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Addressing Barriers to Fair Community Participation in Mangrove Carbon Credit Projects: Insights From Thailand

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ABSTRACT

Thailand has announced ambitious plans to reduce greenhouse gas emissions, including a programme that allows private companies to earn carbon credits from protecting and restoring mangroves. In 2023, the Department of Marine and Coastal Resources (DMCR) began enrolling local communities and private firms in this scheme. We examine whether communities can participate fairly, drawing on 18 semi-structured interviews with government officials, NGOs, community leaders and private sector actors. We identify five barriers: unclear policies that leave communities uncertain about their rights; benefit-sharing arrangements widely perceived as unfair; divergent views among communities and NGOs about carbon offsetting; knowledge and capacity gaps that limit meaningful engagement; and prohibitive verification and implementation costs. We argue that these barriers are not discrete problems but mutually reinforcing features of T-VER's governance architecture, producing distributive, procedural and recognitional injustices that constrain participation. State mediation does not necessarily protect communities. Without formal rights, independent accountability mechanisms and accessible verification pathways, it can instead concentrate power in the hands of state and corporate actors. Thailand's experience raises important concerns for other countries where forest land remains under state control. We conclude with recommendations for reform that could make community participation more equitable and projects more durable.

1 | Introduction

Mangrove forests play an important role in climate change mitigation, sequestering carbon at significantly higher rates than terrestrial forests (Choudhary et al. 2024). They therefore have attracted significant interest as a component of natural climate solutions (NCS) projects, with carbon credit projects potentially offering financial incentives for conservation and restoration while reducing emissions (Ewane et al. 2025). Concurrently, mangroves support coastal livelihoods and provide important habitats, meaning that their importance extends beyond carbon

storage. These initiatives operate as a form of payments for ecosystem services (PES), where those who benefit from ecosystem services compensate those managing or conserving them, usually on the condition that these services are maintained or improved. In this case, the services are the carbon sequestration and other ecological functions that mangrove ecosystems provide (Engel et al. 2008).

In many cases, these ecosystem stewards are local communities who have long protected and managed mangrove forests. They often hold traditional ecological knowledge (TEK)

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TABLE 1 | Three types of environmental injustice and examples of each.

Type of justice	Definition	Example of injustice from mangrove carbon credit projects
Distributive	The fair allocation of environmental benefits and harms across different groups, including the distribution of financial gains, costs and risks (Schlosberg 2007).	In the Kariba REDD+ project in Zimbabwe, communities within the 758,000-ha project area received only a fraction of the more than US\$100 million generated from credit sales with most revenue captured to the offshore developer South Pole (Transparency International 2023).
Recognitional	The acknowledgement of diverse values, knowledge systems, cultural practices and identities, including the legitimacy of TEK and non-market relationships with ecosystems (Martin et al. 2016; Svarstad and Benjaminsen 2020).	In Senegal, mangrove reforestation policies promoted by international NGOs prioritised market-based logic the customary harvesting practices and ecological knowledge of women shellfish collectors whose resource access was curtailed without recognition of their stewardship role (Cormier-Salem 2017).
Procedural	The fairness and inclusiveness of decision-making processes, including whether affected communities have genuine influence over project design, implementation and benefit-sharing (Schlosberg 2007).	In Cambodia, the Southern Cardamom REDD+ project proceeded without substantive consent from the indigenous Chong people who subsequently faced forced evictions and criminal charges for continuing traditional forest use (Human Rights Watch 2024).

which enables them to do so sustainably (Marquez and Olavides 2024). However, as nascent carbon markets expand, particularly in developing countries, concerns are growing that these communities face barriers to fairly participating in and benefiting from carbon credit projects (Friess et al. 2020; Karpowicz et al. 2024).

These challenges stem from power asymmetries, unfair benefit sharing schemes, the privileging of Western environmental values over TEK and insecure land tenure (Berbés-Blázquez et al. 2016; Corbera et al. 2007; Paloniemi et al. 2015). They not only undermine local livelihoods and create injustices but also undermine the long-term viability of the projects (Chomba et al. 2016; Karpowicz et al. 2024). When communities feel excluded or inadequately compensated, their motivation to support conservation efforts diminishes, thereby reducing the likelihood of project success (Wylie et al. 2016). While some critics question whether carbon credit schemes can substitute for direct emissions reductions at all (Dooley et al. 2022; Johannessen and Christian 2023), we focus here on a more immediate concern: the barriers communities face in participating fairly in these projects as they currently exist.

We examine these barriers in the context of Thailand, a case that has received little attention in the blue carbon literature despite the country's rapidly expanding mangrove carbon credit programme (Perera et al. 2025). Thailand's experience is shaped by international frameworks including REDD+, the Paris Agreement and IPBES and shows that linking local conservation with global carbon markets creates opportunities but also significant risks for communities. Thailand is also a useful case because its T-VER programme operates through a distinctive state-mediated model, with a state agency acting as intermediary between communities and private firms rather than through independent standards bodies. The ways in which this architecture shapes justice outcomes have relevance beyond Thailand, particularly for countries where forest land remains under state ownership.

We seek to answer two research questions:

RQ1. *What are the barriers to fair community participation in mangrove carbon credit projects in Thailand?*

RQ2. *How do the three dimensions of environmental justice—distributive, recognitional and procedural—help explain these barriers?*

By examining both questions, we aim to contribute to the development of more just and durable mangrove conservation strategies. We begin with a review of the relevant literature on these barriers, then outline our methods and present our findings, before discussing their broader implications and concluding with recommendations for reform.

