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Challenges in Forest Carbon Governance: Insights From Southeast Asia

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ABSTRACT

Meeting global climate change mitigation targets will require enhanced nature-based carbon sequestration, in which forest carbon schemes play a major role. This is despite criticisms of forest carbon schemes' efficacy, social impacts, and downgrading of other forest functions and services. Against this backdrop, we reviewed existing social science research on the governance of terrestrial forest carbon schemes in Southeast Asia, a forest-rich region with high deforestation rates that is in many respects representative of the wider tropics. Our narrative review focused on four themes: (i) finance and the political economy; (ii) knowledge; (iii) implementation; and (iv) inclusivity, equity, and justice for local communities. We found that forest carbon schemes have been unable to compete with large-scale drivers of deforestation, tend to privilege scientific and expert knowledge in relation to carbon accounting and geospatial analyses, are significantly limited by national and local governance issues, and have often not provided the intended benefits for local communities. The literature reviewed largely focuses on donor-supported and project-scale REDD+. However, forest carbon governance is rapidly changing. We thus make the case for a governance research agenda that focuses on jurisdictional approaches, increasing levels of private sector investment, the diversification of forest interventions, and efforts to restore the legitimacy of forest carbon credits. These directions for future research are essential for ensuring that forest carbon schemes contribute to effective climate change mitigation and the conservation of forest ecosystems in just and equitable ways that benefit local communities in Southeast Asia and tropical latitudes more widely.

This article is categorized under:

Policy and Governance > Multilevel and Transnational Climate Change Governance

1 | Introduction

Alongside reducing greenhouse gas (GHG) emissions from the burning of fossil fuels, achieving the United Nations' target of zero net emissions of greenhouse gases ("net zero") by 2050–2070 requires the protection and enhancement of nature-based carbon sinks (UNFCCC, n.d.-a). Forests account for more than half of the global terrestrial carbon pool, with tropical forests containing almost as much above-ground carbon as temperate and boreal forests combined (Hui et al. 2017). As the third-largest sectoral contributor of anthropogenic GHG emissions, the Agriculture, Forestry and Other Land Uses (AFOLU) sector is unique in that action can be taken to both reduce carbon emissions and enhance its capacity to remove atmospheric carbon dioxide (Dhakal et al. 2022; Nabuurs et al. 2022). Among the climate change mitigation measures available to the AFOLU sector, avoiding tropical deforestation and promoting tropical reforestation have the greatest potential (Buma et al. 2024). These forest-based natural climate solutions, defined as "conservation, restoration, and/or improved land management actions that increase carbon storage and/or avoid greenhouse gas emissions" (Griscom et al. 2017, 11645) are part of the broader concept of nature-based solutions (Ellis et al. 2024), which are "actions to protect, sustainably manage, and restore natural and modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits" (Cohen-Shacham et al. 2016, xii).

Whereas nature-based solutions can be characterized by multiple outcomes, natural climate solutions focus specifically on climate change mitigation through the improved storage and capture of carbon (Marvin et al. 2023; Ellis et al. 2024). They have been enacted through forest carbon schemes and supported by two frameworks under the United Nations Framework Convention on Climate Change (UNFCCC). The first is the Clean Development Mechanism (CDM), which has enabled the market-based financing of "Afforestation and Reforestation" (A/R) activities since 2003. The second is Reducing Emissions from Deforestation and Forest Degradation (REDD+),[1] which provides results-based payments to developing countries for reducing deforestation and was designed to be eventually funded by carbon markets (Wunder et al. 2024). However, forest carbon schemes are not without criticism. Regarding how they mitigate climate change, REDD+ projects have generally failed to engage with larger drivers of deforestation (Turnhout et al. 2017) and overestimated their additionality (West et al. 2023). In terms of their social impacts, some forest carbon schemes have threatened land tenure security (Parola 2020), sidelined indigenous and local voices (de Wit and Mourato 2022), and fallen short on claims to deliver community and livelihood co-benefits (Krause and Nielsen 2019). They also fall short in terms of transparency, standardization and project sustainability (Cadman et al. 2017; Blanton et al. 2024). Further, they tend to exclusively focus on the function of forests as carbon sinks, neglecting other functions, for example, biodiversity conservation and the maintenance of cultural identities (Phelps et al. 2010). They also often overlook forests as lived, social-ecological environments (Walton 2024; Kull et al. 2024).

Despite these criticisms, Article 6 of the 2015 Paris Agreement sets the stage for scaling up a range of forest carbon schemes by allowing countries to pursue diverse financing options (McDermott et al. 2022). Article 6.2 provides cooperating countries with the freedom to decide what projects are to be implemented, including the methodologies and standards to be used (Granziera et al. 2024), thus allowing for a wide range of project outcomes. Focusing on Southeast Asia, we review social science research on terrestrial forest carbon governance, that is, how various actors interact to shape schemes that use forests as a strategy for mitigating climate change. We consider programs and projects in which climate change mitigation efforts intersect with forest landscapes, such as national REDD+ programs as well as afforestation, reforestation, and revegetation (ARR[2]) projects. The objectives of this narrative review are to: analyze the state of current research on forest carbon governance; assess the limitations of this research; and develop a research agenda to guide future governance research in a part of the tropics where the market is increasingly seen as potentially effective in mitigating climate change. A focus on governance provides insight into how decisions are made among relevant actors regarding the distribution of benefits and impacts related to forest carbon schemes (Pierre and Peters 2020).

We focus on Southeast Asia because it contains 15% of the world's tropical forests but experiences high deforestation rates and AFOLU-related emissions (Estoque et al. 2019; Turner and Snaddon 2023; Panda and Yamano 2023). This politically and culturally diverse region faces challenges in balancing the conservation of terrestrial forests, comprising as much as 43% of its land area (Sarira et al. 2022), with its rapidly changing land use regimes, economic growth imperatives, and the burgeoning demands of growing and industrializing human populations (UNESCAP 2017; Hirsch 2020). Overlapping tenurial arrangements, competition over natural resources, and major expansion of commercial agriculture over recent decades place added pressures on forest frontiers (Han and Huang 2021; Charoenratana et al. 2021; Piabuo et al. 2023). Further, although nature-based solutions have been traditionally and informally implemented (Wolff et al. 2023; Dey and Arunachalam 2024), their potential to address a range of societal challenges remains understudied in Southeast Asia (Dunlop et al. 2024). Our focus on Southeast Asia thus enhances understanding of the opportunities and challenges from growing investor interest in natural climate solutions in the region (Koh et al. 2021) and offers important lessons for forest carbon governance more widely.

