Review

Addressing the Policy Gaps and Challenges to Originating High-Quality Blue Carbon Projects in the Asia-Pacific Region: A Systematic Evidence Synthesis Bolstered by Practitioner Consultation

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Addressing the Policy Gaps and Challenges to Originating High-Quality Blue Carbon Projects in the Asia-Pacific Region: A Systematic Evidence Synthesis Bolstered by Practitioner Consultation

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Abstract: The Asia-Pacific region contains almost half of the planet's coastal carbon-sequestering (blue carbon) environments (mangroves, salt marshes, seagrasses). These habitats are highly valuable to sequester carbon and mitigate climate change, but are under threat throughout the region, due in significant part to an insufficient policy environment to protect, restore, or create new coastal wetlands/blue carbon environments. Using a systematic evidence synthesis we reviewed the existing literature on blue carbon policy, and found that gaps and challenges fall under three themes, "Land Tenure and Ownership", "Funding and Protecting Blue Carbon Habitat", and "Conflicting Priorities and Jurisdictions", with two overarching issues, the inconsistent recognition of rights of indigenous peoples and local communities (IPLCs) and women, and sea-level rise. This study makes recommendations to ensure high-quality blue carbon projects through improving equitable outcomes, particularly for women and IPLCs, and to reduce barriers to implementing blue carbon projects. These recommendations include gender sensitive and participatory mapping along with a registry of ownership with extensive gender equitable IPLC consultation to resolve ownership uncertainties. Recommendations for community level and gender equitable benefits beyond individual land owners are important to address the inequity of land ownership. Where land ownership changes under sea-level rise and intentional barrier removal, carbon rights should be retained by the landowner; otherwise, there is little incentive to undertake blue carbon projects. Due to the limited income that results from some carbon credit payments, other crediting and non-market methods can be considered to supplement landowners' incomes and encourage habitat protection. Conflicting priorities between authorities responsible for managing coastal wetlands can be resolved through systematic restructuring/streamlining and collaborative workshops. Some will require changes to policies and amending delegated legislation.

Keywords: blue carbon; environmental policy; carbon credits; Asia Pacific; climate policy; IPLC; coastal wetlands; gender equity; (Min.5-Max. 8)

DISCLAIMER: This is a preprint and has not yet undergone peer review. It should not be treated as the final version of this review.

1. Introduction

Ongoing anthropogenic climate change, caused primarily by the burning of fossil fuels and release of carbon dioxide (CO_2), poses a significant existential threat to ecosystems and to humans across planet Earth (see Pörtner et al., 2022). Vegetated habitats absorb CO_2 and sequester it in the soil, and saline coastal wetlands are particularly effective carbon sinks, sequestering 3-4 times more

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CO_2 per unit area and at a faster rate than terrestrial forests (Byun et al., 2019; Crosta et al., 2023; NOAA, 2023). Because of this, the protection, restoration, and creation of coastal wetlands provides an extremely effective means of mitigating anthropogenic climate change (e.g. Nellemann et al., 2009; Armistead, 2018; Wood and Ashford, 2023; Macreadie et al., 2021). The carbon stored in these habitats (salt marshes, mangrove forests, and seagrass meadows) is often referred to as blue carbon, a term coined by Nellemann et al. (2009). We limit our discussion to these three ecosystem types because they are represented in carbon credit schemes. Other coastal ecosystems may provide significant blue carbon sinks, though significant uncertainty exists regarding the fate of carbon in these environments (Hoegh-Guldberg et al., 2019; Jones, 2021; Northrop et al., 2021; Friess et al., 2022).

The Value of Coastal Wetland Ecosystem Services

Coastal wetlands are estimated to sequester 7-20% of all global CO_2 emissions (United Nations et al., 2023), and are particularly important in the Asia-Pacific region (defined *sensu* United Nations, 2021), which contains an estimated 50.6% of the planet's mangroves (Bunting et al., 2018), 35.8% of the planet's salt marshes (Mcowen et al., 2017), and ~57% of the planet's seagrasses (Fortes et al., 2020). Beyond carbon sequestration, the benefits of restoring and protecting coastal wetland habitats include: protecting uplands from flooding and erosion, including from storms and tsunamis (e.g. Alongi, 2008; Department of Fisheries, 2012; Marois and Mitsch, 2014; Möller et al., 2014; Pearce, 2014), tourism and recreation (e.g. Charkraborty et al., 2020; Moore et al., 2022; Hawes, 2023), food (e.g. Department of Fisheries, 2012; Bhomia et al., 2016; Everard, 2014; Carrasquilla-Henao et al., 2019), building resources (e.g. Daiber, 1986; Nguyen et al., 2015; Palacios and Cantera, 2017), habitat for threatened and commercially-important wildlife, including as a nursery (e.g. Waikato Regional Council, 2016; Hamilton et al., 2017; Wang et al., 2023), and filtering runoff, which protects nearshore subaqueous habitats (including coral reefs) from pollution and smothering (e.g. Cochard, 2017; Theuerkauff et al., 2020).

Altogether, coastal wetlands provide an estimated $3.4 trillion USD to the region's economy in ecosystem services annually (Davidson et al., 2019), and are relied upon for food, resources, and income by millions of people (Trent, 2022). Indigenous peoples and local communities (IPLCs) often rely heavily upon coastal wetland environments, (e.g. Januar et al. 2022; Moore et al., 2024; Scott et al., 2024), and women, in particular (e.g. Bosold, 2012; The Nature Conservancy, 2017; Giangola et al., 2023, James et al., 2021), are frequently disadvantaged in the development of blue carbon projects. In the context of this review, we use the term "women" to include cisgender women, transgender women, femme/feminine-identifying, genderqueer and nonbinary individuals, who are all at a greater risk of gender-based inequity and discrimination (Thorne et al., 2019; James et. al 2023).

Coastal Wetland Loss

Despite the importance of these ecosystems both locally and globally, 0.5-2% of coastal wetlands globally are being lost per year (Scott et al., 2014; Blue Carbon Initiative, 2019), with ~70% of this loss occurring in the Asia-Pacific region over the last 25 years (United Nations et al., 2023). The Asia-Pacific region is therefore highly important in any discussion surrounding coastal wetlands and ensuring the protection of these extremely valuable habitats.

Because of their significant value in tackling climate change, coastal wetlands can potentially be used as a pathway to access revenue from carbon credits to fund environmental restoration and protection projects (e.g. Friess et al., 2020; Jones, 2021; Department of Climate Change, Energy, the Environment, and Water, 2022; Kuwae et al., 2022; Vanderklift et al., 2022; Bell-James, 2023b; Voluntary Carbon Markets Integrity Initiative, 2023). However, major barriers exist to initiating these projects, due in significant part to the policy environment around these practices, alongside an assortment of economic and knowledge-based barriers. This study provides a systematic evidence synthesis (Appendices 1, 2) of existing information and an analysis of feedback from two practitioner workshops, a practitioner survey, and a series of interviews with assorted practitioners, experts, and other interested parties working in coastal environments to determine the scale and impact of challenges to delivering equitable and effective blue carbon projects.

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Addressing Challenges, including Equity and Longevity

We use this analysis to recommend solutions to the challenges to implementing high-quality blue carbon projects. High quality blue carbon projects (defined *sensu* Conservation International et al., 2022; Landis, 2022) are projects which "conserve, protect, and restore lost and degraded coastal ecosystems" and, in so doing, achieve the following five criteria: 1. The safeguarding of nature; 2. The empowerment of (indigenous and local) people (including ensuring gender equitable empowerment); 3. Operate locally and appropriately in the context of their region's environmental and economic situation; 4. Employ the best available information and carbon accounting principles; 5. Mobilise high-integrity capital, ensuring that agreements, contracts, pricing, and benefit-sharing are fair. To ensure equitable outcomes and that a blue-carbon project is effective in the long-term at sequestering CO_2, the challenges to blue carbon project implementation and origination discussed in this review should be viewed through the lenses of two overarching considerations as outlined below

Firstly, throughout the Asia-Pacific region, IPLCs and vulnerable groups within them, particularly women, are regularly sidelined or ignored in policy and management decisions around coastal wetlands (Bosold, 2012; Thomas, 2016; Larson et al., 2015; Warner et al., 2016; Ban et al., 2019; Moraes, 2019; Barletti et al., 2022; Lofts et al., 2021a; Pricillia et al., 2021; Crosta et al., 2023; Lasheras et al., 2023; Schindler Murray et al., 2023; James et al., 2023), and sometimes lose access to these essential habitats (Ban et al., 2016; Thomas, 2016; Warner et al., 2016; Loch and Reichers, 2021; Song et al., 2021; Lasheras et al., 2023; Hamrick et al., 2023). In the context of this paper, (see IPBES, 2024) Indigenous Peoples and Local Communities (IPLCs) refer to individuals and communities who are, self-identified as indigenous and/or, are members of local communities that maintain inter-generational connection to place and nature through livelihood, cultural identity and worldviews, institutions and ecological knowledge. Or they are impacted or directly rely on the coastal resource in question. Furthermore, blue carbon projects which exclude women and IPLCs from decision-making and management have consistently been found to be less successful than those which centre them (Lauer and Aswani, 2010; Thompson et al., 2017; Vierros, 2017; Hoegh-Guldberg et al., 2019; Ban et al., 2019; Pricillia et al., 2021; Barletti et al., 2022; Macreadie et al., 2022; Chanda and Akhand, 2023; Schindler Murray et al., 2023, cf. James et al., 2023). Therefore, improving intersectionality, or the interaction across multiple overlapping axes of discrimination (see Crenshaw, 1989; UN Women Australia, 2019, James et al 2022), must be treated as an essential aspect in resolving the policy gaps and challenges addressed throughout this study. Secondly, solutions should also be viewed through a lens of ensuring the longevity of a coastal wetland. Under sea-level rise, many coastal wetlands are eroding or being submerged at their seaward ends, and migrating landward. These wetlands are often perilously "squeezed" against coastal settlements and barriers (e.g. Blankespoor et al., 2014; Figueira and Hayward, 2014; Hansen and Reiss, 2015; Moraes, 2019; Primavera et al., 2019; Swales et al., 2020; Crosta et al., 2023) (Figure 1).