2 | Literature Review

Scholars have identified three main types of injustices in the environmental justice literature (Schlosberg 2007; Svarstad and Benjaminsen 2020). The first type is distributive justice which seeks to ensure that environmental benefits and harms are fairly allocated. However, Svarstad and Benjaminsen (2020) argue that placing too much emphasis on distributional risks can obscure deeper structural conditions, such as economic and historical inequalities, which actually produce injustice, as highlighted by Marxist analyses (e.g., Purdon and Byakagaba 2025; Swyngedouw 1997). The second injustice is recognition, or the failure to acknowledge diverse values, knowledge systems and cultural practices (Martin et al. 2016). Svarstad and Benjaminsen (2020) contend that scholars should adopt a more decolonial approach, focusing on 'senses of justice', or the ways in which affected people perceive, evaluate and narrate their own experiences. The final one is procedural injustice, which relates to unfair and exclusive decision-making processes. Political ecologists often critique participation processes that are in fact top-down and

give local people little actual influence (Marks et al. 2023). Across all three dimensions, scholars call for incorporating marginalised groups' voices, narratives and lived experiences (Svarstad and Benjaminsen 2020). Table 1 summarises each type of justice, its definition, provides an illustrative example from mangrove carbon credit projects.

2.1 | Distributive Injustice

Researchers have demonstrated that the benefits of PES projects are often distributed unevenly across communities and thus create or reinforce existing inequalities. Local actors often strongly prioritise the fair sharing of benefits such as funds for water projects, schools and health, which align better with Rawlsian principles of justice than with high-level policies that often emphasise procedural or recognitional aspects (Huxham et al. 2023). However, several barriers prevent the distribution of funds equally. First, land tenure arrangements can create significant barriers. For example, Corbera et al. (2007) found in Mexico that unclear or insecure land rights often excluded the most marginalised community members from participation. Wunder (2008) similarly discovered that those without formal land titles were often vulnerable groups, such as women and indigenous groups. Consequently, they were systematically excluded despite being traditional land stewards.

High opportunity costs often disproportionately affect poorer households. Resource-dependent communities have found it economically unviable to participate when their compensation has been insufficient to make up for income lost as a result of changing land-use practices (Pascual et al. 2014). This is particularly salient in blue carbon contexts because opportunity costs heavily depend on current credit prices and are subject to considerable volatility due to market fluctuations (Thompson et al. 2014). Upfront investment requirements also have often resulted in the poorest community members being excluded. Börner et al. (2017) assert that many PES schemes have required initial investments that resource-poor households could not afford, resulting in a participation bias advantaging the relatively wealthy.

Elite capture within communities represents another potential problem. However, it is not necessarily negative because in some instances, the elite may be in a better position to undertake leadership roles due to their education or existing networks (Lund and Saito-Jensen 2013). Other members may view these advantages as justifying a greater share of benefits, particularly, if the community as a whole will gain from the elite's contributions (Naime et al. 2022; Platteau 2004). Nonetheless, it remains important to distinguish between acceptable elite benefits on one hand and corruption or discrimination on the other hand (Dutta 2009) as well as examine accountability mechanisms and the degree to which elite engagement affects project outcomes (Lund and Saito-Jensen 2013; Naime et al. 2022).

2.2 | Recognitional Injustice

To date, numerous mangrove carbon projects have failed to sufficiently address this dimension of injustice. An underlying cause is the prioritisation of Western environmental values

and market-based approaches over TEK (Martin et al. 2016). A major question is whether monetising nature can coexist with indigenous earth-centred cosmologies and whether imposing such market-based perspectives risks displacing other intrinsic ways of valuing nature (Lliso et al. 2020; Wilshusen and MacDonald 2017). Further, scholars, NGOs or other external actors claiming to represent marginalised groups' interests do not necessarily provide genuine recognition. Instead, it is necessary to consider how these groups themselves express their own 'senses of justice' (Svarstad and Benjaminsen 2020).

Several studies have further shown that by framing environmental stewardship primarily in economic terms, many PES schemes have overlooked the cultural, spiritual and relational values that many communities attach to their environments (Wegner 2016). This is not merely an oversight but an expression of deeper power structures where some groups are not recognised as legitimate environmental subjects (Harper et al. 2009). Berbés-Blázquez et al. (2016) similarly contend that ecosystems assessments often ignore the ways in which historical power struggles, colonial legacies, institutions and cultural or spiritual values have shaped landscapes, access rights and resource governance. By neglecting these historical and socio-cultural contexts, PES schemes risk therefore reinforcing recognitional injustices and marginalising community narratives and knowledge systems which do not neatly fit within dominant market or policy paradigms. Scholars such as Pascual et al. (2021) have also stressed the importance of adopting plural valuation approaches to address these limitations and foster more inclusive conservation initiatives.

2.3 | Procedural Injustice

The literature discusses several barriers to achieving procedural justice in mangrove carbon projects. Technical and administrative complexity poses significant obstacles to equitable participation. Loft et al. (2017) reveal how complex application procedures, the use of scientific terminology and stringent monitoring requirements result in often favouring more educated and resource-rich community members, effectively excluding others. Similarly, Kent and Hannay (2020) illustrate how the technical complexity of carbon projects can lead to limited participation by local communities or be used to justify their complete exclusion. Language and cultural barriers have also hindered effective communication. Leimona et al. (2015) show how technical jargon and culturally insensitive communication approaches can obstruct meaningful dialogue between implementing agencies and local communities, thereby deepening their exclusion.

Tokenistic approaches to participation can also undermine justice outcomes. Agrawal and Gibson (1999) critique how many so-called 'participatory' processes have amounted to superficial consultation rather than enabling genuine influence over programme design and implementation. Such tokenism has characterised some mangrove-based community projects, where persistent challenges include inadequate transparency in monitoring, reporting and verification (MRV) activities, carbon accounting, carbon credit sales and benefit-sharing arrangements (Karpowicz et al. 2024). While local communities are often involved in the project pre-feasibility assessments, implementation

TABLE 2 | List of interviewees.