Our review of the literature shows that forest carbon schemes in Southeast Asia have been beset with significant and multifaceted governance challenges. They have been unable to compete with and mitigate large-scale drivers of deforestation, tended to privilege scientific and expert knowledge related to carbon accounting and geospatial analyses, been significantly limited by national and local political roadblocks, and provided limited benefits for local communities. However, much of the research has largely focused on REDD+ projects developed by bilateral and multilateral development donors that operate within a limited geographic area, for example, a protected area or a village. This research is being outpaced by how forest governance is quickly evolving, which includes: the move towards jurisdictional approaches to REDD+, in which results-based payments are based upon forest-related emissions reductions across a larger geographic area (e.g., sub-national/provincial level); the

evolving role of private sector investment, which raises questions about regulatory oversight and emissions accounting; the diversification of forest interventions including ARR, which has received considerably less attention than REDD+; and the forest carbon industry's efforts to rebuild its legitimacy. We propose that future governance research take on these emerging areas in order to provide the insights necessary to effectively mitigate climate change, conserve forest ecosystems, and advance justice in forest landscapes.

2 | Methods

Our narrative literature review method thematically synthesizes existing research in order to redirect research (Cronin and George 2023). Using this method, we reviewed a total of 170 research articles on Southeast Asia published since 2013, when the Warsaw Framework[3] on REDD+ was adopted (UNFCCC, n.d.-b). These research articles were in English, the most common language of peer-reviewed research publications (Morrison et al. 2012). Given Southeast Asia's linguistic diversity, a limitation of focusing on English-language articles is that important empirical and vernacular insights may have been omitted. Nonetheless, we faced practical constraints in the translation and accurate interpretation of the 29 non-English articles (<1%) from our search results, four of which were in Indonesian and the rest in non-Southeast Asian languages.

Although the narrative literature review method acknowledges that reviewing every single article from diverse disciplines is not possible, a thorough approach for selecting articles is still needed to ensure that it does not overlook portions of existing literature (Snyder 2019). Our main source of research literature was the Web of Science and Scopus databases, using the following search string: {"forest carbon" OR "REDD+" OR "carbon credit*" OR "carbon offset*" OR "CDM" (all fields) AND "forest*" OR "tree*" OR "plantation*" OR "agroforest*" OR "afforest*" OR "reforest*" OR "IFM" (all fields) AND "Singapore" OR "Malaysia" OR "Thailand" OR "Cambodia" OR "Vietnam" OR "Lao*" OR "Myanmar" OR "Timor Leste" OR "Indonesia" OR "Philippines" OR "Brunei" OR "Southeast Asia" (title, abstract, keywords)}. We screened the titles and abstracts of >3000 search results to exclude articles that were not focused on the social sciences of terrestrial forests (e.g., articles primarily concerned about carbon quantification, ecological measurement, coastal ecosystems, etc.). We then further screened the resulting 319 articles for their relevance to governance to select 155 articles for full-text review. This set of articles was complemented by the full-text review of 15 additional articles that were not found in the original search and suggested by fellow co-authors.

In our review, Indonesia featured most frequently (36%), followed by Vietnam (20%), Laos (13%) and Cambodia (11%) (Figure 1).[4] Discussions on donor-supported REDD+ projects dominated (53% of papers). Twenty-five percent of the papers were on market-financed REDD+, while only 8% of the papers discussed a mixture of donor-supported and market-financed REDD+. There were very few articles specifically on the social science dimensions of restoration (e.g., ARR) (2.5%) and management (e.g., improved forest management) (<1%) linked to UNFCCC frameworks or the VCM.[5] We also noted an increase in the number of studies on market-financed REDD+ between 2019 and 2020 (Figure 2).

3 | Understanding Forest Carbon Governance

In contrast to a focus on government, which is centered on the role of the state, the concept of governance has become popular for its emphasis on the role of a wide range of non-state actors and institutions, from the private sector, civil society, and communities, among others, that have come to play an increasingly important role in decision-making processes since the 1980s in response to neoliberal reforms (Painter 2000; Pierre and Peters 2020; Bridge and Perreault 2009; Mansourian and Sgard 2021). Environmental governance more specifically focuses on the regulatory processes, institutions, mechanisms, policies, land and resource customs, and organizations through which actors influence environmental actions and outcomes (Lemos and Agrawal 2006). Environmental governance operates at various scales and between various sectors to shape how environmental resources, for example, forest carbon, are managed (Miller et al. 2020). The interactions between different actors are relational and shaped by embedded power relations (Kenney-Lazar et al. 2023) which, alongside existing outcomes, need to be analyzed for advancing justice and sustainability (Agrawal et al. 2022).

Since the 2010 Global Forest Expert Panel report on the international forest regime, the already complex terrain of international forest governance has shifted towards "climatization" (Singer and Giessen 2017; Kleinschmit et al. 2024), whereby forests are increasingly governed in terms of whether they act as a source or sink of carbon through forest carbon schemes (Muthee

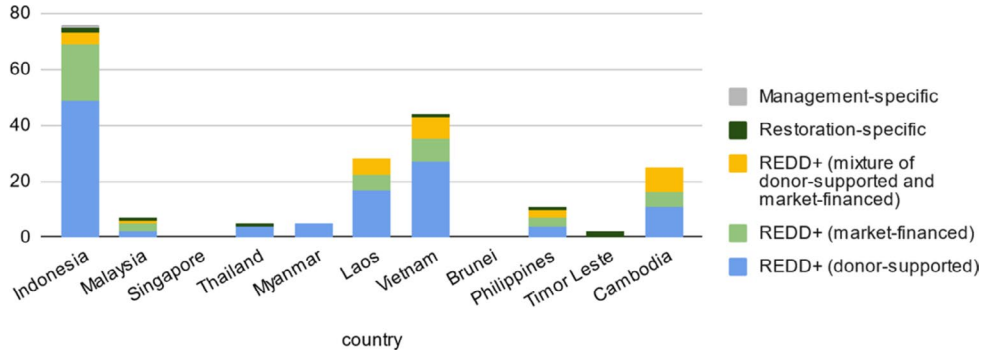

FIGURE 1 | Types of forest carbon schemes mentioned in the reviewed literature, by Southeast Asian country.

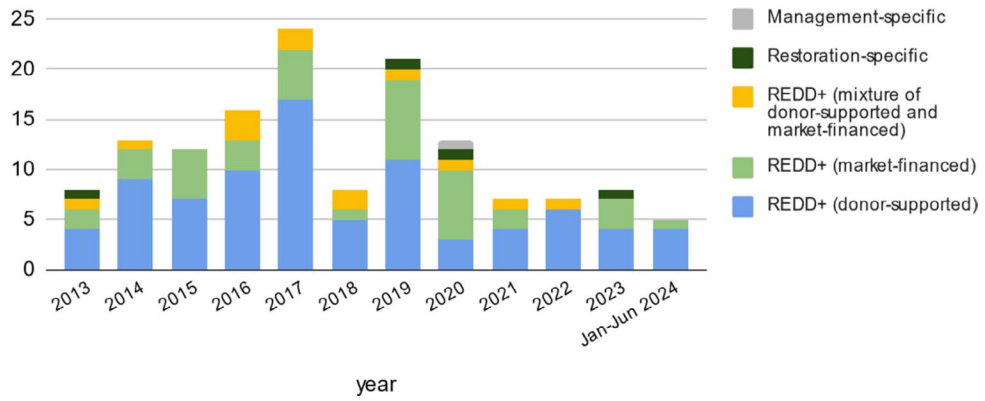

FIGURE 2 | Types of forest carbon schemes in the reviewed literature, by publication year until mid-2024.

et al. 2022). As a sub-field of forest governance, we define forest carbon governance as how various actors—ranging from governments, intergovernmental organizations, scientific institutions, private companies, nongovernmental organizations, civil society, and local communities—interact to shape the design, planning, implementation, and outcomes of forest carbon schemes, with attention to how these processes are influenced by power relations. Our definition adopts a relational lens to environmental governance (Kenney-Lazar et al. 2023) and builds on literature where the term forest carbon governance has been used to refer to the shaping of forest carbon policy and monitoring practices by various actors (Lovell 2014), emphasizes the interconnections between institutions, carbon technologies, and carbon (as matter) (McGregor et al. 2019), and highlights the role of experts and state actors, scalar issues, and uncertainty within carbon accounting methodologies (Ruseva 2023).