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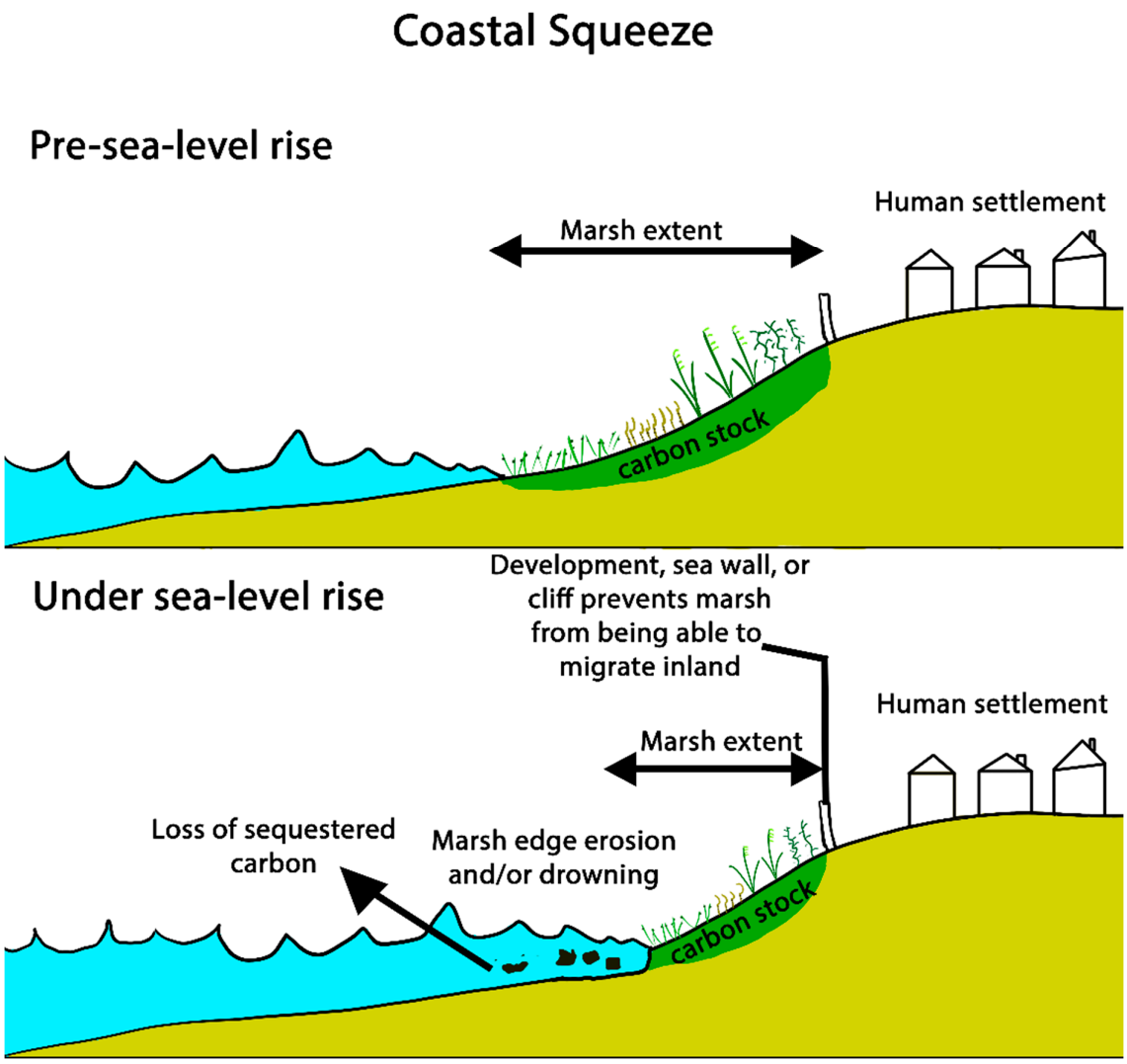

Figure 1. Schematic illustration of the process of coastal squeeze. Based on diagrams presented by Pontee (2013) and Swales et al. (2020).

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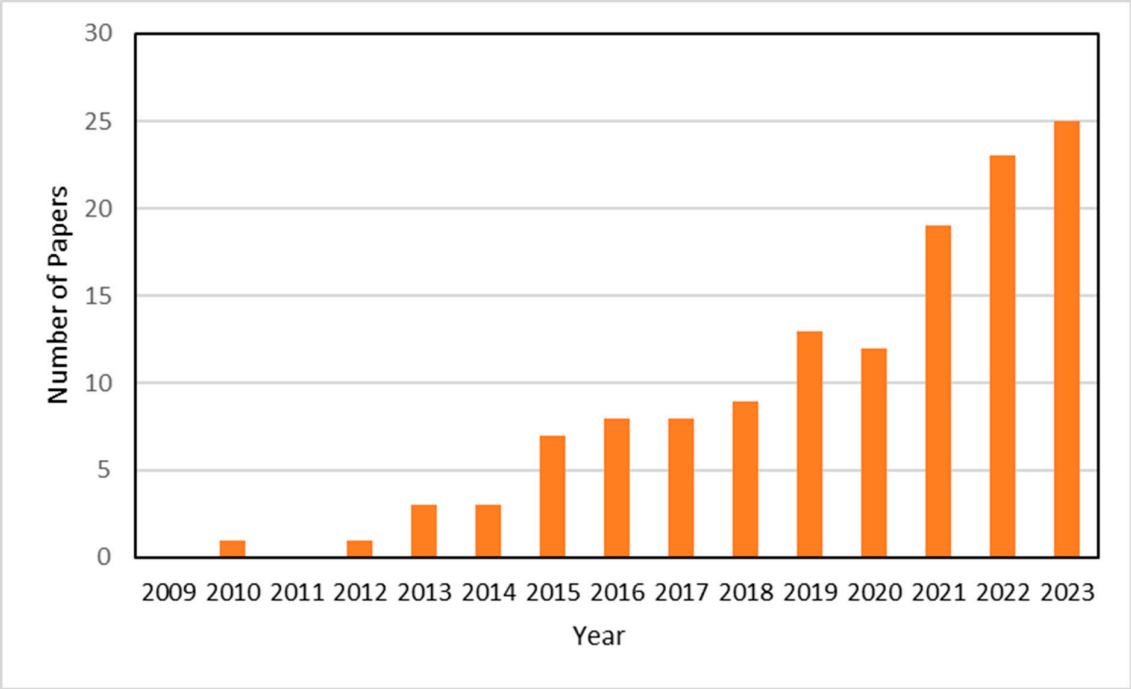

Figure 2. Number of papers covering blue carbon policy issues in the Asia-Pacific region published per year found as a result of the SCOPUS searches and through the references of Schindler Murray et al. (2023), as detailed in this segment of the paper. In-press articles are included within articles from 2023 (through 26th September 2023). Number of papers increases at a mean rate of 1.8 additional papers/year.

2. Materials and Methods

2.1. Literature Review

On the 19th September 2023, we conducted a literature search using the scientific indexing database SCOPUS (https://www.scopus.com/) through two searches through article titles, abstracts, and keywords. The first search (Source 1 in Appendix 1) was for: "blue carbon" AND policy. 199 documents were found. The second search (Source 2 in Appendix 1) was for "carbon sequestration" AND policy AND "salt marshes" OR "salt marsh" OR saltmarshes OR saltmarsh OR mangroves OR mangrove OR seagrass OR seagrasses OR "sea grass" OR "sea grasses". This search provided 128 documents. We used an additional key resource, "The Blue Carbon Handbook" (Schindler Murray et al., 2023), to source papers via its reference list (Source 3 in Appendix 1), which contained 152 documents. Six grey literature reports and books were provided by The Nature Conservancy (TNC) for inclusion in this review (Source 4 in Appendix 1). In total, we gathered 403 resources (papers, books, book chapters, and conference papers) and then applied the following rejection criteria:

1. Paper does not cover Asia-Pacific Region
2. Paper does not discuss policies directly impacting the actioning of blue carbon projects
3. Paper is inaccessible/Not available
4. Paper discusses a different environment from coastal wetlands (salt marshes, mangrove forests, and seagrass meadows)

In total, we gathered 137 papers following this approach. Since 2009, the number of papers covering blue carbon policy in the Asia-Pacific region has almost consistently increased annually, demonstrating an ever-growing interest in the carbon sequestration or ecosystem services provided by these ecosystems. This systematic approach may miss small local journals that have not been indexed by SCOPUS, but is expected to include all major relevant publications.