Interview number	Identity	Date interviewed (in 2024)
#1	Community leader in Trang #1	8 August
#2	Community leader in Trang #2	5 August
#3	Senior government officer of Department of Marine and Coastal Resources (DMCR) (national-level)	4 July
#4	Junior government officer of DMCR in Trang	8 August
#5	Senior government officer of DMCR in Trang	9 August
#6	Senior NGO official in Trang #1	7 August
#7	Community leader in Trang #3	6 August
#8	Community leader in Trang #4	9 August
#9	Community leader in Samut Songkhram #1	23 June
#10	Senior official of Biodiversity-Based Economy Development Office	5 July
#11	Managing director of private sector company	3 July
#12	Senior national-level official of DMCR	4 July
#13	Community leader in Samut Songkhram #2	23 June
#14	Community leader in Trang #5	7 August
#15	Midlevel NGO official in Trang #2	7 August
#16	Lecturer at Prince of Songkla University, Trang Campus	8 June & 5 August
#17	Exporter of charcoal in Samut Songkram	14 August
#18	Senior Thai Greenhouse Gas Organisation (TGO) official	28 June

and MRV, they are frequently excluded from carbon market negotiations and key decisions about benefit sharing (Wylie et al. 2016).

A persistent tension has existed between technocentric and community-based discourses. Technocentric approaches have sought to prioritise scientific accuracy and economic efficiency to assure international policymakers and buyers of the credibility of carbon claims. In contrast, community-based approaches emphasise local agency and project legitimacy (Wells et al. 2020). Projects have often been forced to balance these competing priorities, which can lead to trade-offs, such as diverting resources from community benefits to improve the precision of carbon measurement (Kent and Hannay 2020). Communities have also voiced concerns about the exclusion of minority groups or 'outsiders,' the influence of social norms such as limits on women's participation in meetings, difficulties in understanding project finances, lack of government support and the absence of effective conflict resolution processes (Huxham et al. 2023; Karpowicz et al. 2024). These concerns can adversely affect the equity and long-term viability of these projects.

Uneven power dynamics also feature prominently in the literature. Corbera et al. (2007) demonstrate that pre-existing power imbalances between stakeholders often result in elite capture of PES benefits. Similarly, Van Hecken et al. (2015) argue that PES schemes frequently reinforce rather than transform existing power structures. They assert that decisions about

ecosystem services are not made in a vacuum but are shaped by relationships between social groups whose unequal capacities to influence one another have affected ecosystem governance to serve their dominant interests. This critique, however, requires qualification. The power structures are not monolithic: they comprise both the external ones through which companies and state agencies bypass community decision-making and the internal social norms which can exclude marginalised voices from within communities (Agrawal and Gibson 1999; Lund and Saito-Jensen 2013). Respecting local agency therefore does not mean deferring uncritically to all existing customs since some community members already contest those norms. As Svarstad and Benjaminsen (2020) argue, attending to communities' own 'senses of justice' means listening to the full range of voices within them, not only those of leaders or elites.

This section has discussed how distributional, recognitional and procedural injustices intersect in mangrove carbon projects. These injustices, overall, resonate with broader critiques of NCS governance (Seddon et al. 2020, 2021). These challenges point to the need to examine whether similar injustices have occurred in Thailand.

3 | Methods

We conducted 18 semi-structured interviews in Thailand between June and August 2024 (see Table 2). We sought to capture

a diverse range of perspectives from (sub)national government agencies (6), community leaders (7), private sector companies (2), NGOs (2) and academics (1) (see Table 2), whose actions influence the governance of mangrove carbon credit projects. We asked participants about their views on these projects, governance arrangements, the fairness of the projects, problems arising from them and their suggestions for addressing these issues. Almost all interviews were conducted in Thai. Interviewees were located in three different provinces: Bangkok (5), Samut Songkhram (3) and Trang (10).

We conducted purposive sampling together with snowballing in order to be able to ascertain the views of a wide range of actors. While we focused on Trang (see below), we also conducted interviews in Bangkok to understand perceptions and the governance at the national level and in Samut Songkhram as a comparison to understand sub-national processes in another province. We manually coded the interviews, conducted an inductive thematic analysis and extracted key quotes and findings. Interviews were mostly conducted in Thai with a few conducted in English. The second author translated and transcribed them.

A limitation is that the major companies involved in the carbon credit schemes, such as Dow, refused our interview requests. However, 18 interviews were sufficient to generate meaningful findings. Research indicates that data saturation often occurs within the first 12 interviews (Guest et al. 2006), as in this case. Other studies have reached saturation with as few as 10 participants, particularly where research aims are narrow (Malterud et al. 2016).

To triangulate the interview findings, we analysed 30+ documents, drawing on publicly available sources such as policy documents, DMCR and TGO reports, journal articles and media reports. We searched these materials for themes related to benefit-sharing arrangements, community rights and mangrove and carbon credit governance in Thailand.

3.1 | Context of Thailand

Under Thailand's Nationally Determined Contributions (NDCs), the country has ambitiously pledged to achieve carbon neutrality by 2050 and net-zero greenhouse gas (GHG) emissions by 2065. To meet these targets, Thailand plans to offset emissions from key sectors such as energy, industry and agriculture, while expanding forest carbon sinks from 90 to 120 million tonnes of carbon by 2037 (STIP Compass 2022). To support these goals, the government established the Thai Greenhouse Gas Management Organisation (TGO) in 2007 to create a structured framework for carbon trading.

A key component of this effort is the Thai Voluntary Greenhouse Gas Emission Reduction Project (T-VER), which enables organisations and projects to voluntarily reduce GHG emissions and earn carbon credits. Unlike typical voluntary carbon market (VCM) models in which project developers, standards, verifiers and buyers are institutionally distinct (Perera et al. 2025). T-VER operates through more of a state-mediated structure in which the Department of Marine and Coastal Resources (DMCR) acts

as an intermediary between communities and private firms. Thailand has also recently introduced a 'Premium T-VER' standard with the aim of meeting requirements of international markets, including the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) approval in late 2025 (ICAO 2025).

The link between mangrove conservation and the T-VER framework offers a blue carbon pathway for corporations to meet increasingly stringent ESG (environmental, social and governance) targets. Since mangroves sequester carbon at rates significantly higher than upland forests, they could become high-value assets for Thai companies with large carbon footprints, such as PTT, Thai Oil and Dow (Wachpanich 2024). For these corporations, T-VER serves as a strategic hedge against the National Climate Change Act. With Thailand's carbon tax introduced in early 2025 and a full emissions trading scheme expected by the late 2020s, the regulatory cost of emitting carbon is moving from voluntary to mandatory (KPMG 2025), thus making mangrove credits an increasingly attractive compliance hedge for large emitters.