There is substantial history and diversity in forest carbon governance. Internationally, various programs to govern forest carbon have been developed under the UNFCCC. Since 2003, A/R activities in developing countries have been funded by developed countries under the market-based Clean Development Mechanism (CDM), an instrument created under the Kyoto Protocol at the UNFCCC's 3rd Conference of Parties (COP) in 1997 (Kägi and Schöne 2005).[6] At COP11 in 2005, Costa Rica and Papua New Guinea, on behalf of the Coalition of Rainforest Nations, proposed funding for developing countries under Reducing Emissions from Deforestation (RED) (Lederer 2011). This initiative was later expanded to include forest degradation (REDD) in 2007 at COP13, and further broadened at COP15 in 2009 to encompass conservation, sustainable management of forests, and enhancement of forest carbon stocks (REDD+) (Sacherer et al. 2022). Since its official adoption, most participating countries have completed the readiness stage of REDD+ and have progressed to the implementation and results-based payments phases (McDermott et al. 2022). While emissions reductions from A/R under the CDM have been used by the funding country to meet their own climate change mitigation targets, this was not the case for REDD+ activities prior to Article 6 of the Paris Agreement (Angelsen 2017; Granziera et al. 2024). Besides these inter-governmental programs under the UNFCCC, the emergence of carbon trading mechanisms outside of the UNFCCC has enabled the purchase of nature-based carbon credits by private actors and institutions. Voluntary carbon markets (VCMs) have facilitated the global trading of REDD+ carbon credits for offsetting since 2011, when the first REDD carbon credits were issued under the Verified Carbon Standard (Verra 2011; Wyburd 2023).

To summarize, forest carbon schemes differ according to the type of forest intervention, the mode of financing, their implementation scale, and how the emissions reductions are used (Streck et al. 2021; Figure 3). The types of forest interventions can be categorized into forest protection (e.g., activities to reduce deforestation and forest degradation on the VCM and UNFCCC-REDD+), restoration (e.g., A/R projects on the CDM and ARR projects on the VCM) and management (e.g., improved forest management projects on the VCM) (Griscom et al. 2020; Figure 3). Although conserving and enhancing forest carbon stocks and sustainably managing forests are also considered REDD+ activities, reducing emissions from deforestation and forest degradation has been the main focus of UNFCCC negotiations and discourse (Lederer 2012; La Viña et al. 2016). In line with this, we use REDD+ in this review to refer to results-based schemes aimed primarily at emissions reductions from deforestation and forest degradation. Further, forest carbon schemes can either be donor-supported (i.e., non-market based), market-financed, or a mixture of both in which donor funds are used in the initial phases. Forest carbon schemes can be implemented at either local or jurisdictional scales. Finally, the emissions reductions can be used for meeting countries' respective Nationally Determined Contributions to mitigate climate change under the Paris Agreement or traded as carbon credits for offsetting emissions by industries or by other countries.

4 | Forest Carbon Governance Challenges in Southeast Asia

Based on our narrative literature review, governance challenges in Southeast Asia can be categorized into four emergent themes: finance and political economy; knowledge; implementation; and inclusivity, equity, and justice for local communities. Within each theme discussed below, recent developments that could benefit from further governance research are highlighted.

4.1 | Finance and Political Economy

Within a wider political context, substantial financial resources are needed to incentivize forest owners, users, and managers