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Fifty-two additional resources were identified through stakeholder consultations, most of which related to specific arguments within the context of this review, and are addressed in the discussion. However, four of these (Bell-James, 2023b; Bell-James et al., 2023a; 2023b; Stewart-Sinclair et al., 2024) were papers which directly met the characteristics for inclusion in the systematic review but were published just before or after the SCOPUS search was conducted, and therefore not indexed by them at the time. Twenty-two papers, which related to the ecosystem services that coastal wetlands provide, were gathered as part of a related ongoing systematic evidence synthesis (King et al., in prep). These papers were not included in the literature review (Appendix 2, Appendix 1) but are discussed elsewhere in this paper. While no filtering was conducted to exclude non-English-language literature, it is noted that only English-language papers were gathered using this approach, likely because search terms applied were in English.

At a prior 2023 TNC workshop, participants identified the key challenges of "gender equity and land tenure", "interventions for rights/zonation", "accounting for de-facto vs statutory ownership", "difficulty accessing land ownership data", "legislative mismatch between restoration and development", "conflicting priorities between management agencies", "non-achievable/non-scientific targets", "distribution of benefits to landowner vs. resource user" and "valuing/accounting for natural capital/resilience". We used a spreadsheet to assess which of the preceding topics were addressed by each of the 137 documents (Appendix 3). These data were used to create a comprehensive systematic evidence synthesis summarising the literature on each topic. Through this synthesis, presented as Appendix 4, it became apparent that all of the aforementioned issues could be condensed to three main themes: Land Tenure/Ownership, Funding and Protection of Coastal Wetlands, and Conflicting Jurisdictions and Priorities Between Agencies, with the additional two overarching considerations: ensuring the rights of IPLCs in a gender-equitable manner, and the effects of sea-level rise. These themes drive the structure of this paper.

2.2. Stakeholder Consultations

To assess the in-the field applicability and accuracy of the findings of the literature review and identify any additional challenges to the actioning of blue carbon projects in the Asia-Pacific region, we consulted with interested parties in these environments and projects using the following avenues:

- A workshop with 30 TNC personnel working on blue carbon projects across the Asia-Pacific to discuss barriers and potential solutions (conducted through Microsoft Teams on November 8 and 9, 2023).
- A survey sent to TNC staff and external individuals involved in the management or implementation of coastal wetlands. This survey received 8 responses (Appendix 3) from participants based in Aotearoa New Zealand (2 respondents), Australia (1 respondent), Hong Kong Special Administrative Region (1 respondent), India (1 respondent), Indonesia (2 respondents), and Malaysia (1 respondent) (Appendix 3). Of the survey respondents, four were TNC employees, three were external, and one remained anonymous to the authors. A graphical summary of survey responses is presented in Appendix 3.
- Nine interviews were conducted with practitioners, experts, and other interested parties who were considered likely to provide valuable insight due to their specific expertise and/or experience. Interviews were recorded, transcribed, and the transcriptions assessed for information in each category of information. Transcripts for each interview, including questions asked, are presented as Appendix 4. Of these interviewees, seven were unaffiliated with TNC, while two were affiliated.
- All interview and workshop participants were anonymised and assigned a random alphanumeric using GIGACalculator (2023), though an option to be named in the paper was also provided.

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- Interviews, surveys, and workshops were treated as an information resource in the same manner as literature.

3. Findings

Of the 137 papers gathered through the SCOPUS search, 65% were global studies, with the most well-documented countries being Indonesia (8%), and Australia (7%) (see Figure 3). As outlined in Appendix 1, seven of these papers discuss gender equity (5%), twenty-three of these papers discuss IPLC rights and tenure (17%), seven of these papers discuss issues accessing land ownership data (7%), 21 discuss conflicting priorities between agencies responsible for managing coastal wetlands (15%), 36 discuss the use of non-scientific targets by policymakers or within policy (26%), 47 discuss issues around the distribution of benefits to landowners and/or IPLCs (34%), 61 discuss issues around valuing or accounting for natural capital or resilience (45%), and six discuss the streamlining of blue carbon projects (4%).

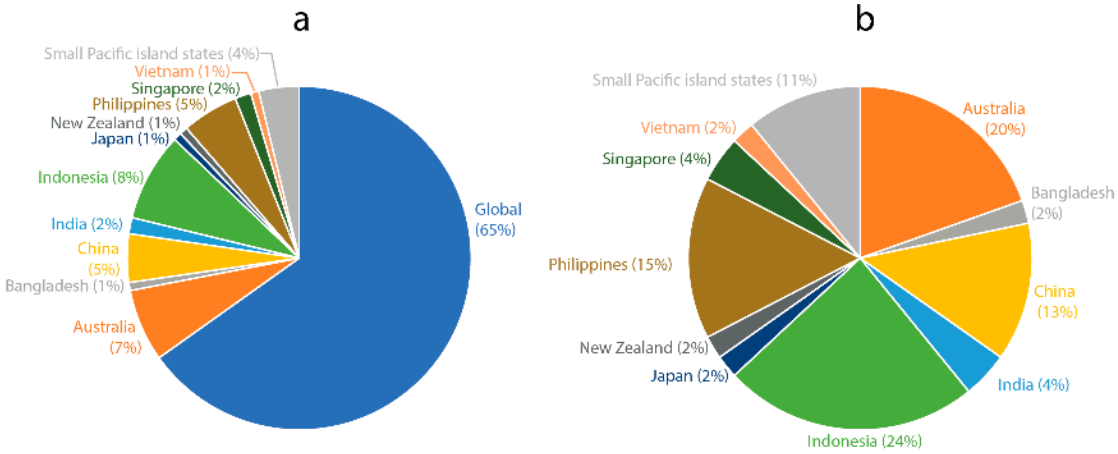

Figure 3. Plots of the proportion of the literature accessed through the methods described in Section 2a, by country. Plot a displays the total proportions of all 137 studies, while plot b removes global studies.

3.1. Land Tenure/Ownership

3.1.1. Clarifying Tenure

Difficulty in accessing land-ownership data provides a direct challenge to the implementation of blue carbon projects (Hejnowicz et al., 2015; Beeston et al., 2020; Hamrick et al., 2023), and for land-owners to access financial incentives (Hejnowicz et al., 2015; Hoegh-Guldberg et al., 2019). Land tenure is often greatly uncertain, especially for IPLCs (Ammar et al., 2014; Hejnowicz et al., 2015; Warner et al., 2016; Gevaña et al., 2018; Lofts et al., 2021a; Merk et al., 2022; Dencer-Brown et al., 2022).

Uncertain tenure was reported as an issue that needs resolving in approximately one third of all REDD+ projects (forestry-based carbon-sequestration projects, where REDD stands for "reducing emissions from deforestation and forest degradation in developing countries. The '+' stands for additional forest-related activities that protect the climate, namely sustainable management of forests and the conservation and enhancement of forest carbon stocks) (Hamrick et al., 2023). Stakeholders expressed similar perspectives to what was discussed in the literature. For example, the Carbon Market Institute has noted that land tenure issues remain a consistent barrier to many blue carbon projects" (Interviewee Janet Hallows). Other survey respondents and workshop participants agreed with the published literature that land ownership data is difficult to find.

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In much of the world, IPLCs have customary rights, or ownership born out of custom or tradition, to the land they occupy (e.g. Bouvier, 1856; Huggins, 2012), but these rights are often not legally recognised (Warner et al., 2016; Lofts et al., 2021b; Song et al., 2021; Lasheras et al., 2023; Hamrick et al., 2023). There has been a declining trend in policy-makers recognising customary land rights for IPLCs under statutory law in Vietnam (Warner et al., 2016) and uncertainty of tenure has driven the exploiting of IPLCs in Indonesia (Hamrick et al., 2023).

Even legally recognised land tenure may not equate to legally recognised carbon rights, negatively affecting how IPLCs and landowners can financially benefit from blue carbon projects (Pham et al., 2013; Lofts et al., 2021a; Merk et al., 2022; Yu and Wang, 2023; Hamrick et al., 2023), as well as often leading to their exclusion from the project planning process, and opening them up to exploitation (Hamrick et al., 2023). In the 31 countries surveyed by Lofts et al. (2021b), approximately half of all land area customarily held by IPLCs is not recognised by their governments, with carbon rights being poorly defined. Of these countries, only three explicitly recognise IPLC carbon rights on land they own (Ethiopia, Peru, and Republic of Congo, none of which are in the Asia-Pacific), with Fiji and Vietnam having ambiguous laws that may or may not recognise IPLC carbon rights. In Indonesia, carbon rights for IPLCs are "partially recognised" by law, and issuing of tenure rights and district regulations to these communities has not been uniform (Lasheras et al., 2023). This has resulted in a lack of involvement of IPLCs in mangrove restoration projects, and significant negative impacts on the livelihoods of local peoples (Warner et al., 2016). However, the World Bank's Forest Carbon Partnership Facility has since resulted in the distribution of benefits from a jurisdictional REDD+ program to IPLCs in East Kalimantan Indonesia (see Adityasari, 2022). This was distributed as reward- and performance-based payments via a Benefit Sharing Mechanism, with village government and village community organizations set to receive benefits worth IDR 119,368,448,400 as performance allocation and IDR 11,430,000,000 as reward allocation, according to the East Kalimantan Governor Decree of 2023. A proposal for this distribution is currently being worked on by village government (Alfan Subeki, pers. comm. 2024).

In the 13 countries Pham et al. (2013) surveyed, of which 5 are in Asia, there was general consensus among policymakers that "benefits [of payments for ecosystem services (PES) and REDD+ schemes] should go to those with legal rights" or to those incurring costs to develop the projects. This has led to the increased marginalisation of IPLCs, and the loss of their rights to the land (Pham et al., 2013), a factor further exacerbated by the fact that major funders (often corporations) of carbon sequestration projects often end up with a significant amount of control over the project and can override the will of IPLCs (Pham et al., 2013; Thomas, 2016; Hamrick et al., 2023). The same study found that land tenure security for IPLCs could be improved by the inclusion of boundary clarification and issuing of land certificates as part of the payments for PES schemes (in this case for the protection of carbon-sequestering habitats in Indonesian and Vietnamese forests) (Pham et al., 2013).