The DMCR, established in 2004 under the Ministry of Natural Resources and Environment, is the main state actor in this system. The DMCR holds formal jurisdiction over mangrove conservation nationwide (Thompson 2018). This corporate investment is governed by a specific benefit-sharing mechanism which DMCR oversees: 70% of credits go to private companies, 20% to local communities and 10% to the DMCR (Wachpanich 2024). In this model, the private company functions both as a buyer of credits and the project proponent (developer) by assuming the financial risk and the project management burdens. Instead of purchasing credits solely from an open market, companies typically invest upfront in project development and subsequently receive a share of the generated credits (Apinunwattanakul 2023; Wachpanich 2024).

Land tenure significantly shapes mangrove carbon projects in Thailand. Under Thai law, mangrove forests are classified as state property and local communities generally do not hold formal ownership rights (e.g., *chanote* title deeds) over these areas as stated in the National Reserved Forest Act B.E. 2507. Instead, communities are granted limited use and management rights through state-sanctioned arrangements, such as community forest agreements overseen by DMCR (Rawichutiwan 2019). As a result, carbon rights and financial benefits from carbon credit projects are not tied to private land ownership but are mediated through government institutions. This state-led tenure system shapes who can participate in carbon credit schemes and the ways in which projects are structured and benefits are distributed (Cho et al. 2025).

In practice, companies provide compensation to these communities, including THB 100,000 for general purposes, THB 2813 per hectare initially and THB 1250 per hectare annually in exchange for 30 years of protection (Wachpanich 2024). Under T-VER, additionality is typically justified through claims that project interventions, such as enhanced protection, restoration of degraded areas or improved monitoring, lead to carbon sequestration outcomes that would not have occurred in the absence of corporate investment (Apinunwattanakul 2023). However,

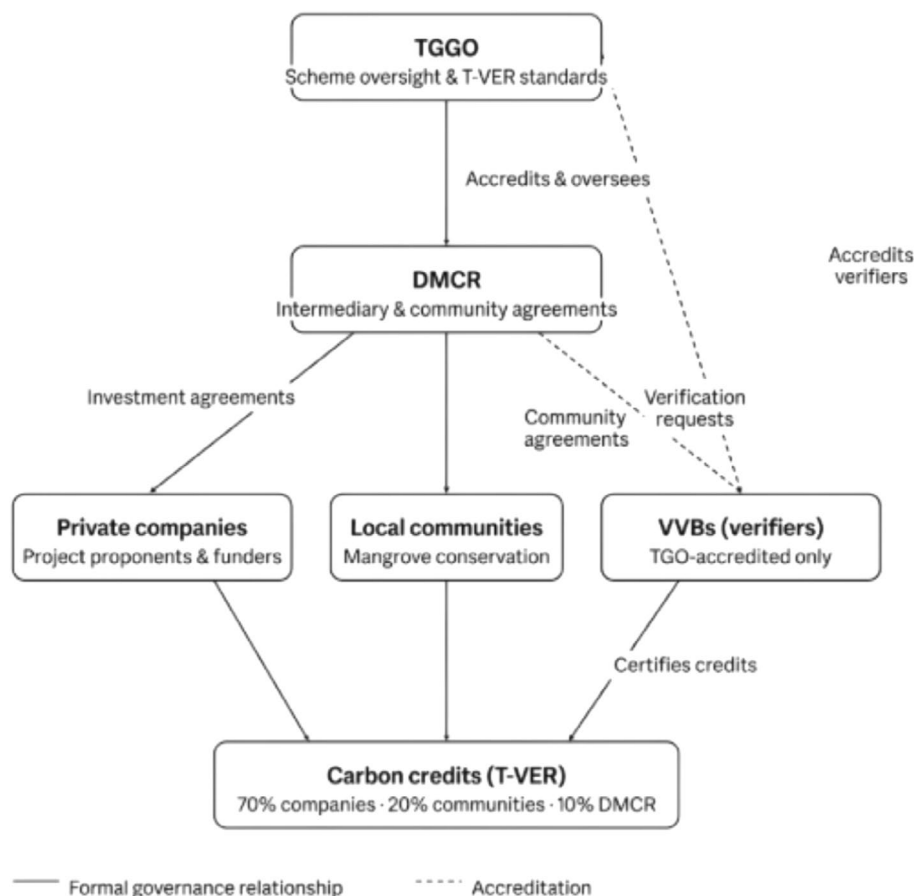


FIGURE 1 | Governance and benefit-sharing framework for Thailand's Mangrove T-VER Projects.

in cases involving mature or already dense mangrove forests, the basis for additionality is less clear and remains contested, particularly when compared to stricter international standards (Schneider and La Hoz Theuer 2019).

Thailand has a poor track record of translating carbon market ambition into measurable emissions reductions (Climate Action Tracker 2022; Marks 2011) and the expansion of T-VER into mangrove blue carbon does not automatically address the political economy constraints that have hampered earlier efforts (Thompson 2018). Since 2020, Thailand's Ministry of Natural Resources and Environment has been seeking to improve this record by advancing the National Climate Change Act, which is now in the final stages of parliamentary revision. The Act focuses on three key mechanisms. First, it introduces mandatory GHG accounting, requiring designated industries to report their GHG emissions. Second, it establishes the Climate Change Fund to support initiatives aimed at reducing carbon emissions, including forest carbon credit projects and the measurement and certification of carbon footprints. Third, it implements carbon pricing mechanisms, notably an Emissions Trading System and a Carbon Tax (Ministry of Natural Resources and the Environment 2024). The mandatory GHG accounting provisions are particularly relevant, given they determine which industrial actors face direct obligations and thus which corporations have the strongest incentive to invest in T-VER mangrove credits as a compliance hedge.