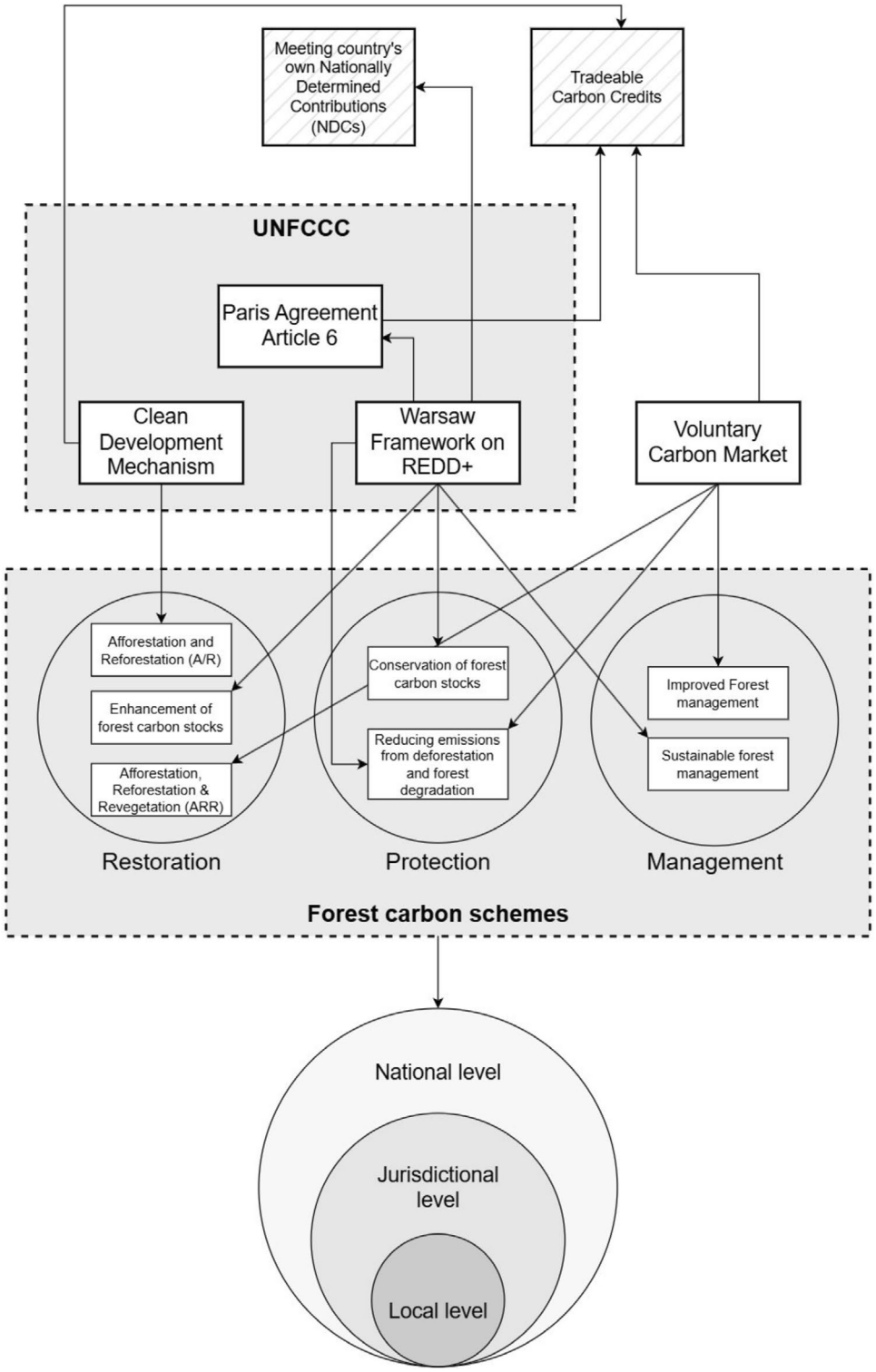

FIGURE 3 | Forest carbon schemes comprise a variety of forest interventions, operate under different frameworks for funding and emissions reductions, and are implemented at various scales.

to conserve rather than clear forests for other uses (Graham et al. 2016). The financing of REDD+ has, however, been limited by the disjointed financing landscape with varying objectives, modalities, and conditions across different multilateral and bilateral sources of funding, as well as slow progress on a global carbon trading framework (Well and Carrapatoso 2017; Angelsen 2017; Pham, Moeliono, et al. 2021). Coupled with low carbon prices, these issues affect the ability of REDD+ to compete with major drivers of deforestation, such as industrial plantations, agricultural land clearing, mining, economic land concessions, and other development investments (Duker et al. 2019; Kissinger 2020; Carrilho and Chervier 2023). A focus on localized, project-scale interventions rather than jurisdictional programs has also contributed to the limited effectiveness of REDD+ in reducing tropical deforestation (Fletcher et al. 2017; Wunder et al. 2024).

Consequently, large-scale deforestation drivers have prevailed due to fundamental tensions between national economic development priorities, demographic changes, and forest conservation (Dwyer et al. 2016; Cole et al. 2017; Maxwell et al. 2018). Rather than addressing large-scale deforestation drivers such as commercial plantations and agriculture, REDD+ projects have largely targeted the types of land uses that are the cheapest and most politically viable to change, especially smallholder farms and swidden cultivation (McElwee 2016; Wong et al. 2019; Bos et al. 2020). Such projects, however, have been unable to prevent smallholder farmers from converting forests to cash crops (Kurashima et al. 2014; Salvini et al. 2016; Irawan et al. 2019). They have also been unable to prevent forest encroachment when low-income populations remained food-insecure or when their immediate financial needs were not met (Tabeau et al. 2017; Ken et al. 2020). Together, the above research findings show how REDD+ incentives have often been insufficient for conserving forests, at the local scale and at larger scales.

The "projectification" of REDD+ (Moeliono et al. 2020, 1), in which systematic long-term plans are replaced by simplified approaches (Li 2016), along with its associated challenges, is linked to pilot activities implemented during the REDD+ readiness phase as well as to the slow process of mobilizing large-scale funding to support jurisdictional approaches. Jurisdictional approaches should integrate government-led multi-stakeholder processes to achieve forest emissions reductions at the subnational/provincial level (Seymour et al. 2020). While Indonesia embarked on jurisdictional-REDD+ implementation in the early 2010s through funding from Norway's International Climate Forest Initiative, multilateral funding supporting jurisdictional approaches such as the UNFCCC's Green Climate Fund and the World Bank's Forest Carbon Partnership Facility's Carbon Fund only became available for more countries later in the decade (Jodoin 2017; Wunder et al. 2020). This is still far from the original vision of REDD+ being eventually funded by carbon markets (Fletcher et al. 2017); whether Article 6 of the Paris Agreement will facilitate more financing for REDD+ remains to be seen.

The private sector has funded REDD+ projects mainly through the purchase of carbon credits on the international VCM (Morita and Matsumoto 2023). This is significant because, unlike the CDM's A/R projects that generated tradable emissions reductions credits, REDD+ projects under the UNFCCC framework earn only results-based payments. The VCM operates outside regulatory frameworks (Dixon and Challies 2015) but has been financing forest conservation in Southeast Asia.[7] Demand for REDD+ carbon credits increased from the 2010s when private companies (mostly headquartered in the Global North) wanted to meet their environmental, social, and governance (ESG) commitments (Parotta et al. 2022).[8] While we could not find any data specific to Southeast Asia, the role of the VCM in financing forest carbon schemes is substantial. Compared to the USD 1519.6 million in global multilateral funding for REDD+ in 2008–2020 (McDermott et al. 2022), voluntary REDD+ carbon credits were globally transacted at USD 584.2 million in 2022 and USD 222.3 million in 2023 (Forest Trends' Ecosystem Marketplace 2024). This system is facilitated by voluntary third-party verification and accounting standards and supported by an industry of private consultants and intermediaries, who command fees for their services (Fleischman et al. 2021).

However, with low carbon prices in the VCM, additional carbon revenues from ARR projects constitute a small portion of existing revenue sources for plantation companies and, for REDD+ projects, are unlikely to induce systemic changes in land use (Pichler and Ingalls 2021; Morita and Matsumoto 2023). Research in Cambodia has shown that carbon-market volatility challenges the provision of sufficient and sustained financial support (Nathan and Pasgaard 2017; Ken et al. 2020). The persistence of leakage and other problems associated with project-scale implementation has led to the voluntary carbon industry introducing standards for jurisdictional REDD+ (McDermott et al. 2022).

Green finance instruments, such as green bonds and green Islamic bonds (Faizi et al. 2024), have the potential to mobilize greater capital. However, they have been less attractive to investors due to uncertain returns and ambiguity over what constitutes a green project (Setyowati 2020a; Anas et al. 2023). Carbon credit trading and associated services, like Indonesia's Carbon Exchange and ratings agencies, may stimulate the flow of green finance by enabling investors to identify good quality carbon credits (Yuspin et al. 2024). However, green finance has conventionally focused on non-forest projects, such as green infrastructure development and renewable energy technologies (McFarland 2018; Nurfatriani et al. 2022; Zhou et al. 2024). In Indonesia, while green finance has sometimes been channeled toward plantations, the clearance of natural forests continues due to limited regulatory oversight (Budiasa 2020; Setyowati 2020a).

