the main advantages of the Nagoya Protocol is recognizing the rights of the local and indigenous to benefits sharing of traditional knowledge and genetic resources use (Hasrat, 2018). Effective implementation of the Nagoya Protocol is based on the national policy and institutional framework in compliance with the broader guidelines. Unlike other policy mechanisms that are more market-oriented, Nagoya Protocol recognizes the participation of the indigenous people. It creates a structured system through informed consent, negotiation, representation and participation in policy development and execution. A study by Sangeetha et al. (2020) establishes that different countries have domesticated the protocol. India and South Africa have 1006 and 32 internationally recognized certificates, respectively, while Mexico and Peru have 6 and 4 competent national authorities. Broggiato et al. (2015) further recommend developing a national centralized input system with transparent monitoring and compliance systems infused within the national policy framework and standards, using Belgium as the country of focus. Such a robust framework is ideal for promoting tropical forest conservation and simultaneously benefiting the local communities who are custodians of knowledge and genetic resources.

The indigenous and local communities' actual representation, participation, and engagement of the indigenous and local communities in the national and bilateral political processes remain largely inadequate. Koutouki and Bieberstein (2012) establish a low transition from international to national and local protection and benefits access concerning traditional knowledge and benefits access. This also violates intergenerational justice, noting that conventional systems are passed from one generation to the next, hence the need for a robust protocol that promotes more representation and engagement of the indigenous communities in the decision-making process. It is also notable that biotechnology is underdeveloped in many economies despite them having indigenous genetic resources. In China, for example, Humphries et al. (2021) argue that patents are removed in some genetic materials for use by developing countries leading to inequalities in access and benefits sharing. Inadequacy in national policy and regulatory framework is also a significant challenge facing the execution of the protocol at the national level, coupled with unfamiliarity with the protocol's provision, especially to the local and indigenous communities (Davis et al., 2015). There is a need for more investment in communication, research, capacity development and compliance in biotechnology and conservation in general. Such interventions can contribute to conserving tropical forests, especially the Amazonia that are home to diverse genetic resources and traditional knowledge. A summary of the strengths (benefits) and weaknesses (challenges) related to the Nagoya Protocol are summarized in **Table 8** below.

TABLE 8 | Key strengths and weaknesses related to Nagoya Protocol.

Strengths/benefits	References
Recognition of the rights of indigenous and local communities to traditional knowledge and genetic resources	Hasrat, 2018
Conformity with the local policy and institutional mechanisms	Sangeetha et al., 2020
Weaknesses/challenges	References
Inadequate participation by indigenous and local communities	Koutouki and Bieberstein, 2012; Hasrat, 2018
Gaps in the monitoring process at the national levels	Broggiato et al., 2015
Weak national policy and regulatory capacity, and biotechnology underdevelopment	Wu et al., 2015
Inadequate knowledge on the applicability of the protocol	Davis et al., 2015

The Cartagena Protocol on Biosafety to the Convention on Biological Diversity (Cartagena Protocol) was adopted in 2000 and entered into force in 2003 as an international treaty guiding the movement of living modified organisms (LMOs) (Helmut, 2016). The protocol outlines guidelines on risk assessment related to LMOs emanating from modern biotechnology development at the national level. If well implemented, the protocol can combat tropical deforestation and destruction and climate change effects at the national level by providing a legal framework for handling, using, and transferring living modified organisms at transboundary levels. This could play a vital role in reducing pressures in critical ecosystems such as tropical forests. Jank and Gaugitsch (2001) establish that the protocol provides crucial guidelines to the countries in developing precautional and risks assessment mechanisms and delivering an environment at par with the trade at the international level. Countries such as Malaysia have successfully created a Biosafety Act (2007) based on the guidelines of the Cartagena Protocol. However, its domestication is faced with many challenges, including gaps in its formulation and development, inadequate expertise, lack of set precedent on non-compliance internationally and ambiguities in the domestication process (Hilbeck and El-Kawy, 2015; Chan, 2016; Karen, 2019). Such gaps are recorded in other developing nations that are yet to benefit fully from this critical protocol. As a result, the protocol has not significantly impacted tropical forests conservation and climate risks management, especially within developing economies.