In 2022, DMCR launched a project to encourage private companies to invest in mangrove planting and protection in exchange for carbon credits (Wachpanich 2024). The project involves two types of initiatives. First, the DMCR is directly restoring 480,000 ha of mangroves, including 80,000 ha of abandoned shrimp farms, under a five-year plan. To date, 246,400 ha have already been reclaimed. Second, the DMCR engages coastal communities as key stakeholders by enabling them to generate carbon credits from mature mangroves in their areas. Through this programme, private companies invest in carbon credits while providing compensation to local communities for their conservation efforts. Communities receive THB 100,000 (US\$ 1 = THB 32) per community for general purposes, THB 2813 per hectare initially and THB 1250 per hectare annually thereafter, in exchange for protecting and restoring mangroves over a 30-year period. The DMCR acts as intermediary under TGO oversight, applying the 70–20–10 benefit-sharing formula described above (Wachpanich 2024) (see Figure 1).

In 2023, a total of 99 mangrove community forests were approved to participate in the mangrove forest and carbon credit programme. These forests cover approximately 26,014 ha across 10 provinces, including Krabi (36 projects), Phang Nga (23 projects), Satun (17 projects), Trang (8 projects), Ranong (6 projects), Surat Thani (4 projects), Chumphon (2 projects), Phuket (1 project), Nakhon Si Thammarat (1 project) and Trat (1 project). In addition, 35 private companies joined the programme, among them major firms such

as PTT Public Company Limited, Thai Oil Public Company Limited and Bangchak Corporation Public Company Limited (GreenNews 2023). Communities are engaged in both conserving mature mangroves and restoring degraded areas, which are the two main project types under T-VER.

Trang Province, located in Southern Thailand approximately 828km from Bangkok, has a significant mangrove forest area covering 35,356ha (Department of Marine and Coastal Resources 2019). In Trang, 22 community forests were previously registered under the Royal Forest Department (RFD); however, their registrations have since expired and they are no longer affiliated with the RFD (5). Currently, eight communities are actively participating in community forest and carbon credit programmes, while five are in the process of gathering information and registering for carbon credits. The remaining communities have yet to decide whether to join the initiatives (4). We selected Trang as a case study because of its early-stage involvement in carbon credit initiatives and the diversity of community perspectives it offered, making it a useful lens for examining how governance and justice concerns played out.

4 | Results

4.1 | Unclear Policy

The criteria for carbon credit programmes remain ambiguous, particularly, regarding the number of trees to be planted and their locations. While this model could benefit communities with available land, there is uncertainty about whether the DMCR fully comprehends the requirements. Clearer conditions and shorter contracts are needed to make the process more accessible. Many communities hesitate to engage with the system due to these uncertainties and are waiting for more defined policies before committing. A community leader explained that the initial step involves surveying the area and determining the appropriate course of action (2). Some communities already have dense tree coverage and may be advised to selectively harvest certain trees to improve carbon efficiency. However, if communities refuse to remove trees, alternative plans must be developed, potentially leading to a 'wait-and-see' approach.

The recent surge in interest in carbon credits, driven by new policy announcements, has created a rushed process. This has left little time to adequately prepare for pilot projects, resulting in numerous challenges. Additionally, the department's previous affiliation with the Royal Forest Department has caused complications. Following the separation, some communities no longer fall under the RFD's jurisdiction, leading to confusion and management difficulties.

A senior DMCR official asserted that the primary issue lies in unclear policies. For example, while there are plans to allocate land to people, the process requires extensive surveying and identification, which 'takes a lot of time' (3). A recent case in Thap Lang, where the government aims to allocate land to long-term occupants, illustrates this challenge. Although not inherently difficult, resolving such issues requires significant time and the governor's approval, which is often hard to obtain. Further complications arise with community mangrove forests,

which fall under two jurisdictions: the RFD and DMCR. He declared: 'there is overlap. It is still unclear'. (3).

A Trang provincial official pointed out that the core issue concerns community forests within marine areas, where there is a lack of clear laws and regulations (5). A significant gap exists between existing laws and their implementation. The Community Forest Act, which falls under the RFD, no longer covers mangroves following the department's separation, creating a regulatory void. RFD's laws, however, are stricter compared to those of the DMCR. For marine areas, the criteria need clarification and strong demand exists for measurable project outcomes to demonstrate carbon emission reductions. Under the RFD, community forests grant 100% rights to the communities. However, in marine areas, full authority is not given to the communities; instead, oversight remains with DMCR staff. The fundamental issue is that the DMCR operates under government authority rather than community control, which complicates governance and decision-making (5).

A local NGO official echoes these concerns, stressing the need for clear, community-driven policies to address these challenges effectively (6). From the companies' perspective, investing in carbon credits is primarily about financial returns, but it remains unclear how they will generate profits. Forests are already quite dense and there is limited land available for reservation. Additionally, the price of carbon credits is currently very low. According to a private company director working on this issue, strong corporate interest in impact investments has emerged for mangrove planting, but investors are uncertain about the returns (11). Questions remain about how much carbon credit can be generated and what changes are needed to make these projects viable. She lamented that for many companies: 'right now the money from carbon credit is not enough to protect their investments. The government policy is still not clear' (11).

She further added that while the funds are intended for conservation activities, the specific details of how the money will be used to support meaningful conservation efforts remain unclear (11). A senior DMCR official argued for the importance of transparency and clear guidelines to ensure that conservation funds are used effectively (12). Without these, the potential for mismanagement and loss of trust increases, undermining the overall goals of carbon credit programmes and conservation initiatives.

4.2 | Unfair Benefit-Sharing Among Actors

The current distribution of benefits in carbon credit programmes is widely perceived as unfair, with communities receiving only 20% of the profits despite their critical role in conservation efforts (1). As a local community argued, 'I think it's not fair that communities receive 20%. Communities receive too little. Should be at least 40% because the private sector didn't do much (1)'.