Several questions remain that future research could usefully target. How do private and public finance overlap? Private finance for REDD+ has mainly flowed through the VCM, but schemes that blend public and private finance are attracting increasing interest (Morita and Matsumoto 2023). How do private flows of finance fit into existing forest carbon governance frameworks? For example, voluntary forest carbon projects pursued by the private sector can result in double counting of emissions reductions if they geographically overlap with a jurisdictional emissions reductions program (Wunder et al. 2020). Nested accounting has been proposed to address this (Streck 2021), but significant work is first needed by governments to set up the required carbon accounting architecture (McDermott et al. 2022). What is the effect of government regulations as well as private rules and institutions in influencing the behavior and actions of private actors? Regulations can determine the operation of forest carbon trading and facilitate collaboration and coordination between different land users (Hamzah et al. 2019; Cadman et al. 2019; Ng and Webber 2023). In the interest of protecting the legitimacy of forest carbon schemes and the reputations of investors, voluntary forest carbon project developers can also highlight the need for clearer legislation and enforcement action on effective social safeguards (Lau et al. 2024). To what extent will a global carbon trading framework and increased private financing reshape the political economic calculations of forest carbon schemes that had previously been reliant on mostly donor support, especially REDD+? It remains to be

seen whether there will be sufficient finance to provide sizable and sustainable incentives to compete with major drivers of deforestation.

4.2 | Knowledge

Biases in the production and use of knowledge, shaped by power relations, can hinder the long-term effectiveness of forest carbon schemes (Kenney-Lazar et al. 2023). Knowledge thus emerges as another critical theme, as both the content and production of knowledge influence how issues are framed and how decisions are made (Morrison et al. 2017).

Lessons from other subfields of forest governance, such as community forestry and forest landscape restoration, highlight the importance of integrating diverse forms of knowledge into the development and implementation of programs (Elias et al. 2022). However, the design of forest carbon schemes has privileged biophysical and geospatial expert knowledge over Indigenous/local knowledge and the social sciences (Sharma and Shivakoti 2017; Neimark et al. 2020; Manahan 2023). The inherently technical nature of measuring forest carbon means that issues like the establishment of baseline levels of carbon emissions in REDD+ action plans (Irawan et al. 2019; Li et al. 2022) and estimations of macroeconomic-influenced deforestation rates (Mertz et al. 2018; Sandker et al. 2021) have tended to be prioritized.

The overriding focus on carbon emissions reductions and the associated monetary benefits have resulted in a techno-managerial culture in REDD+ (Nathan and Ramcilovic-Suominen 2020), in which non-carbon forest ecosystem functions are often deprioritized and the affected local communities frequently underrepresented (Milne et al. 2019; Krause and Nielsen 2019). Many forest restoration carbon projects are also carried out with insufficient ecological considerations (Banin et al. 2022). Knowledge about on-the-ground, tangible processes of labor and social inclusion have been abstracted to demonstrate compliance with international carbon standards and enable the flow of funding (McElwee 2016; Frewer 2021). By obfuscating on-the-ground knowledge about complex land use-livelihood linkages and local contestations (Lestrelin et al. 2019; Milne and Mahanty 2019), and against the backdrop of insufficiently clear legislation on how local communities should be engaged in decision-making (Vongvisouk et al. 2016), an approach of reporting up to decision-makers reinforces top-down implementation and the hegemonic control of forest users' environmental practices (Dressler et al. 2015; Boer 2020a; Ramcilovic-Suominen et al. 2021). Monitoring and evaluating the long-term social effects of REDD+ projects has also not been accorded a similar level of importance as the monitoring of forest carbon stocks (Jagger and Rana 2017; Duchelle et al. 2017).

A techno-managerial approach towards knowledge production has meant that knowledge tends to be primarily accessible to technocratic and political elites rather than the broader society, including affected communities (Astuti and McGregor 2015; McElwee 2016; Aryal et al. 2024). Knowledge systems and tools providing a more comprehensive understanding of forest cover change, for example, national systems established in Indonesia and Laos, have largely remained within the realms of national-level institutions rather than disseminated to subnational jurisdictions and local communities (Veridiano et al. 2015; Boer 2020b). Participatory or community-led measurement, reporting, and verification (MRV) of forest carbon has been suggested as a means of democratizing forest carbon expertise and governance, by empowering local communities with the tools of forest carbon measurement alongside improving local ownership of forest conservation and linking forest monitoring with local decision-making (Brofeldt et al. 2014). Despite this potential, Bayrak and Marafa (2019)'s study of two REDD+ projects in Vietnam found that communities felt insufficiently equipped with tools for forest protection and monitoring. Studies on participatory MRV have largely focused on how it produces data for measuring forest carbon rather than how it enhances local ownership and decision-making over forests (e.g., Danielsen et al. 2013; Boissière et al. 2014; Uttarak and Laosuwan 2020; Fauzi et al. 2024).

Despite the importance of transdisciplinary approaches, the design of forest carbon schemes has not adequately integrated important domains of knowledge (Miller and Taylor 2024). For example, Bayrak and Marafa (2019) found that REDD+ projects, including one adopting a relatively inclusive approach, overlooked the spiritual dimensions of forest management. Besides knowledge about indigenous and local belief systems that govern human-forest interactions in many parts of the world (e.g., Dam and Barber 2015; Pascual et al. 2023; de Pater et al. 2023), other essential domains include critical social science perspectives that challenge taken-for-granted assumptions (Shelton et al. 2024) and the emerging science on how forests' role as carbon sinks may be overestimated (e.g., Allen et al. 2022; Qie et al. 2017; Hasler et al. 2024). This lack of transdisciplinarity may stem from the overarching structure of REDD+, which limits modifications and improvements to its design (Kono and Upton 2024). It could also result from the fact that certain forms of knowledge are more readily available and easily communicated to meet decision-makers' informational needs (Pasgaard and Mertz 2016; Nguon 2019). Further research into the "black box processes" behind policy regimes (Arts et al. 2024, 6) is useful to understand the causes of epistemological rigidity and promote the integration of diverse forms of knowledge. This is particularly important as the forest carbon industry seeks to address integrity critiques and restore its legitimacy.

The proliferation of new technologies in recent years is an emerging area for research, especially regarding how they influence knowledge processes. The increased use of automatic data collection devices (e.g., LiDAR for forest inventories or drones for remote monitoring of climate risks), big data analytics, as well as the rise of Artificial Intelligence (e.g., in assessing project potential on a web-based platform), all raise questions of how forests are represented digitally, who represents them, how they are financed, and who bears responsibility for decision-making (Zou et al. 2019; Urzedo et al. 2022). Open-source datasets (e.g., GEDI; Global Forest Watch) and digital apps that purportedly link up various stakeholders (e.g., DePuy 2023; TreeO) are also becoming more publicly available. A key area of further research is whether these developments can lead to a democratization of forest carbon governance or whether they will simply reinforce

the ways in which state, expert, and technocratic knowledge are privileged.

4.3 | Implementation

The implementation of forest carbon programs has provided opportunities but also faced challenges in effectively governing land, forests, and livelihoods across scales, sectors, and actors. This theme thus reveals the multi-actor, inter-scalar nature of forest carbon schemes and the connections between decision-making and action (Miller et al. 2020).