CROSS-SECTIONAL ANALYSIS OF DIFFERENT GLOBAL POLICY MECHANISMS

The study developed seven-point criteria to analyze the different tools under UNFCCC, UNCCD, and UN-CBD. The variables included the geographical scope/focus of the tool, the central sector of emphasis (such as forests, climate change, and

TABLE 9 | Matrix for analysis: global geopolitics of tropical forest conservation and climate risks management.

Policy tool/instrument/ mechanism	Attributes for comparative insights							
	1: Geographic scope/focus	***2: Sectoral emphasis***	***3: Incentive models or mechanisms***	***4: Extent of global ratification***	***5: National level mainstreaming mechanisms***	***6: Global funds or financial supports for implementation***	***7: Global institutional responsibility or task force to spearhead implementation***	***8 Global progress monitoring mechanisms (tools, methods, conventions, etc.)***
Kyoto Protocol	Global	GHG emissions reduction	Adaptation Fund (AF)	192 signatories	Mainstreamed through national emissions targets	Emissions Trading, Clean Development Mechanism (CDM), Joint Implementation (J.I.), Adaptation Fund (A.F.)	UNFCCC	UNFCCC – COPs Annual GHG inventory submissions
Clean Development Mechanism (CDM) of Kyoto Protocol	Global	GHG emissions reduction	Carbon trade and financing		Designated National Authorities are the national focus persons for CDM activities	Certified emission reduction (CER); adaptation fund	CDM Executive Board	UNFCCC
Paris Agreement	Global	GHG emissions reduction	National and regional commitments.	197 signatories	Mainstreamed through nationally determined contributions (NDCs).	Climate Financial Mechanisms such as GEF and GCF	UNFCCC secretariat	UNFCCC – COPs, National GHG inventory, technical review/analysis
Reducing emissions from deforestation and forest degradation and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries (REDD+)	Developing countries	Forests (Deforestation and forest degradation)	Performance/ Results-based payment		Country readiness and implementation phases.	Largely bilateral and multilateral channels.	UN-REDD Programme Secretariat	UNFCCC – COPs National Forest Monitoring System National REDD+ strategies
Cartagena Protocol on Biosafety	Global	Biosafety on biotechnology (GMOs) development	Safeguarding environment and human health from biotechnology risks	173 parties	Establishment of National Biosafety Framework	Bilateral/unilateral funds, e.g., GEF	CBD secretariat	CBD – COP-MOP
Nagoya Protocol on Access and Benefit-sharing	Global	Genetic resources and traditional knowledge	Equitable benefit-sharing	130 parties			CBD secretariat	CBD – COP-MOP
National Biodiversity Strategy and Action Plan (NBSAP)	Global	Biodiversity conservation		192 of 196 Parties have developed at least one NBSAP	Developing national biodiversity strategies and action plans (NBSAPs)		CBD secretariat	CBD – COP-MOP

(Continued)

TABLE 9 | (Continued)