National strategies to resolve overlapping boundaries and unclear land rights are clearly necessary (Beeston et al., 2020), and these strategies must ensure and prioritise the customary rights of IPLCs. As-yet, no such strategies have been detailed in the literature beyond incorporating coastal wetlands into marine protected areas (see Friess et al., 2016), which may help resolve authority jurisdictions, but can have a detrimental impact on individuals who hold a claim to the land (Detailed in Section 3.3).

Efforts to register customary land tenure historically in Papua New Guinea, supported by the World Bank, have resulted in widespread protest and allegations of being a land-grab from local people (e.g. Healy, 2001; Joku, 2024). Situations such as this result from the inherent inequity that results from fixed boundary tenure systems over customary land which formerly had more fluid, group-based rather than individual-based ownership. In this regard, placing an individualist capitalist approach to carbon rights can dispossess IPLCs of their traditional co-ownership and ability to participate in management systems (see Chomba et al., 2016; cf. Kingi, 2008).

In Southeast Asia, large areas of disused aquaculture ponds are theoretically available for mangrove restoration and blue carbon projects. However, overlapping claims of ownership, overlapping land leaseholds, and usage rights issues by IPLCs cause significant conflicts between

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stakeholders, and create major barriers to initiating restoration (Hoegh-Guldberg et al., 2019; Beeston et al., 2020). For example, in Indonesia, since the passing of Law 23/2014 in 2014, there have been extensive changes to the jurisdiction of mangroves in and out of designated forestry areas. This both greatly complicates prior management and restoration plans and has meant that local people are now often uncertain who has authority over which mangroves (Ayostina et al., 2022). Because of this uncertainty and contentions over overlapping ownership claims, in two Indonesian sites where 100% and 81% of mangroves have been considered biophysically suitable for restoration, socio-politics have rendered it such that only 2.5% and 0.4% of the mangrove area are legally possible to restore (Beeston et al., 2020 and refs therein). Positively however, interviewee 75vzi noted that there has been an increase in understanding regarding who is responsible for the different aspects of blue carbon restoration in Indonesia, with KKMD (the Regional Mangrove Working Group) coordinating efforts on a provincial level, and KKMN (the National Mangrove Working Group) coordinating efforts at a national level.

Workshop participant 7dd8t noted that more recently in Papua New Guinea communities are being supported to engage in participatory boundary and land use mapping, in which communities draw their own lines, walking the boundaries using GPS devices where land is disputed, and creating birds-eye view maps that are then discussed and agreed to by clans, reducing conflict and ensuring that the right people can benefit from blue carbon projects.

Gender issues

Even where IPLC land tenure is recognised and upheld, this does not mean that everyone in those communities equally benefits from the carbon credits. This is particularly pertinent for coastal wetland ecosystems (e.g. mangroves) that are generally primarily utilised by women who rely on these natural resources for food and fuel (e.g. Fiji - see Pearson et al, 2019; James et al. 2023) but rarely own the land. When excluded from carbon project negotiations, women can be harmed threefold: 1. they are excluded from any financial benefits (i.e. carbon credits) tied to land ownership; 2. they are denied access to a resource on which they depend as it is now of financial value to the community; 3. they are at higher risk, for example of gender-based violence, if they try to continue to access their resources (Minney, 2020; James et al., 2023). For example, across the Asia-Pacific region, women are disproportionately less likely to exclusively own or have a right to sell land than men, as determined in a major study of Georgia, Mongolia, and the Philippines (see Swaminathan et al. 2017), and globally make up only 12.8% of agricultural landowners, while being disproportionately affected by economic crises in coastal wetlands (Minney, 2020). On the basis of this ownership discrepancy, women stand to lose out if benefits of carbon credits are exclusively tied to land tenure and if the processes of determining land tenure do not recognize the patriarchal systems of land ownership that projects are operating within (James et al 2023). Our interview, literature review and workshop results demonstrated that most carbon practitioners are not considering gender in the development of projects.

3.1.2. Impacts of Restoration and Sea-Level Rise on Ownership

In some countries, changes to the tidal regime may alter land ownership status and the government agency in charge of management (Macreadie et al., 2023; Bell-James, 2023a; Dencer-Brown et al., 2022; Urlich and Hodder-Swain, 2022; Stewart-Sinclair et al., 2024). To date, this issue has only been discussed in Australian and Aotearoa New Zealand literature, and it is unclear whether it causes significant setbacks elsewhere. For example, in Australia's Northern Territory, "marine waters" (public land) are defined by the position of the high-water mark (Sangha et al., 2019), which will change at a site once opened to tidal influence. This may jeopardise the ability of former or traditional users of these environments to gain an income from carbon credits or other payments for ecosystem services (PES) (Macreadie et al., 2022; Bell-James, 2023a).

Both interviewees (9dh75 and Elizabeth Macpherson) and survey participants from Australia and Aotearoa New Zealand confirmed this lack of clarity in those two countries. One survey participant based in India further stated that it was likely that ownership is expected to become public

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under sea-water inundation. An issue regarding a lack of policy in Fiji reveals that local people are required to register to receive land and carbon rights, but the process to register for this is not yet in place. Without this registration, anything below mean high-water is state property. With customary land rights not legally recognized, there is high uncertainty regarding the impact of sea-level rise on land ownership (Interviewee Mei Zi Tan).

3.2. Funding and Protection of Blue-Carbon Habitats

3.2.1. Size of Payments

Many challenges exist to adequately funding coastal ecosystem conservation or restoration projects through carbon credit and other PES schemes. For example, in Thailand, some PES schemes pay landowners in mangrove systems as little as ~USD$15 per month total income per landowner, an income so small that it could be considered almost negligible (Friess et al., 2016; Friess et al., 2020), and in Australia, restoration costs can be so expensive that it may take decades for blue carbon projects to become profitable (Hejnowicz et al., 2015; Jones, 2021; Knight et al., 2022). This is due to the difficulty of accurately determining the monetary value of ecosystem services provided by coastal wetlands (Hejnowicz et al., 2015; Friess et al., 2016; Gevaña et al., 2018; Yang et al., 2019; Potouroglou et al., 2020; Chanda and Ghosh, 2022), the lack of scientific understanding of carbon stocks and fluxes across the Asia-Pacific region (e.g. International Partnership for Blue Carbon, 2015; Herr et al., 2017; Schile et al., 2017; Hoegh-Guldberg et al., 2019; Moraes, 2019; Thuy and Thuy, 2019; Sejati et al., 2020; Alemu et al., 2022; Corcino et al., 2023; Howard et al., 2023; Smeaton et al., 2023; Windham-Myers, 2023), and the inequity of carbon markets (Huxham et al., 2020).

Compounding this issue, investment in blue carbon projects operating in the voluntary carbon market is both inadequate with respect to their true cost and value (Hamrick et al., 2023) and much lower than in compliance markets (Huxham et al., 2020). Resultantly, limited money is available for new projects and practitioners (Potouroglou et al., 2020). This creates a significant challenge, as transaction costs are high, and extensive resources are needed for creating enabling conditions and accreditation (Huxham et al., 2020).

In addition, around 80% of the average carbon credit price across Asia-Pacific goes to project developers without benefiting local communities (Crosta et al., 2023). In this regard, market-based systems have shown a tendency to perpetuate inequity with the result that financial incentives throughout Southeast Asia are often insufficient to dissuade land users (including IPLCs) from engaging in mangrove-degrading livelihoods, such as shrimp aquaculture, planting rice paddies, and logging (Warner et al., 2016; Gevaña et al., 2018; Miller and Tonoto, 2023).

Significant difficulties in determining the economic value of blue carbon in many coastal wetlands result from uncertainty in their spatial extent (Macreadie et al., 2014; International Partnership for Blue Carbon, 2015; Rogers et al., 2016; Herr et al., 2017; Vanderklift et al., 2019; Denya and Peters, 2020; Rudianto et al., 2020; Alemu et al., 2022; Friess, 2023; Quevedo et al., 2023a). This is worsened in countries which lack obligate halophyte non-seagrass plants (e.g. Aotearoa New Zealand) (Partridge and Wilson, 1986; Johnson and Brooke, 1998). Lack of adequate mapping of seagrasses, combined with their fragile nature, also challenges the demonstration of permanence for a site (interviewee Janet Hallows). This has led to Australia excluding seagrasses from their emissions reduction programme (Kerin et al., 2021).

In mangrove ecosystems, there are examples in the literature of additional income generation through aquasilviculture (the practice of keeping or planting a significant mangrove population within a fish or shrimp pond) to sustain shrimp/fish-farming industries (upon which many local people in mangrove ecosystems, including IPLCs, depend, see Aziz et al. (2016); Warner et al. (2016)), without causing a significant loss of belowground carbon storage, and preventing further emissions (e.g. Wylie et al., 2016; Flores et al., 2016; Susitharan and Sindhu, 2021; Crosta et al., 2023; King et al., in prep.). These examples are explored further in Section 4b.