National REDD+ programs were designed to create opportunities for governments to elevate the agenda of forest conservation from the silos of traditional forestry institutions and coordinate across different governmental sectors and scales (McGregor et al. 2015; Phromlah and Martin 2015; Enrici and Hubacek 2016). International donor agencies have assisted this transition by providing financial and technical resources to support coordination across different government sectors (Vongvisouk et al. 2016; Enrici and Hubacek 2018). Additionally, REDD+ has created opportunities for developing technical capacity in forest carbon MRV within national governments (Korhonen-Kurki et al. 2013). In Southeast Asia, notable outputs from these efforts include the OneMap Initiative in Indonesia that seeks to unify and digitize divergent maps of primary and secondary forests (Mulyani and Jepson 2017), Indonesia's development of legislation and land management systems that support forest carbon trading (Boer 2018), and Vietnam's development of the Emissions Reduction Program (ER-P) (Wurtzebach et al. 2019).

However, challenges of political and administrative coordination within and between scales, sectors, and actors exist. In Vietnam, two different ministries used different land classifications for forestland allocation, while provincial governments in Indonesia continued to grant logging permits that compromise national targets (Korhonen-Kurki et al. 2016). Coordination between government and the private sector in market-based REDD+ schemes has also been compromised by the limited and slow rollout of regulations required for efficient and trustworthy international trading in carbon credits (Pham et al. 2016; David et al. 2022; Do and van Noordwijk 2023).

Such challenges are compounded by the broader political context of elite capture, in which private investors co-opt state and military elites and institutions to ensure that they can continue to extract resources without restrictions imposed on them by forestry and carbon regulations (Williams and Dupuy 2019; Boer 2020a; Skutsch and Turnhout 2020). Such interests by the elites in resource extraction and commodity production in forested areas, especially related to logging, timber, and industrial crop plantations, mining, and infrastructure, affect the political economy of forest carbon schemes. Together with corruption, elite capture has impeded the efficacy of participatory approaches, social safeguards, and legal and regulatory changes in REDD+ programs (Williams and Dupuy 2019; Kane et al. 2018; Pichler and Ingalls 2021).

The implementation of REDD+ has also highlighted issues of unclear and historically complex tenurial arrangements and resource rights. These affect the determination of rights, responsibilities, and level of participation among local communities and are important for successful project implementation. Experience from REDD+ implementation has shown that resolving tenure issues helps to prevent project failure and guide benefit-sharing frameworks (Richards and Hobley 2016; Loft et al. 2015; Rochmayanto et al. 2019). As such, some forest carbon schemes have incorporated the clarification of land tenure (Mahanty et al. 2015; Bos et al. 2020). More generally, the implementation of forest carbon schemes has provided renewed opportunities for discussing a range of long-standing social policy issues, such as the formal recognition of the role local communities play in managing forests (Manahan 2023).

Although resolving land tenure issues inclusively is vital for project success (To et al. 2017; Enrici and Hubacek 2018), forest carbon schemes have often avoided grappling with deeper and politically complex issues that limit the translation of policy to practice (Gverdtsiteli 2024). Such issues include the historical injustices of dispossession from customary lands (Sunderlin et al. 2014; Duchelle et al. 2017) and enduring business-as-usual interests dominating land use decision-making (Sunderlin et al. 2018). The failure to adequately address these issues has led to cynicism about forest carbon schemes and their advocates, such as NGOs, in the Philippines (Dressler 2017) and even the rejection of project benefits as a form of local protest in Indonesia (Myers et al. 2018).

The implementation challenges of forest carbon schemes have been well documented with regard to donor-supported, project-based REDD+. However, forest carbon governance is changing rapidly, and there has been less research on how these new developments address the implementation challenges that have been faced so far. The ongoing transition from project-based to jurisdictional REDD+ has promised to address issues of leakage, better enforce policies, enhance integration of commodity-related policies, and resolve land tenure issues by reconciling competing land uses and reducing forest-level emissions at the subnational scale (Sloan et al. 2018; DePuy 2023; Bahruddin et al. 2024). All these require better coordination among government and non-government actors involved in forest governance, the latter including private firms, civil society, Indigenous peoples, forest users, and peasant farmers. However, the existing research on jurisdictional REDD+ has mainly focused on Indonesia. For example, Irawan et al. (2019) found that subnational jurisdictions have not been sufficiently empowered to plan their own emissions reductions. Seymour et al. (2020) described Indonesia's jurisdictional approach as characterized by multistakeholder mechanisms but noted that incentives remained insufficient.

The architecture of carbon markets and Article 6 of the Paris Agreement allows for various actors to pursue different types of forest carbon schemes. The growing role of the private sector in REDD+ projects and voluntary carbon offsets (e.g., Visapra 2024) is impacting governance, particularly in the ways private actors coordinate with government offices and international donors and organizations. Private and non-governmental actors, such as plantation companies and community-based organizations, are also playing an increasing role in generating

and selling carbon credits through other forest interventions like ARR, in which land is required for tree-planting (e.g., Silvicarbon 2024). These form emerging areas of research on the implementation opportunities and challenges of forest carbon schemes.

4.4 | Inclusivity, Equity, and Justice

The fourth theme of inclusivity, equity, and justice for local communities has been a major area in forest carbon governance, because forest-dependent and forest-proximate local communities have been targeted in the design of forest carbon schemes (Skutsch and Turnhout 2020). Justice differs from equity in that it refers to the "rightful meaning and intent" (Bensimon 2018, 95), and local perceptions of justice also contribute to social feedback that affect the receptivity and success of forest governance interventions (Dawson et al. 2017; Hoang et al. 2019).

Inclusivity in forest carbon schemes is not only important to their success, but also in ensuring that harm is reduced and benefits are enhanced (Bong et al. 2016; Sanders et al. 2020). One key mechanism for stakeholder engagement is Free, Prior, and Informed Consent (FPIC), which aims to ensure that affected land- and forest-users are on board with projects prior to commencement (Nzioki 2021). Reflecting how FPIC can act as a learning process between the project developer and local stakeholders (Pham et al. 2015), Ken et al. (2020) and Palmer and Jackson (2023) showed how local people are active agents who reshape the power dynamics with project developers as they become more proactive in demanding transparency and being informed about their rights.

Whether the implementation of FPIC genuinely facilitates inclusivity remains a source of contention. Often operating largely with a checkbox approach, FPIC has been criticized for limited transparency, unfair due process, and partial participation (Avtar et al. 2019; Filer et al. 2020; Ramcilovic-Suominen et al. 2021). REDD+ program officials often presume local stakeholders' needs or engage in superficial dialogue (Kenney et al. 2015) and the bulk of decision-making in project activities has been done by the central government and development partners (Boutthavong et al. 2017). Creating a robust FPIC process is also difficult when a culture of representation and bottom-up participation is lacking (Sharma and Shivakoti 2017; Kane et al. 2018). There have been instances when FPIC has been viewed with suspicion (Pham et al. 2015) and the participation of civil society organizations has been limited (Milne et al. 2019). There are a few encouraging examples, however. In Cambodia, a REDD+ project was the first in the country to implement a thorough FPIC process following international guidelines (Mahanty et al. 2015). In Laos, the FPIC implementation team included women and was proficient in ethnic minority languages, thus facilitating outreach and communication to otherwise marginalized groups (Sawathvong and Hyakumura 2024).