Another community leader echoed this sentiment, expressing frustration with the current system. He stated: 'Companies often ask you to do this and this. But they want to get the most benefits. I already have many mangroves' (2). Despite the community's significant contributions, such as maintaining extensive

mangrove areas, they receive only 20% of the benefits, while companies take 70% and DMCR gains the remaining 10%. This lopsided arrangement has sparked concerns about equity and fairness, calling into question the sustainability of such partnerships.

A senior DMCR official proposed a more balanced approach, suggesting that 'at least 50% of that money should be used for conservation' (12). The remaining funds could be used to establish low-interest loans for low-income individuals, with the long-term goal of reinvesting 100% of the money back into the community. Since these funds originate from the private sector, government involvement would be limited, but communities would need to maintain proper records of transactions. She also stressed the importance of collaboration, suggesting that a joint plan should be developed by the government, private companies and the community.

A local NGO representative highlighted the financial challenges of conservation efforts, noting that the government's limited resources and bureaucratic processes often hinder progress (8). The private sector's involvement, such as contributing 450 Baht (US\$ 13.84) per rai (US\$86 per hectare), has helped bridge this gap, allowing communities to focus on forest conservation. However, clearer frameworks and more efficient processes are needed to ensure the sustainability of these collaborations. A provincial DMCR official raised concerns about the risks associated with carbon credit prices and who bears them (5). While the 70%–20% split may seem unfair at first glance, as one corporate representative argued, it is important to consider the significant financial investment made by the private sector (11). The high costs and non-permanent nature of contracts mean that adjustments may be necessary.

Some interviewees added that carbon credits, in their current form, do not always benefit conservation projects (6, 14, 16). As a local NGO official explained, 'Instead of conservation, they [local communities] use money for computers and other personal expenses' (6). In the southern region, some NGOs viewed the existing model as unfair and are pushing for a more equitable distribution of shares. Another model under consideration is the community carbon credit programme, where private companies partner with communities to address capacity gaps. Since communities often lack the resources or expertise to manage carbon credit projects independently, private companies step in to provide support. In this model, benefit-sharing is based on negotiations, with a proposed distribution of 10% to the DMCR and 90% to the project developer or community. In practice, companies finance restoration or conservation activities upfront, communities implement and maintain these activities and carbon credits are later issued and allocated according to this distribution (Wachpanich 2024). Companies then retain the credits for ESG reporting, future compliance use or potential sale (KPMG 2025). Currently, the revenue from carbon credits is insufficient for comprehensive protection and government policies remain unclear.

While the communities we interviewed in Trang were unanimously dissatisfied with the benefit-sharing arrangements, there are rare examples of positive outcomes in Thailand's mangrove projects elsewhere. In places such as Pred Nai and Rayong,

communities have achieved both ecological and livelihood gains through co-management (Enright et al. 2025). However, these cases did not involve carbon credit projects. Nonetheless, the unequal 70-20-10 formula and the long-term lock-in of 30-year contracts are forms of distributive injustice since communities bear the conservation burden while corporate and state actors capture most of the financial value.

4.3 | Differing Perceptions

4.3.1 | Opposition to Carbon Credit Projects

An NGO official expressed strong opposition to carbon credit projects. She stated: 'The first priority should be to reduce emissions. Second, the private sector can maybe grow trees. But don't touch existing ones that are already there' (15). While the private sector could support tree-planting initiatives, existing forests, particularly, mangroves, should remain untouched. These concerns align with existing literature, which finds that carbon credit projects can strip local communities of their rights to manage and protect their forests, transferring control to companies (Huxham et al. 2023; Irvine-Broque 2022). For example, the Cardamom REDD+ Project in Cambodia led to forced evictions and criminal charges against the indigenous Chong people (Human Rights Watch 2024). Similarly, the Kariba REDD+ Project in Zimbabwe resulted in severe restrictions of local communities' land-use rights while offshore companies such as South Pole and private landowners reaped almost all of the financial benefits (Transparency International 2023).

These projects, according to the same NGO, also fail to effectively reduce emissions or combat climate change. If mangroves can be claimed for carbon credits, large corporations like PTT should be allowed to manage them, rather than placing pressure on local communities to participate. Relying on carbon credits, critics argue, fails to address the root problem. Instead prioritising emissions reduction must come first (15; Duangklad 2024). This critique aligns with a broader concern in the literature that carbon credit schemes, including blue carbon initiatives, are not a panacea for climate change mitigation and cannot substitute for rapid emissions reductions at source (Dooley et al. 2022; Johannessen and Christian 2023).

A local community leader echoed this perspective. He asserted: 'Producers who create carbon need to change their behaviour. Not only for us to give carbon sinks. Why must they give more burden to us? Why do we have to plant more trees?' (2). He further criticised superficial solutions that ignore root causes, stating that their involvement is not driven by money. Instead, funding should protect mangroves and prioritise biodiversity. The carbon credit system, he argued, is flawed, favouring monoculture for maximum carbon sequestration at the expense of biodiversity. Private sector involvement risks prioritising profit over ecological balance and communities may focus on short-term gains over long-term environmental health.

Another community leader noted that opinions on carbon credit projects are divided: '50% for and 50% against' (9). Before any project begins, the government must hold public hearings and locals should regain control over mangrove land.

Carbon credit projects often create inequality, as land may be in another province, making it difficult for locals to benefit. Land used for credits typically belongs to the government and locals lose access to it for up to 10 years, with no guarantee of success. Many feel the long wait and uncertainty are not worth it.

He added that if he was the Prime Minister, he would focus on identifying suitable areas for mangrove planting and collaborating with the private sector. While they did not claim that tourism was necessarily a better alternative than carbon credits, they found the carbon credit process overly complicated and burdensome. Many locals already feel they are protecting the environment through their existing practices and question the need for additional mechanisms like carbon credits. Their primary concerns are socioeconomic rather than environmental: they seek tangible improvements to their livelihoods rather than navigating complex carbon markets.