Policy tool/instrument/ mechanism	Attributes for comparative insights							
	1: Geographic scope/focus	*2: Sectoral emphasis*	*3: Incentive models or mechanisms*	*4: Extent of global ratification*	*5: National level mainstreaming mechanisms*	*6: Global funds or financial supports for implementation*	*7: Global institutional responsibility or task force to spearhead implementation*	*8 Global progress monitoring mechanisms (tools, methods, conventions, etc.)*
Sustainable Land Management (SLM)	Global	Land degradation			Country and project-specific interventions	Bilateral/unilateral funds, e.g., GEF	UNCCD	UNCCD COPs
Land Neutrality Target (LDN)	Global	Land degradation		127 countries committed	National Voluntary Targets For LDN	LDN Fund LDN Technical Assistance Facility	UNCCD	UNCCD COPs
National Action Programmes (NAP)	Global	Combating desertification and land degradation			Country specific NAP	Global Mechanism (GM) of UNCCD	UNCCD	UNCCD COPs
Land Use, Land-Use Change and Forestry (LULUCF)	Global	Offsetting GHG emissions			National commitments	Different public, private and multilateral agreements	UNFCCC	UNFCCC through Kyoto Protocol mechanisms
Bonn challenge	Global	Restoring degraded/ deforested landscapes	Voluntary national pledges on landscape restoration	61 countries 74 pledges	National and regional commitments	Different public, private and multilateral agreements	Bonn Challenge Secretariat	National and regional level actions, e.g., AFR100, ECCA30 and Initiative 20 × 20

greenhouse gas emissions), incentives models adopted by the tool and the extent of ratification in terms of the member countries ratifying the tool/mechanisms. The analysis also included the national mechanism for localization, financial support mechanism and institutional spearheading the implementation. **Table 9** below summarizes the analysis.

Critical Lessons of Policy Mechanisms Development for Tropical Forests Conservation and Climate Risks Management

Several concluding thoughts and critical lessons can be drawn from the review of studies on different policy mechanisms. Conservation of tropical forests is crucial in managing climate risks, primarily through sequestrating and sinking carbon emitted from various sources. Geopolitics play a critical role in effectively tropical forests conservation and climate risks management through developing policy frameworks and mechanisms. Policy mechanisms must be supported by strong policy and institutional frameworks to impact the national level. Appending signatures and ratification on the multilateral tropical forest conservation and climate risks management agreements may have little meaning at the national level if there are no clear frameworks for domestication, implementation, accounting, and verification. Nations with strong domestic policy and institutional frameworks have the potential for more accrued benefits than those with inadequate domestic systems. Unfortunately, this remains a significant gap that needs to be addressed across all the policy mechanisms. Factors such as bureaucracies and insufficient capacity are among the leading causes of inadequate policy domestication.

The transition from negotiation, decisions, actions, and policies development is also a significant gap that needs consideration across all the policy mechanisms. More than ever, more evidence-based decision making is required for the policy mechanisms to be impactful at national levels. However, most of the policy mechanisms are politically oriented, leaving out the crucial economic and ecological balances. The critical lesson drawn here is the need for more integrated, multi-stakeholder and cross-cutting considerations from social, economic, and environmental interests when developing policy mechanisms. Of particular interest are the local and indigenous communities directly in the use and conservation of the critical tropical forests such Amazon and Congo Rainforests, who are denied their fundamental human rights of participation and benefits sharing in the projects design and implementation.

Increased investment and incentives are crucial, especially in supporting community participation when the projects

are rolled out. These can be utilized to build local and national technical capacities and create awareness to implement the ratified policy mechanisms, and increase co-benefits such as employment, revenue generation, and ecological regeneration and health. Contextualization is also crucial when designing and implementing policy mechanisms, considering the geographical differences and geopolitical interests between developed and developing countries. The study emphasizes the need to move from a one-size-fits-all arrangement to a more flexible and customizable approach in domesticating the policy mechanisms based on local contexts. Uneven distribution of related projects translates to uneven benefit sharing and may lead to increased vulnerability of the communities conserving tropical forests to climate change effects. The last essential consideration is the need for interlinking and coordinating tropical forests conservation and climate risks management mechanisms developed under UNCED 1992 at national and international levels. Looking at each policy mechanism individually without considering the associated impacts on the other means may collectively affect the overall performance at national and global scales.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

AUTHOR CONTRIBUTIONS

KM and LD conceived the study, methodology, and formal analysis. KM prepared the original draft. KM, LD, and PW reviewed the first draft. LD and PM supervised the study. All authors contributed to the review, editing and approval of the submitted draft.

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SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/ffgc.2021.748170/full#supplementary-material

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