The equity and justice dimensions of benefit-sharing schemes—that is, who should receive the result-based payments or carbon revenues—are thus key concerns. The distribution of carbon revenues differs from the co-benefits of forest carbon schemes (e.g., infrastructural improvements, poverty reduction), which may have uneven net effects on local well-being (Jagger and Rana 2017; Sunderlin et al. 2017). In national REDD+ programs, benefit-sharing is enacted through fiscal mechanisms that distribute REDD+ results-based payments to the subnational and village levels (Pham, Moeliono, et al. 2021; MAF 2021; Do and van Noordwijk 2023). Although such benefit-sharing schemes and some voluntary projects' revenue flow models recognize that local people provide important labor, they have yet to adequately reflect and compensate for the precarity (e.g., opportunity costs, and livelihood risks) that local people face (Neimark et al. 2020; Bond et al. 2020; Bayrak and Marafa 2019). The implementation of benefit-sharing has also been problematic in some forest carbon projects, such as when arrangements were not agreed in advance with local communities (Nathan and Pasgaard 2017) and the benefits arrived late (Myers et al. 2018) or worse, were not delivered (Ken et al. 2020).

An important element of ensuring equitable participation and distribution of benefits concerns heterogeneous and unequal intra-community dynamics (Astuti and McGregor 2017; Setyowati 2020b; Musthafa and Youn 2022). Heterogeneous intra-community features include ethnicity, forestland area and assets owned, existing structures of income and livelihood activities, educational levels and concerns about forest degradation (Kurashima et al. 2014; Le et al. 2023). Intra-community power imbalances have led to the misappropriation of the FPIC process by self-interested local leaders (Rotz 2014) and exacerbated inequalities and conflicts among households and ethnic groups (Nguyen et al. 2017; Hiratsuka et al. 2022; Kobayashi et al. 2022). This community-scale intersectionality extends to gendered inequalities, in which women often have fewer access entitlements to markets than men and are victims of dispossession processes due to gendered dynamics of discrimination (Howson 2017). Traditional societal norms and gendered labor divisions also mean that women have been less active participants than men in REDD+ activities (e.g., forest patrolling) (Kane et al. 2018), while having to bear more of the burden in ARR activities (e.g., smallholder tree-planting projects near home) (Bond et al. 2020).

Injustices and inequality have also been exacerbated within REDD+ project areas in the form of land tenure and access issues, often with no meaningful improvement of community rights to natural resources (Nhem and Lee 2019; Wong et al. 2020). Through redefining the actors in charge of forest property rights, REDD+ implementation has strengthened local control in decentralized governance contexts such as Indonesia (Rochmayanto et al. 2019), but has challenged customary forest governance systems and led to more insecurity where centralized government is strong (Mahanty et al. 2015; Broegaard et al. 2017). In Laos, for example, Sikor et al. (2017) observed that state agencies and REDD+ international actors claim the authoritative rights over forest property. Additionally, REDD+ has made it harder for local people to access forest areas and use resources for their livelihoods. In a REDD+ project in Vietnam, many villagers felt that their livelihoods were impacted as they had no alternatives to harvesting forest products and farming (Kane et al. 2018). In Cambodia and the Philippines, Neimark et al. (2020) pointed out how the establishment of protected areas displaced locals

from their livelihoods. In Indonesia, Howson (2018) reported how the enclosure of a forest area exacerbated inequalities within the community. Further, the focus on formalizing tenure according to modern administrative norms of individually held property rights has sometimes led to the unintended outcome of locals using REDD+ tenure instruments to secure access to land for cash crops and timber production, at the expense of more sustainable customary community management practices (To et al. 2017).

Questions remain regarding how inclusivity, equity, and justice for local communities are being addressed in the most recent developments in forest carbon governance. Alongside the VCM, Article 6 of the 2015 Paris Agreement enables the expanded implementation of forest carbon schemes. While intended to help achieve the UN's net zero target, the research reviewed has shown that this poses substantial risks to local communities. More research is needed on how local communities can be protected from such risks and the ways in which governments are developing legislative frameworks of carbon rights to guide benefit-sharing. Such legislation is needed to provide clarity on how carbon revenues should be shared with local communities (e.g., linked to land tenure rights) to help avoid challenges in the implementation of benefit-sharing schemes and to minimize the influence of social and political relationships (Howson and Kindon 2015; Goh et al. 2023). Greater understanding is required of which grievance mechanisms are acceptable and how they can be used effectively to address injustices, for example, those stemming from elite capture, power inequalities, and corruption. Local communities may prefer customary modes of dispute resolution (Lau et al. 2024), partly because official grievance mechanisms may lack the independence and reliability needed to protect them from contradicting policies, conflicts of interest, and land-grabbing (Phromlah and Martin 2015; To et al. 2017).

Efforts to restore the legitimacy of forest carbon schemes present an opportunity for clarifying and enhancing the social integrity of projects. However, although transparency across the carbon credit value chain can highlight social concerns to investors (Dixon 2019; Delacote et al. 2024), it is challenging to translate complex social dynamics into reportable social indicators. For example, gender equity has been included into some REDD+ strategies through women's participation and representation in deliberative forums (Wong et al. 2019). This does not, however, necessarily translate to a genuine concern for addressing gendered power differentials (Wong et al. 2019; Pham, Duyen, et al. 2021). The lack of consensus "around the level and type of understanding that projects are aiming for and what is required for 'informed consent'" (Kent and Hannay 2020, 373) means that FPIC remains an unreliable indicator of procedural justice. Another knowledge gap pertains to how decision-makers in forest carbon governance consider concerns regarding inclusivity, equity, and justice for forest-dependent and forest-proximate local communities. This includes whether decision-makers consider customary notions of justice (Newell et al. 2021), which may reveal that procedural equity is less important than distributive matters for some marginalized groups (Sikor and Cầm 2016). It also includes whether they consider the intersectionality of local communities (McConnell et al. 2023), which may reveal their vulnerability to climate impacts and underscore the importance of designing forest carbon schemes that simultaneously enhance their climate adaptation capabilities (Landicho et al. 2023; Fischer et al. 2024).

5 | Conclusions and Recommendations for Future Research

Forest carbon schemes, especially REDD+ projects and initiatives, have been developed and implemented in Southeast Asia for over a decade, attracting significant research attention. Much of the research on forest carbon governance has focused on donor-supported REDD+ at the local project level, which has struggled to compete with commercial, especially large-scale, drivers of deforestation, partly due to low carbon prices. Additionally, this research has shown that forest carbon schemes have often privileged scientific and expert knowledge related to carbon accounting and geospatial analyses and have faced significant implementation challenges linked to national and local governance issues, for example, institutional fragmentation, lack of clear land tenure, the privileging of special economic interests, and corruption. Our review also found that many projects have failed to deliver the intended benefits for communities due to inadequate consultation and consent processes, leading to unintended consequences such as unequal benefit-sharing arrangements and the exacerbation of land and forest tenure issues.