4.3.2 | Support for Carbon Credit Projects

A senior provincial DMCR official acknowledged that while carbon credits are not a perfect solution, they represent a step forward. As he argued: 'Carbon credit projects help raise environmental awareness and introduce private sector to be involved in mangrove conservation and distribute money to locals' (3). However, the director stated that meaningful community participation and long-term commitment are essential for success. He added that many NGOs distribute funds but withdraw once budgets are exhausted, leaving communities without sustainable solutions.

Some community leaders expressed support for carbon credit projects, disagreeing with the opposition of NGOs (1, 8). As a long-time resident, one leader expressed: 'I lived here; I have to take care of mangroves anyhow. The carbon credit project can support some activities—we cannot keep spending without support' (1). The carbon credit project provides financial support for conservation efforts that would otherwise be impossible to fund independently. While this leader acknowledged some uncertainty about his position, he maintained that the project would bring benefits, including improved forest monitoring. He also recognised that conflicts may arise but believes that with clear laws and regulations, the project can proceed smoothly and effectively. Overall, supporters of carbon credit projects deem the projects imperfect but still view them as an avenue forward to raise awareness and provide resources for conservation as well as community development.

4.3.3 | Neutral Perspective

A private sector official took a neutral stance on carbon credit projects: 'We don't promote or reject carbon credits as a tool to help community. But for us, there is a lot of backlash from the community. We try to focus on supplemental income and education' (11). She believed that the success of such initiatives depends on the type of information shared and the companies involved. While many companies engage in corporate social responsibility (CSR) or go beyond environmental, social and

governance (ESG) standards, some have faced criticism for greenwashing. Additionally, she added, stock exchange standards can play a role with the hope that companies that demonstrate higher environmental and social standards tend to attract more investment (11).

4.4 | Knowledge and Information Sharing

A senior DMCR official asserted that while some communities possess financial resources, they often lack the technical expertise required to participate in carbon credit projects. He believed therefore that his organisation can fill this gap by providing technical knowledge, guidance on project implementation and other resources. Community leaders emphasised that access to information is a significant barrier (2, 13). For instance, the specific area where one leader cultivates land remains unclear and their community-based volunteer organisation receives no government funding. Although some companies contribute through CSR initiatives, such support is inconsistent and unreliable, leaving communities without steady assistance.

A senior government official pointed out that poor communities often struggle to benefit from the voluntary carbon credit system, which demands actions beyond standard regulatory requirements. As a senior TGO official explained: 'Poor people cannot benefit from the current system ... They lack knowledge and the costs are too high' (18). This statement points to a recognitional injustice: the system assumes a level of technical literacy and institutional familiarity which many communities do not possess and hence delegitimises their capacity to participate on their own terms.

Under current laws, activities like rehabilitation do not qualify for carbon credits, further marginalising these communities. Many communities also lack the expertise to navigate the complex carbon credit process. If someone within the community could verify carbon sequestration, costs would be significantly reduced (3). Additionally, individual efforts are less impactful; communities must work collectively to achieve meaningful results (9). Larger projects yield greater benefits, while small-scale projects often require hiring third-party verifiers, which increases costs and makes participation unfeasible for poorer communities. For example, a reforestation project with a carbon sequestration potential of approximately 7.5–8.8 t per hectare must have an area of at least 1.6 ha to be eligible for T-VER verification (Apinunwattanakul 2023). Since the carbon credit system remains voluntary, low-income communities in Trang and elsewhere have often faced substantial barriers to accessing its benefits.

4.5 | High Costs Associated With Carbon Credit Projects

According to calculations made by the journalist Patchar Duangkhlad, a hypothetical 160 (1000 rai) hectare community forest carbon credit project, equivalent to 1.6 km², over 10 years based on T-VER forest project conditions has a total cost of THB 1,210,000. This includes three certification requests as follows: the Project Development Phase Cost of THB

100,000 for Survey and Layout Sampling, covering the initial assessment and planning for the project area and the cost of the External Verifier of THB 197,500, representing fees for third-party verification during the development phase; the Project Enrolment Phase cost for Registering for T-VER of THB 5000; and Project Implementation Phase costs, which vary depending on community involvement and resource management. These include a Survey and Layout Sampling Cost of THB 300,000 and a Fee for Carbon Credit Verification of THB 592,500, representing the costs for verifying carbon credits during the project lifecycle. Additionally, there is a Carbon Credit Verification Fee per request of THB 15,000, with three verification requests over 10 years amounting to THB 45,000 in total. In total, the costs would be over 1.2 million Baht (US\$ 37,090) which most communities cannot afford (Duangklad 2024).

A senior government official: 'Very high standards of verification and it is very expensive: there is a monopoly of only four companies who can do it. In terms of other sectors like industry, this process is very clear. But for mangroves and forests, it's still unclear (10)'. She added that these companies should be closely monitored to ensure fairness and transparency. While her usage of 'monopoly' is imprecise—an oligopoly is more accurate—her frustration points to a deeper structural issue: TGO accredits verification organisations operating under T-VER are accredited under a framework differing from international standards such as Plan Vivo. Further, the small number of authorised firms increases costs and restricts community participation.

The high cost of verification poses a significant barrier to participation. The official suggested that if the government were to support the verification process, it could extend the lifespan of trees, enable the generation of carbon credits and even facilitate the production of charcoal. However, in the Thai context, the situation is already quite ambiguous, making it difficult for communities to navigate. Thailand has its own standard, T-VER, which is more affordable and accessible. However, global standards are often too complex and costly for local communities to meet. This creates a gap where local people struggle to comply with international requirements. Overall, the high costs associated with carbon credit projects, particularly, verification and forest management, present significant challenges for communities (10). The concentration of verification capacity within a few firms and the absence of subsidised or community-accessible pathways creates procedural injustice which excludes poorer communities from the outset.