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3.2.2. Land Valuation and Opportunity Costs

Counterintuitively, consistently high demand for coastal property, in spite of sea-level rise, means that prices for coastal properties, and thus opportunity costs for the initiation of blue carbon projects that require land purchases, are increasing in Australia, (Runting et al., 2017; Workshop participant 9rzng). While this issue has yet to be discussed outside of Australia in published literature, workshop participants and interviewees outside of Australia did consider the economic value of coastal land to be a significant issue. For example, according to workshop participant Felix Leung, Hong Kong's government has preferred to sell land to private developers instead of protecting blue carbon habitats.

In Australia, a legislative mismatch exists in which applications to restore an environment by planting seagrass or breaching a barrier to the sea are legally considered dredging or development, and treated the same as practices that can be harmful to the environment (Kelleway et al., 2020; Bell-James, 2023a; 2023b; Carmody, 2023; 2024). This creates significant regulatory approval challenges and fees that may be too expensive for small-scale local landowners (Carmody, 2023; Bell-James et al., 2023b).

3.2.3. Additionality

Another barrier to funding blue carbon credit projects noted in the literature is the difficulty of demonstrating additionality (that is, for carbon credits to be generated, it must be demonstrated that without the establishment of this new project, the carbon would not have been sequestered) (e.g. Pham et al., 2013; Ullman et al., 2013; Ralph et al., 2018; Moraes, 2019; Vanderklift et al., 2022). This means that there is high economic incentive to restore damaged wetlands and create new ones, but less clear incentive to protect existing blue carbon stocks that are not under apparent imminent threat (Pham et al., 2013; Ullman et al., 2013). Because additionality is often hard to prove in protective projects, many countries have policies prioritising restoration in lieu of protecting existing blue carbon habitats and preserving existing carbon stores (Macreadie et al., 2014; Interviewees 75vzi and Ibp2I). Additionality requirements have been noted to be the largest barrier to blue-carbon financing in Papua New Guinea (Richard Hamilton, pers. comm. 2024). An issue therefore with carbon financing is that it directs the attention of developers towards monetary benefit rather than ecosystem health. Additionality has been noted to be particularly hard to prove in seagrass systems (Interviewee Janet Hallows), resulting in them being neglected in policy for protection and restoration in comparison with other coastal wetlands (Potouroglou et al., 2020).

3.2.4. Protected Areas

The protection of blue carbon habitats by incorporating them into government-run marine protected areas (MPAs) or terrestrial protected areas (e.g. Cranshaw & Fox, 2022) is an alternative solution for preserving existing coastal wetlands outside the framework of carbon markets that has proved effective at protecting mangroves in parts of Indonesia and Malaysia (Moraes, 2019). Areas where mangroves have been incorporated into MPAs in Indonesia have been attributed to preventing the loss of 14,000 ha of mangroves, or the equivalent of 13 Mton CO_2 (Howard et al., 2017). However, while MPAs can be managed with extensive input from IPLCs (Pricillia et al., 2021), they have been criticised for utilising a top-down approach to management, which can exclude IPLCs and have a negative impact on their wellbeing (Vierros, 2017; Newell et al., 2019). The large size of MPAs and broader environmental gradient covered also limits the amount of funding that can be specifically diverted to protecting coastal ecosystems (Newell et al., 2019). Locally managed marine areas (LMMAs) are run via a "bottom-up" approach and have been broadly considered to be more successful at allocating benefits to local people, demonstrating additionality, and ensuring local knowledge is used in environmental management (Vierros, 2017; Moraes, 2019; Newell et al., 2019). However, as discussed in Bell-James et al. (2023b), undertaking restoration in a protected area can be highly challenging, instilling barriers to investment as the likelihood of obtaining a financial return

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is reduced. In these areas, additionality may only be demonstrable if degradation, potentially associated with encroachment from adjacent human activities, occurs.

3.2.5. The Challenge of Sea-Level Rise

Globally, policies around coastal wetlands have failed to account for coastal squeeze (Urlich and Hodder-Swain, 2022) and in many parts of the Asia-Pacific region there are no regulations in place that require wetland restoration and protection projects be permitted room to migrate inland (e.g. Wylie et al., 2016; Urlich and Hodder-Swain, 2022; Bell-James et al., 2023a)), with Tasmania and New South Wales being notable exceptions in Australia (Bell-James, 2020; Bell-James et al., 2023a). Land subsidence-enhanced sea-level rise also affects Indonesian mangroves, with many mangrove forests subsiding faster than can be managed by mangrove-planting schemes (Interviewee 2vzhc). This has been addressed in regulations on groundwater use to reduce subsidence (Keputusan Menteri ESDM Nomor 291.K/GL.01/MEM.G/2023 tentang Standar Penyelenggaraan Persetujuan Penggunaan Air Tanah), with further related policies already in-place around green-belt and riverine environments, yet these have been sub-optimally enforced (Topik Hidayat pers. comm. 2024). Furthermore, in China 60% of the entire country's coastline is protected by seawalls (Bell-James, 2020), which lie inland of 90% of the country's mangroves (Daming et al., 2020), severely restricting their long-term survivability. Simply restoring and protecting blue carbon habitats may not protect them in the long-term without removing some coastal barriers and settlements.

3.2.6. Knowledge-Related Issues

A lack of awareness by local people about blue carbon was noted as a potential barrier to originating blue carbon projects by 7 out of 8 (85.7%) survey participants, as well as by 4 interviewees and workshop participants from Malaysia, Papua New Guinea, Indonesia and Hong Kong. Crosta et al. (2023) connected this lack of knowledge among local communities to a similar deficit among local and regional authorities and the disconnect between scales of government (national, regional, local). Interviewee Dr. Jamaludin noted that, in Malaysia, knowledge-related challenges have been the biggest hurdle to initiating blue carbon projects, with stakeholders uncertain of how to create connections between ownership and finance mechanisms, or understanding the difference between concepts such as additionality, carbon flux, and carbon stock.

Lack of knowledge by policymakers about coastal wetland ecology has also resulted in poor planning and implementation of projects. This has been highlighted by interviewees from Indonesia (75vzi and lbp2l) who note that, following a $400,000 loan from the World Bank (Ferro et al., 2022), authorities in Indonesia have emphasised using the funds to initiate a mass-mangrove-planting scheme (though the funds have also been directed for policy and sustainable management support, among other practices outlined in Ferro et al. (2022)). This past planting has often occurred in unsuitable habitat for the species being planted (wrong soil type, salinity level, water level, amount of inundation), and has little consideration for the ecology of the sites in question (Interviewees 75vzi and Ibp2I). Because of this, most seedlings failed to survive, with survival rates of only around 25% in some projects (Interviewee Ibp2I). Corporate-funded restoration initiatives are also focused overwhelmingly on planting new mangrove seedlings (with the same issues as the aforementioned government programs), without sufficient emphasis on conserving what already exists (Interviewees 75vzi and Ibp2I).

In contrast to the lack of knowledge of carbon markets among IPLCs, their traditional knowledge as customary users of coastal habitats can be essential for the sustainable management of coastal wetlands but is routinely undervalued/ignored (Lauer and Aswani, 2010; Vierros, 2017; Ban et al., 2019; Hoegh-Gulberg et al., 2019; Pricillia et al., 2021 Macreadie et al., 2022). For example, Miller and Tonoto (2023) discussed an incident where planted mangroves were washed away by storms because they were planted on a budget-driven timescale during the monsoon season without consulting traditional landowners. Women in IPLCs in particular often have extensive knowledge of these ecosystems as the primary users of these resources, and yet are regularly left out of consultation (James et al., 2023). In contrast, LMMAs in Fiji centered indigenous methods of environmental and

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resource management in conservation initiatives and empowered IPLCs in management initiatives (Vierros et al., 2017; Newell et al., 2019). It has also been noted that LMMAs are more likely to meet additionality requirements to sell carbon credits than MPAs, enabling them to provide more direct benefits to local communities (Moraes, 2019). This may be because LMMAs (or other types of "other effective area-based conservation measures"/OECMs) often allow for more subsistence and/or livelihoods activities which may contribute to the release of carbon emissions and/or degradation of sequestration capacity (such as grazing) .

3.3. Conflicting Jurisdictions and Priorities

Blue carbon projects in the Asia-Pacific region often fall under the jurisdiction of multiple different agencies and authorities (Pham et al., 2013; Warner et al., 2016; Quevedo et al., 2021; Arifanti et al., 2022; Li and Miao, 2022; Macreadie et al., 2022; Urlich and Hodder-Swain, 2022; Bell-James, 2023b; NCSC, 2023; Sidik et al., 2023). This may be due to limited coordination across different levels of government (national, regional, local), historical and traditional reasons (e.g. Urlich and Hodder-Swain, 2022), or the fact that coastal wetlands bridge terrestrial and marine habitats, and thus fall under the jurisdictions of both terrestrial and marine-based agencies (Friess et al., 2016; Miller and Tonoto, 2023). Different authorities are not always incentivised to collaborate, as has particularly been noted in Indonesia (Friess et al., 2016; Arifanti et al., 2022; Miller and Tonoto, 2023; Sidik et al., 2023), the Philippines (Friess et al., 2016; Quevedo et al., 2021; Arifanti et al., 2022), and Aotearoa New Zealand (Urlich and Hodder-Swain, 2022; Stewart-Sinclair et al., 2024), and have often been documented coming into conflict around protection strategies (e.g. Friess et al., 2016; Warner et al., 2016; Arifanti et al., 2022; Macreadie et al., 2022; Bell-James, 2023b; Crosta et al., 2023). These agencies and authorities may design their own plans for restoration independently, as has been documented in Aotearoa New Zealand (Urlich and Hodder-Swain, 2022) and Indonesia (Friess et al., 2016). For landowners, the large number of authorities responsible for managing or legislating coastal wetlands creates an environment of uncertainty regarding obtaining blue carbon project approvals and following sometimes contradictory regulations (Beeston et al., 2020; Macreadie et al., 2022; Urlich and Hodder-Swain, 2022; Quevedo et al., 2023a; Bell-James, 2023b; Sidik et al., 2023).