While the long-term monitoring of projects is important, existing research is being outpaced by the speed of changes in forest carbon governance. Regarding financing and political economy, private sector actors are injecting additional finance. However, questions remain about the overlap between private and public finance, the relationship between private actors and regulations, and whether a global carbon trading framework will reshape the political economy of forest carbon schemes. On the production and use of knowledge, there is a need to understand whether and how transdisciplinarity occurs, as well as how emerging technologies may play a role in the democratization of governance. Regarding implementation, the ongoing transition to jurisdictional REDD+ and the growing role of Southeast Asia-based private actors in this process will multiply existing national and local governance challenges and pose questions about how they will be overcome. To achieve inclusivity, equity, and justice for local communities, the impending scaling up and out of forest carbon schemes for climate change mitigation necessitates an expanded understanding about risks to local communities. This also requires research on how benefit-sharing legislations are developed, how grievance mechanisms work, and how the forest carbon industry's ongoing efforts to restore its legitimacy can help to mitigate such risks.

Our narrative review has shown that forest carbon governance is evolving in terms of the implementation scale, the actors involved, the types of forest carbon schemes, and the ways in which legitimacy is constructed. To advance justice in forested areas (Larson et al. 2021) while ensuring the durability of carbon sequestered, it is necessary to understand how these latest developments are governed. We highlight four main areas for future governance research:

1. The implementation scale of forest carbon schemes is shifting from project-based to jurisdictional REDD+. Most studies on jurisdictional approaches to REDD+ have been carried out in Indonesia, where REDD+ projects received substantial levels of funding before other Southeast Asian countries. Assessing the prospects and roll-out of jurisdictional REDD+ in other parts of Southeast Asia and evaluating its engagement with powerful sectoral interests, impacts on local communities, and levels of deforestation are likely to prove rewarding. As part of this, any lessons from the implementation of jurisdictional approaches in other sectors, for example, palm oil in Indonesia and Malaysia (Buchanan et al. 2019), will be of relevance.

2. Private sector investment in forest carbon schemes is intensifying. This includes investments from private actors with a Southeast Asian base. However, this shift raises questions about regulatory oversight, transparency, and accountability, in which civil society organizations should play an important role (Mustalahti et al. 2017). Because national political institutions are often beholden to private funding and interests, it will be necessary to examine how transparency and accountability are maintained in order to prevent elite capture that can undermine the rights of local communities (DePuy 2023). Understanding the dynamics between international and national forest carbon standards (e.g., in Indonesia), which can reveal contestations between various actors in forest carbon schemes (McDermott et al. 2022), will also prove fruitful.

3. The architecture of the VCM and Article 6.2 of the Paris Agreement opens up avenues for the implementation of various forest interventions as part of increasing efforts to mitigate climate change. Particularly, around a quarter of Southeast Asia's land area is environmentally suitable for ARR, but socio-political barriers continue to accumulate amidst growing land and resource scarcity (Zeng et al. 2020). Trade-offs in smallholder land use are inevitable between agriculture and tree-planting projects (Bond et al. 2020), and conflicts have occurred between local communities and plantation concessionaires in the absence of clear government policies (Kenney-Lazar 2017). Local communities also risk exclusion from participating in forest carbon schemes due to the high costs of project verification (Ruseva 2023), while traditional agro-forest landscapes can be deemed suitable for ARR due to the political-technical ways in which forests are defined (Vandergeest and Peluso 2015; Kull et al. 2024). It will thus be useful to understand: who are the proponents and implementers of different forest interventions, how are new technologies being used, and how are inclusivity, equity, and justice dimensions integrated. Lessons from other subfields of forest governance, for example, community forestry and forest landscape restoration (Mansourian et al. 2022), are relevant.

4. The forest carbon industry is trying to regain investors' trust through efforts to review benchmarks of high-integrity forest carbon credits (e.g., ICVCM 2024). Such responses to the legitimacy crisis of forest carbon schemes invoke several governance-related research questions. Who are the actors that constitute the committees reviewing forest carbon credits and the associated methodologies? What are the effects of the tightened methodologies on national and local capacity-building to supply carbon credits? How is governance adapting to newly generated information, and how can transdisciplinary approaches be better promoted? What voice do local communities have in these efforts to restore the legitimacy of forest carbon credits?

These four areas for further governance research are timely as actors and institutions across Southeast Asia become more active in regional climate stewardship. The private-sector led ASEAN[9] Alliance on Carbon Markets aims to scale up nature-based carbon trading, and ASEAN recognizes the importance of an interoperable carbon market and regulatory harmonization (Rakhiemah et al. 2024). This marks a shift from the 2010s, when it was common for Southeast Asian governments to individually engage with international forest carbon actors (e.g., Mahanty et al. 2015). Our research agenda for forest carbon governance in Southeast Asia is time-critical for avoiding irreversible climate change and associated impacts while equitably governing forest carbon sinks for communities amid a rapidly evolving investment landscape that is often moving ahead of policy. In this linguistically diverse region, addressing key knowledge gaps through dialogue with policy actors, practitioners, and other stakeholders across language barriers is essential to ensure that findings inform tangible action. The research insights and perspectives from our narrative literature review on forest carbon governance in Southeast Asia are also likely to prove relevant to other parts of the world where forest carbon schemes are underway because of increased global awareness of the importance of nature-based carbon sinks to both achieving net zero carbon emissions by mid-century and avoiding the most dangerous levels of climate change.

Author Contributions

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Related WIREs Articles

REDD+ Governance

Envisioning REDD+ in a post-Paris era: between evolving expectations and current practice

Endnotes

[1] Reducing Emissions from Deforestation and Forest Degradation, plus the sustainable management of forests, and the conservation and enhancement of forest carbon stocks.

[2] While the CDM adopts the acronym "A/R" to refer to its Afforestation and Reforestation methodologies, the acronym "ARR" refers to Afforestation, Reforestation and Revegetation under the Verra's methodologies. For this paper, we use the acronym "ARR" rather than "A/R" when we refer to a broader swath of activities entailing the act of planting, but we use "A/R" when we refer to activities specifically under the CDM framework.

[3] The Warsaw Framework is significant because it provides guidance on bilateral and multilateral agreements for operationalizing REDD+ under the UNFCCC, including on the sources of finance, forest carbon monitoring and social and environmental safeguards requirements for developing countries to be paid for proof of emissions reductions (Streck et al. 2021; Parotta et al. 2022).

[4] These figures do not include the number of studies or the number of country-mentions in the papers that did not focus on forest carbon schemes.

[5] The remaining 12% of the papers did not focus on forest carbon schemes.

[6] Due to complexities in the reporting and accounting of forest carbon, REDD+ and improved forest management were not included in the CDM (Sacherer et al. 2022).

[7] Examples of REDD+ projects in Southeast Asia include the Xe Pian National Protected Area project in Laos, the Oddar Meanchey and Keo Seima project in Cambodia, and the CarBi Project and the REDD+ Community Carbon Pool Program in Vietnam (Atmadja et al. 2023).

[8] It is estimated that 42% of the transacted Verified Carbon Standard carbon credits are related to REDD+ activities (Ecosystem Marketplace 2021).

[9] Association of Southeast Asian Nations.

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