Additionally, other key challenges remain for local communities in mangrove carbon credit projects. Carbon credit prices vary widely depending on project type (e.g., reforestation, ability to capture carbon) and market supply. This volatility makes it difficult for businesses and investors to plan and allocate resources effectively (Tangkitvanich 2023). Further, carbon credit metrics which prioritise biomass accumulation can incentivise monoculture planting over ecologically richer approaches and thus lead to restoration outcomes which, while better than bare ground, provide less biodiversity than natural or mixed-species mangrove forests (Su et al. 2021). A community leader in Trang criticised the scheme for favouring monoculture at the expense of biodiversity (2).

5 | Discussion

In the previous section we answered [RQ1](#) by identifying five empirical barriers to fair community participation in mangrove carbon credit projects in Thailand. Here we address [RQ2](#) by drawing on environmental justice theory and the broader comparative literature to explain why these barriers exist and persist. We argue that the three dimensions of environmental injustice are not separate problems but reinforcing features of T-VER's governance architecture.

A first and cross-cutting feature is the scientific and governance ambiguity embedded in the scheme's design. T-VER's additionality logic rests on the claim that corporate-funded interventions, such as improved surveillance and active restoration of degraded areas, create sequestration benefits which would not have occurred under previous management. However, several communities we interviewed already maintained dense, mature mangrove forests, which makes it difficult to demonstrate credible additionality (Irvine-Broque 2025). More troublingly, some were advised to selectively harvest trees to improve carbon efficiency. This practice is common in plantation forestry but ecologically contested in mangrove settings since it can reduce biodiversity and structural complexity (Malik et al. 2015). The tension between carbon metrics and ecological integrity echoes a broader pattern in which technocentric frameworks are prioritised over community and ecological values (Kent and Hannay 2020). Above all, it is a form of procedural injustice. When the scientific basis of a scheme is contested or unclear, it becomes more difficult for communities to give full consent to or evaluate their participation (Corbera et al. 2007).

A second feature is recognitional injustice. Specifically, the failure of T-VER's market logic to accommodate communities' own moral framing of the situation. Community leaders' statements that they are already protecting the forest misalign with an additionality framework that treats existing stewardship as a baseline with no market value unless formalised through corporate investment. These leaders' insistence exemplifies communities' 'senses of justice' (Svarstad and Benjaminsen 2020) or a moral claim about responsibility that has been ignored by T-VER's market logic. Communities also value biodiversity, livelihoods from fisheries and their relational connections to the mangroves in ways that carbon metrics cannot capture (Martin et al. 2016). Similarly, in Fiji, the major beneficiaries of blue carbon initiatives are not the communities who implement them and whose voice and agency 'remain limited' but the international actors institutionally committed to promoting them (Purushotham and Thompson 2026). In the Sundarbans, top-down conservation regulations have produced comparable patterns of uneven risk exposure and exclusion from governance decisions (Subroto et al. 2026).

A third source is the institutional architecture of T-VER itself. Unlike Plan Vivo and comparable independent-standard VCMs, T-VER collapses several roles (regulator, intermediary, benefit administrator) into DMCR while companies simultaneously act as developers and buyers. This concentrates power and reduces the number of opportunities for communities to contest decisions. Thompson (2018) showed that prior to the advent

of carbon credit projects, DMCR's receipt of corporate funding reduced the agency from a community advocate to a technical assistant for the private sector. This trend continues to the present. Thailand's horizontally fragmented governance structure exacerbates the problem (Marks and Lebel 2016); the unresolved jurisdictional boundary between DMCR and RFD means that no single actor can readily be held accountable for inaction or injustice, a pattern also observed in Fiji (Purushotham and Thompson 2026). Perera et al. (2025) call for greater transparency in benefit-sharing, non-permanence risk and credit pricing in blue carbon projects. However, as our findings show, T-VER addresses none of these sufficiently. State mediation, therefore, does not automatically protect communities. Without structural safeguards, it can instead safeguard corporate interests from community accountability.

The three dimensions of injustice are not parallel but reinforce each other. Procedural exclusion (opaque criteria, verification oligopoly, lack of a genuine consent process) prevents communities from contesting the unequal distributive formula. The distributive imbalance (20% share, 30-year lock-in and prohibitive upfront costs) enacts recognitional injustice by reducing communities to service providers for corporate ESG strategies instead of rights-holders with their own claims on the mangroves. These injustices intersect, leaving the most vulnerable actors with the least power over how restoration is implemented (Löfqvist et al. 2023).

Addressing them requires more than tweaking the benefit formula or adding capacity-building programmes. Communities need formal rights over carbon benefits derived from forests they have long stewarded, independent recourse to contest project terms and a verification system whose costs do not exclude poorer communities (Löfqvist et al. 2023). Thailand's integration into international carbon markets through Premium T-VER and CORSIA makes this more urgent because, as credits gain value and compliance pressure grows, the structural disadvantages communities face will deepen unless governance is transformed.

6 | Conclusion

We examined barriers to fair community participation in mangrove carbon credit projects in Thailand. We identified five key barriers: unclear policies, unfair benefit-sharing arrangements, differing actor perceptions, knowledge gaps and prohibitive verification costs. Taken together, however, these barriers are not discrete challenges but interrelated aspects of the T-VER scheme's governance. They embody and reproduce distributive, procedural and recognitional injustices which reinforce one another and constrain meaningful participation. Without reform, such projects risk entrenching existing inequalities rather than addressing them.

Thailand's experience has lessons for other countries where forest land is state-owned and governments play a central coordinating role in carbon markets. State mediation is not neutral. Without formal community rights, independent accountability mechanisms and genuine procedural access, it tends to concentrate power with corporate and state actors at the expense

of local communities. Countries developing similar blue carbon frameworks should treat Thailand as a cautionary case.

This study contributes a detailed case study of mangrove carbon governance in Thailand, connecting political economy, environmental justice and natural carbon solutions in a specific and understudied context. It shows that socio-political conditions, institutional fragmentation and governance structures interact to produce injustice and that technical fixes alone will not resolve them. Future research could extend comparisons to other state-mediated models, track the evolution of Thailand's governance arrangements as the Climate Change Act and full emissions trading scheme take effect and develop conceptual frameworks that explicitly integrate environmental justice with carbon market design.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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