Regulatory hurdles to the development and protection of blue carbon can also stem from the priorities, funding, and management of the organisations in question. For example, some authorities have de-prioritised protection of blue carbon environments due to economic valuations favouring other uses for the land (Hejnowicz et al., 2015; Miller and Tonoto, 2023). Authorities are also often tightly constrained by budget and may make decisions on the timing of restoration projects that are driven by budgetary constraints, and not by science, as discussed in Section 3.2.6 and by Miller and Tonoto (2023).

Survey participants working across the Asia-Pacific region all noted that significant difficulties to coastal wetland restoration are a result of contradictory regulations stemming from different authorities, with 75% noting significant difficulties, and 25% noting somewhat significant difficulties. 87.5% of survey participants said that significant difficulties arose due to uncertainty over which agency is in charge of managing coastal wetland environments. Practitioners in both Aotearoa New Zealand (Interviewee: Elizabeth Macpherson) and Indonesia (Interviewees 2vzhc and 75vzi) have faced unclear guidance for which authority is responsible for any phase in the approval process due to the fragmentation of policy across sectors, scales of government, and institutions (though the Indonesia government is making efforts to improve this; interviewee 2vzhc).

The issue of conflicting jurisdictions and priorities was highlighted as a prominent issue in Indonesia with different aims between ministries and funding between levels of government as well as a lack of dissemination of knowledge from Central to District governments creating significant problems for the success of blue carbon projects. Interviewee lbp2l noted that there have been contradictory actions put in place between ministries regarding planting strategy, due in-part to the economic drive to enhance shrimp aquaculture in the region. Similarly, in India, there are contradictory regulations between protecting and restoring marine and forest environments and, depending on the level of connection between mangrove forests, terrestrial forests and the sea,

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different authorities have responsibility for the mangroves, creating an often-ambiguous situation (Workshop Participant 4q9st).

In Australia, there are significant difficulties obtaining permits for use in restoring or creating blue carbon habitat, which restricts Australia's abilities to meet their sequestration targets (Bell-James et al., 2023b). The process of gaining a permit has at times been so complex that blue carbon projects have been forced split into smaller sites than would have been ideal (Interviewer 9dh75). This issue clearly extends beyond Australia, as 50% of survey participants stated that it was "hard" and 50% stated that it was "somewhat hard" in their countries to obtain permits or approval for wetland restoration.

4. Discussion and Recommended Actions

Before discussing each of the primary topics, it should be noted that the entire Asia-Pacific region is not evenly weighted in terms of representation in the literature. The vast majority of information in the literature came from Indonesia, the Philippines, and Australia, with limited information available elsewhere (Figure 3), e.g. Papua New Guinea. It is unclear how well the proportion of published literature as a whole reflects the global distribution of blue-carbon opportunity, though assumed that the proportion is roughly equivalent, as Bertram et al. (2021) noted that the largest economic benefit from coastal wetlands in the Asia-Pacific are projected to be had in Indonesia and Australia. However, there are clearly major gaps in the available literature on how challenges to the implementation of blue carbon projects are experienced and addressed across much of the region. In addition, the discussions with practitioners held for this paper were limited largely to countries where TNC operates. However, as many of the issues addressed in this paper are present across many countries, we expect that this discussion and recommendations will be useful to practitioners and policy-makers in countries which are not well-represented in the literature.

4.1. Ownership and Rights

Investing in Gender Equitable Participatory Mapping of Tenure Rights

One essential method for improving enabling conditions for blue carbon projects is to generate maps to resolve ownership uncertainty, which currently is one of the most significant hurdles to the origination of blue carbon projects. Participatory boundary mapping efforts using GPS systems with the active involvement of IPLCs to clarify land ownership, such as are underway in Papua New Guinea (workshop participant 7dd8t), are also an essential means of preventing exploitation of IPLCs during the origination of projects and can enable local people to legally prevent deforestation by outsiders. The ethical nature of resolving land ownership in the context of determining ownership of carbon credits must also be considered, as tenure uncertainty often fails to consider who "should" have access to carbon rights (e.g. IPLCs), and the clarification of land tenure alone will not provide equitable outcomes if land rights are not equitably distributed (Lofts et al., 2021a).

To prevent conflict and ensure a more equitable outcome, these property mapping efforts should involve IPLC village administration and acknowledge customary land claims, including resolutions around where customary claims overlap. Gender must also be intentionally addressed in this process, as women own very little land, and yet are often primarily dependent on the coastal resources in question. Without their inclusion and efforts made to include them in land ownership and benefit sharing they will be made worse-off by their exclusion from these projects - e.g. economic/livelihood impacts of excluding women from accessing coastal resources and the risk of increased gender-based violence if women-owned or utilised spaces suddenly attract value (James et al 2023). One critical step towards avoiding these negative outcomes is to ensure a thorough detailed gender analysis is completed in early stages of project design. This will help to identify who owns land, controls household finances, etc. and who has control over and access to different natural resources. It will also identify who stands to lose or gain from a project if all people information is gender disaggregated. It will also help to identify any potential gendered risks associated with the intended carbon project. Resources and time can then be focused on working with communities to address

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these risks and ensure benefits are equitable and risks are minimised (James et al 2023). A project should never go ahead or be deemed high quality without this step being undertaken.

Equally important is the engagement of the appropriate government agencies, which often includes multiple ministries, departments and levels of government (also see sub-Section 4.3 on conflicting jurisdictions below). Governments can help fund these efforts to improve enabling conditions through grants, such as Australia does with the Blue Carbon Accelerator Fund (workshop participant 4qs9t). In Papua New Guinea, a National Carbon Register has been proposed (James, Konia, et al. [in prep]) to help accurately record and verify carbon rights, and the generation of carbon credits. This has the aim of both securing the inclusion of carbon-sequestering environments in the country's Paris Agreement NDC, and securing the carbon rights of landowners, ensuring that all voluntary carbon market activities are registered. This proposal ensures that the government can keep track of carbon sequestration and carbon market transactions, as well as track changes in land ownership.

To enable increased transparency around the development of carbon projects and to ensure that all of the appropriate stakeholders have equitable access to tenure information, maps of statutory and customary ownership and use rights should be made available in a public repository and funding set aside to ensure that they are kept up-to-date. A template example that governments could use to present this is the interactive tool used by LINZ (2023) to display land-ownership data. In all cases, it is recommended that indigenous land rights are honored following the principles of The Land Rights Standard (Rights and Resources Initiative, 2022).

Mandating Equitable IPLC and Gender Engagement for Blue Carbon Projects

While many of the papers discussed in Section 2.1 discussed "inclusion" and "participation" of IPLCs in blue carbon projects, it is noted that this language still echoes a colonial dynamic. As discussed by interviewee Dr. Elizabeth Macpherson, this dynamic of participation de-emphasises Indigenous People's sovereignty over their land. To ensure best use of traditional knowledge and the most equitable outcome for customary landowners, governments should ensure that IPLCs have the ability (resources, capacity and equitable access to a process) to self-determine the role they play in any blue carbon project, and are not merely "permitted" to participate. Currently there is a lack of legally-mandated safeguards for the rights of IPLCs and women in existing blue carbon projects across the region. This can in-part be attributed to the fact that recognition of blue carbon as a significant mechanism by which countries can contribute to mitigating climate change is very recent. This is the same for women who are disproportionately impacted by climate and yet are largely absent from decision making around climate including blue carbon projects (James et., all 2023)

Voluntary safeguards have been broadly applied to protect IPLCs and women (Barletti et al., 2021; 2022; Lofts et al., 2021a; Lasheras et al., 2023; United Nations Framework Convention on Climate Change, 2023; Hamrick et al., 2023), but are sometimes of limited effectiveness due to the lack of legal enforcement and insufficient funding. Additionally, women and IPLCs may depend upon additional exploitative industries, in particular charcoal mills, negating the value of safeguards designed to protect them (Interviewee lbp21).

Existing safeguarding mechanisms for REDD+ projects (see United Nations Framework Convention on Climate Change, 2023; United Nations REDD+ Programme, 2023; Verra, 2023) and insight from critiques of these mechanisms (e.g. Lofts et al., 2021a; Barletti et al., 2022; Hamrick et al., 2023; Lasheras et al., 2023) can be used as a template for governments to bring about laws and policies that prevent the exploitation of IPLCs and women in the development of blue carbon projects and require their involvement in project leadership, design and planning, and ongoing development. As noted by Lofts et al. (2021a) and Hamrick et al. (2023), it is imperative that these policies exist to ensure that IPLCs and women are actually protected, empowered, and able to fully participate, as well as to support the ongoing credibility of voluntary schemes. Ongoing work in Papua New Guinea conducted by TNC (as part of the Mangoro Market Mari (MMM) project [see Griffith Asia Institute, 2019]) to improve women's land rights in IPLC groups where they otherwise have none (discussed by workshop participant 7dd8t), may also provide a valuable template for safeguarding of women's

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land rights in future blue carbon policy and practice. Other examples, include Plan Vivo, which provides a carbon standard emphasising and creating opportunities for IPLCs (Wrangham, 2023), and WOCAN's W+ Standard that quantifies, verifies and generates income for women's empowerment within projects (WOCAN, 2024). There is also a clear need for gender-analysis to serve as part of the human rights, environmental, and social risk assessments during the scoping phase of the projects, to prevent the exclusion of them from project benefits and ensure that the plan is most effectively managed (James et al., 2023).

Free, Prior, and Informed Consent

Awareness programmes, aimed towards local people, policymakers, and authorities, are a valuable tool to improve and develop a shared understanding of blue carbon projects as a mechanism for protecting, conserving, and creating coastal wetlands, and are an important component of ensuring indigenous peoples right to Free, Prior and Informed Consent (FPIC) (UN Declaration on the Rights of Indigenous Peoples, 2007). Education programs, led by experts, should discuss the causes and impacts of climate change and outline the myriad ecosystem services, including blue carbon sequestration, provided by coastal ecosystems, as well as the economic value of coastal wetlands and what could be lost if transformed. For example, TNC has been engaging with landowners and local communities as part of MMM to ensure that they understand how to benefit from mangrove protection and restoration and associated potential sources of revenue. This project focused on empowering women and enabled women to be part of assessing economic opportunities available through their coastal ecosystems, from mud crabs to blue carbon. Workshop participants also noted that a community education program is ongoing in Australia to inform local people about carbon sequestration potential. While the aforementioned programmes have been run by NGOs at provincial government and community-levels, these programmes could be much more wide-reaching if organised by governments at a federal or state-level. Example educational campaigns include widely distributing easy-to understand written materials or videos on mangrove importance, conservation and policy (Hayman, 2023), (Workshop participant 7668t) in local languages. Policy-makers could encourage and empower local landowners to accurately assess the true values of their coastal ecosystems using similar workshopping strategies elsewhere.

Removing Regulatory Disincentives

The legislative mismatch in Australia between restoration and development projects was not found to be a significant issue elsewhere, though following the incorporation of blue carbon in Australia's Paris Agreement Nationally Determined Contribution (NDC) commitment in 2022, emphasis must be placed on rectifying this issue in policy. This could be done through removing fees for applications for coastal wetland restoration projects (but not for development projects) and creating a separate application avenue for projects aiming to restore and/or create coastal wetlands from those aiming to develop the coastline (see also Carmody, 2024).

As outlined in Section 3.1, in several countries, governments need to firmly clarify in policy how land ownership and governance will change both under sea-level rise and the intentional opening of tidal flow to ensure that land-owners do not lose carbon rights and thus be disincentivized to restore coastal ecosystems. This issue has been partially overcome in Australia through contractual agreements over the retention of carbon rights, even if land rights change due to the new tidal influence (Macreadie et al., 2022). In Aotearoa New Zealand, while land below the high-water mark is considered public, Māori are permitted to apply for customary marine title over an area under the Marine and Coastal Area Act 2011, which may enable traditional landowners to benefit from future carbon market schemes when established (Stewart-Sinclair et al., 2024).

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4.2. Funding and Valuing Coastal Wetlands

Adequately Pricing Benefits from Blue Carbon

Existing carbon credit prices for nature-based carbon projects, particularly in the voluntary carbon market, make blue carbon too small of an income source to support many landowners (see Section 3.2.1.). Governments can set price floors, or send a signal by paying a high price for demonstrable high quality carbon credits, to encourage more accurately valuing the protection of blue carbon habitats. This approach has been applied to some extent by Queensland's Land Restoration Fund (LRF). The LRF considers the cost of generating the carbon credits as well as the additional benefits delivered by the project in setting its price on the LRF website; currently AUD $81.08 per tonne of CO_2 (see Queensland Government, 2023; 2024). The LEAF programme, an initiative focused on jurisdictional REDD+ programs, also provides a valuable template, as it offers forward purchase agreements for an agreed price, with a floor price commitment of USD $10/tonne for at least 100 million metric tonnes of CO_2, helping to finance large projects (see LEAF Coalition, 2023; 2024).

"Stacking" Economic Opportunities in Coastal Wetland Ecosystems

Carbon credits and economic mechanisms such as aquasilviculture, sea cucumber farming, and broader Payment for Environmental Services (PES) schemes, should be considered in concert whenever possible and utilised together to ensure that people stewarding coastal ecosystems can obtain maximum benefits (workshop participant x4886). In this regard, carbon credits should best be viewed as a supplemental source of income, rather than a sole or even primary source, particularly in locations where other concurrent livelihoods exist. Other nature-based credit schemes should also be considered if they can provide additional financial support for the management of coastal wetlands, including PES schemes (see Waage et al., 2008), biodiversity credits (Khatri et al., 2022), resilience credits, and the recently-proposed nature repair credits in Australia (Department of Climate Change, Energy, the Environment and Water, 2023). As additional crediting opportunities for environmental services develop, it is critically important that these are designed with compatibility with carbon markets as a key objective and that projects can access multiple crediting schemes where appropriate.

An economic opportunity which is being trialed to help protect seagrasses in Papua New Guinea is sea cucumber ranching, which encourages protection as it can only be conducted in healthy seagrass ecosystems (see Hair et al., 2016; 2022). Aquasilviculture practices have been promoted for mangrove protection and economic development by the Ministry of Environment and Forestry (KLHK) in Indonesia (Miller and Tonoto, 2023), and are being promoted as a means of both restoring mangrove ecosystems and providing an income for local people in the Philippines (Flores et al., 2016), as well as across Asia and in some Pacific Islands (Susitharan and Sindhu, 2021).

A major case study in how this practice can protect mangrove ecosystems and provide a sustainable income for IPLCs is demonstrated in the Mekong Delta with the Market and Mangroves (MAM) scheme. Active throughout Asia (see: Mangrove Alliance, n.d.), MAM works with governments and assists the drafting of policy to prevent deforestation by creating an economic incentive to protect at least 50% of existing mangroves (Wylie et al., 2016). This is done by supporting projects which keep at least 50% mangrove coverage within their ponds, and helping local communities who conduct aquaculture in this way obtain organic certification for their shrimp, allowing them to be sold at higher market prices, and further supplementing this income with carbon credits (Wylie et al., 2016). This practice provides a more lucrative and beneficial means for IPLCs to gain an income than carbon credit or PES schemes alone, having greatly improved the livelihood of the ~6,000 participating farming households in the Mekong Delta while preventing the loss of 23.5 ha and protecting 3,371 ha of the region's mangroves (Wylie et al., 2016). This case study may provide a template for governments at multiple levels finding a way to ensure the protection of mangroves elsewhere where carbon credit or PES schemes are not considered viable as the sole solution,

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particularly in parts of the world where aquaculture is prolific. It is noted however, that it is not clarified by the available literature how well gender inequity is factored into who directly benefits from the MAM scheme.

Similarly, a mangrove-retaining "eco-farming" programme in Guanxi, China, is being trialed, and is beginning to show great promise for protecting the ecosystem, enhancing species richness, and restoring the wellbeing of the local community (Hangqing, 2021). However, aquasilviculture is not a viable means of protecting any non-mangrove coastal wetlands, for which other strategies are needed, and none of these practices should necessarily be viewed as an "alternative" to blue carbon income, but as complementary benefits.

While the recommendations in the above two sections will help increase income, they do not address the current inequitable distribution of carbon credits, whereby 80% of profit goes to developers. It is paramount that policies and mandatory safeguards are implemented that ensure a greater proportion of profits reach IPLCs and crucially, that these benefits are equitably distributed within communities to ensure they also reach women and other vulnerable groups. This underlines the importance of the safeguards and case studies referred to in 4.1.

Integrating Sea-level Rise in Property Valuations for Coastal Areas

The high economic value of coastal wetlands and coastal land more broadly has been repeatedly noted to negatively affect the willingness of local governments to originate blue carbon projects or protect existing coastal wetlands (also discussed in Adame et al., 2021; Primavera et al., 2019, and by workshop participant sjkfo). This may be particularly true in Australia, where sea-level rise increasing the amount of in-demand coastal land has been projected to increase the price of land, and thus the opportunity cost (Runting et al., 2017, but see contradictory work by Fuerst and Warren-Myers, 2021). These high economic valuations of coastal land should be reconsidered under the context of the negative impacts of sea-level rise on both agriculture (e.g. Johnson, 2014; Genua-Olmedo et al., 2016; Jamwal, 2019) and the habitability of urban land (e.g. Bell et al., 2015; Hauer et al., 2020; Bell, 2021). It is recommended that countries develop sea-level projections based on long-term and short-term vertical land movement and relative sea-level change data across their coastlines, as has been templated by Naish et al. (2024) (presented in NZ SeaRise, 2022). These can be used alongside model projections of changes in vegetation under different sea-level rise scenarios (as shown in a recent proposal by Albot et al. (2022)) to understand how a coastal wetland is likely to change in the future. A site's ability to sequester carbon may decrease due to erosion (Figueira and Hayward, 2014), but may also substantially increase as salt marshes are replaced by lower-growing mangroves which store substantially more carbon (Kelleway et al., 2015; Raw et al., 2019; Saintillan et al., 2019). A case-study implementing this approach is present in South Australia, where coastal zones are identified using sea-level rise scenarios, with bans being put in place for the development of these zones, further disincentivising development around their surroundings (workshop participant jtuiy).

Investing in Public Funding for Coastal Wetland Protection

Market requirements for carbon additionality should not be treated as the only metric by which a coastal wetland ecosystem holds value, as sustaining protection of these healthy wetlands that fall short of meeting additionality requirements is essential to preventing the loss of sequestered carbon among many other ecosystem services and other benefits outlined in Friess et al. (2020). While the importance of additionality should not be downplayed, carbon markets are not always the best method of financing the protection of coastal wetlands. The extent to which different areas of coastal wetlands are suited to market-based mechanisms or not should be considered by planners and policy-makers in their allocation of funding, so that funds are still directed towards areas that are in need of investment, but might not be suited to the requirements of carbon or other environmental markets.

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Policy makers should also ensure that planting projects are set up for success by investing in scientific research or existing best-practices. These can include establishing breakwaters to promote calmer seas, promoting the growth of mangroves (interviewee lbp2l) and/or researching the preferred tidal position and hydropoint tolerances of mangrove and salt-marsh plant species, and designing planting schemes based on this research, as well as study into carbon stocks and fluxes of coastal wetlands in a given area. Policy-makers should also support local communities with equitable gender representation to engage as co-designers of projects and contribute their knowledge and expertise around managing these ecosystems. Funding this kind of enabling support to increase the investment readiness of projects may encourage or improve the effectiveness of private investment in restoration projects. This should be done without de-prioritising the protection of existing coastal wetlands where carbon markets are not expected to be a suitable vehicle for investment.

4.3. Regulatory Mandates and Priorities

Clarifying and Aligning Political Mandates and Jurisdictions

Steps must be taken to streamline and clarify which national agencies are responsible for coastal wetlands across much of the Asia-Pacific. Throughout much of the Asia-Pacific region, it is necessary to find ways to address and simplify overlapping political mandates and jurisdictions, as well as ensure that it is easier for landowners to initiate blue carbon projects without significant jurisdiction-related complications and extensive permit waits and fees.

Resolution of issues where conflicting jurisdictional mandates exist is highly complicated and location-specific, and requires extensive discussion-based workshops between authorities as well as consultations with stakeholders and IPLCs to ensure that all challenges are properly resolved. Interviewees noted examples where governments are making efforts to do this. In Papua New Guinea, for example, two different agencies have overlapping jurisdiction over mangrove restoration (workshop participant 7dd8t). In 2014-2015 workshops were held with TNC involvement to facilitate collaboration across the agencies by helping them align their differing and conflicting priorities and develop mangrove policy (workshop participant 7dd8t). Interviewee 75vzi noted that in Indonesia there has been an increase in understanding regarding who is responsible for the different aspects of blue carbon restoration through the creation of the KKMD (the Regional Mangrove Working Group) coordinating efforts on a provincial level, and KKMN (the National Mangrove Working Group) coordinating efforts at a national level.

To offer a long-term solution to the fundamental issue of conflicting institutional mandates and authorities it is important that governments take the effort to create larger-scale institutional change. True long-term solutions can only exist if mandated at the appropriate levels in governments (also noted by Bell-James et al., 2023b).

A topic which arose during the workshops associated with this paper is the notion that international agreements, such as the Paris Agreement, can help motivate national governments to ensure that different levels of government and authorities over coastal wetlands are brought into alignment with one another, and/or that application processes are streamlined. This is because, as has been done in Australia (Kelleway et al., 2020) and Vanuatu (Thuy and Thuy, 2019), blue carbon can be incorporated into nationally declared contributions (NDCs) towards meeting targets to avoid +1.5°C warming. Including coastal wetland ecosystems in a NDC carbon accounting framework requires rigorous planning and robust capacities (see Hamilton et al., 2020). In order to meet their commitment, a government will need to establish a framework that supports and enables the protection and restoration of coastal wetlands, including through institutional coordination and policy coherence. Additionally, their inclusion into NDCs can signal opportunities for climate finance in support of climate mitigation and/or adaptation actions.

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Improving Effectiveness of Enforcement

An issue borne out of all three of the aforementioned themes is that, throughout much of the Asia-Pacific, existing regulations designed to protect coastal wetlands are seldom enforced or implemented (Thomas, 2016; Thompson et al., 2017; Gu et al., 2018; Primavera et al., 2019; Denya & Peters, 2020; Rudianto et al., 2020; Chanda, 2022; Miller and Tonoto, 2023). Survey participants list a number of reasons for this, including a lack of penalties, insufficient funding to those responsible for enforcing regulations, a lack of awareness of existing regulations, exploitable loopholes in regulations, corruption, underdeveloped legal frameworks, and a "shifting of responsibility" between agencies with overlapping authority. These myriad reasons have different solutions, many of which have already been outlined above.

In some places, introducing penalties may help to dissuade damaging practices to blue carbon habitats. However, the presence of a penalty given towards local people who have not been consulted or engaged in regulatory changes will not lead to an equitable outcome. We recommend that governments undertake community outreach and engagement programmes with local communities living in and near coastal areas, to ensure that community members are engaged in any efforts to strengthen and improve enforcement of regulations, including by introducing penalties for ecologically damaging activities. For example, community-based ranger programs have proven successful in improving biodiversity outcomes from carbon projects in savanna ecosystems in Northern Australia (ALFA, n.d.; Northern Land Council, 2024). Adaptation of this to approach to coastal wetlands should be explored.

Workshops can be held between government agencies to resolve who has what authority, and thus who is responsible for enforcement of protection, as have been conducted in Papua New Guinea(also see Section 4.3 on regulatory mandates and priorities above). These prior workshops can be used to template resolutions, and should involve consultation with practitioners and IPLCs (ensuring inclusion of women and other vulnerable groups) to identify loopholes, in order to find the best way to close them without negatively impacting the rights of IPLCs.

Project development teams should have sufficient engagement and communications with the appropriate scales of government. The scale of government at which decisions are made must be considered, as more local-scale government efforts may better involve and connect with local people, and be able to work around. The establishment of codes of practice, e.g. as templated by Bates (2023) to streamline and standardise the process of restoring and protecting blue carbon habitats could also greatly benefit the oversight of blue carbon projects, in particular by helping to establish shared understanding and framework for compliance among stakeholders.

5. Conclusions

In order to accelerate high-quality blue carbon development in the Asia-Pacific region and to enable coastal ecosystems in the region to meet their full potential as a nature-based solution to climate change, and ensure that outcomes are equitable, there are a number of things that policy-makers and funders can do. It is noted these may not always be applicable due to differences in environment, including biophysical, socioeconomic and political differences, among others.

- To clearly establish land tenure and ownership where IPLCs hold customary rights over coastal wetlands, we recommend that policy is implemented to ensure that prior to any blue carbon work, gender equitable and participatory GPS-guided property mapping be conducted following and in discussion with IPLCs and existing local governance structures as appropriate, taking into account customary land claims. Using this approach, blue carbon projects can strengthen IPLC claims to coastal wetlands and lead to more equitable outcomes, deter exploitation, and encourage IPLC leadership/co-management in the project, which will lead to a much greater likelihood of project success.

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- To recognise that blue carbon projects are not gender neutral and we must build in thorough gender analysis and implementation of tools such as the W+ Standard into all blue carbon projects to ensure that benefits are more equitable and at a minimum do no harm.
- To address cases where landownership might change from private to public as its position within the intertidal zone changes, we recommend legal clarifications be put in place ensuring that landowners who allow their land to become blue carbon habitats do not lose carbon rights as a result of this. Legal reviews of existing legislation in countries and states will assist with this.
- Regarding the funding and protection of blue carbon habitats, a number of issues were noted.
    - Firstly, the size of carbon credit payments are often very small, and insufficient to provide for the living of those who manage and hold claim over these habitats. A number of steps can be taken towards resolving this. Where environmental and ecological protection allows, carbon credits can be a supplementary income on top of methods such as aquasilviculture, sea cucumber farming, sustainable aquaculture, etc, as well as stacking with other credit schemes. New crediting schemes for environmental services should be designed with compatibility with carbon markets as a key objective. Additionally, mandating of price floors and purchasers paying a higher price for high-quality nature-based carbon credits as a price signal may prove to be an effective method of increasing the value of carbon credits and supporting local projects and the people responsible for them. It is noted that these measures will only have significant impact if the current inequities in profit distribution are addressed.
    - Secondly, to accurately determine the amount (and value) of blue carbon sequestered, and the salt/inundation tolerances of species used in planting schemes to create blue carbon projects, more research is necessary throughout much of the Asia-Pacific region. It is recommended that funding be dedicated towards this research, and restoration/protection/wetland creation projects be designed on the basis of this research. Economic accounting should also be applied to co-benefits to quantify additional outcomes that underpin adequate carbon prices and/or stack benefits through complementary schemes. Policy-makers should also provide funding to support local communities with equitable gender representation to engage as co-designers of projects and contribute their knowledge and expertise to valuing the outcomes delivered through high-quality blue carbon projects..
    - Thirdly, without undermining the importance of additionality for market-based mechanisms, it is clear that carbon markets are not always the best method of funding the protection of coastal wetlands. Non-market funding sources and alternative payments for ecosystem services schemes may be more effective at protecting blue carbon stored in coastal wetlands when additionality cannot be demonstrated. We recommend that policy-makers take this differentiation into account and allocate public funds to areas that are in need of investment, but might not be suited to the requirements of carbon or other environmental markets.
- To begin to address the challenge of conflicting jurisdictional mandates between authorities responsible for managing coastal wetlands, and the complex, fragmented legislative environment that results, more inter-agency dialogues and workshops are needed to improve

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alignment and to define shared goals and strategies for these ecosystems wherever possible. These should include consultations with practitioners and IPLCs and can be facilitated by external parties initially. However,true, long-term solutions to this can likely only exist if mandated by the appropriate levels of government.

- Governments in the region might also consider the use of a national code of practice for protection and restoration of coastal wetlands that is used by all agencies and levels of government, and incorporates standards to ensure quality and equity across all code-compliant projects.

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