The blue carbon market in Vietnam

Future development, potential and challenges

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Abbreviations

AFOCO	Asian Forest Cooperation Organization
AGB	Above-ground biomass
BGB	Below-ground biomass
CDM	Clean Development Mechanism
CGIAR	The Consultative Group on International Agricultural Research
CO_2e	Carbon dioxide equivalent
Corg	Organic carbon
FCPF	Forest Carbon Partnership Facility
GCF	Green Climate Fund
GHG	Greenhouse gas
Gt	Gigaton (1 Gt equal to 1 billion ton)
IFC	International Finance Cooperation
JI	Joint Implementation
JICA	Japan International Cooperation Agency
LEAF	Lowering Emissions by Accelerating Forest Finance
MARD	Ministry of Agriculture and Rural Development
MOF	Ministry of Finance
MONRE	Ministry of Natural Resources and Environment
MRV	Measurement, reporting and verification
$MtCO_2e$	Million tons of carbon dioxide equivalent
NDC	Nationally Determined Contribution
REDD+	Reducing emissions from deforestation and forest degradation, sustainable management of forests and the conservation and enhancement of forest carbon stocks
tCO_2e	Ton of carbon dioxide equivalent
tdm	ton dry matter
Tg	Teragram (1 Tg equal to 1 billion kilograms)
UNFCCC	United Nations Framework Convention on Climate Change
UN-REDD	United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation
USD	United States Dollar
VCM	Voluntary Carbon Market
VCS	Verified Carbon Standard
VVB	Verification and Validation Body

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Summary

This report was prepared in response to a request from the Vietnamese government, notably that of the Ministry of Agriculture and Rural Development. Its aim is to provide information on the carbon market in general, but also specifically as it relates to forestry, with a focus on blue carbon. This information is intended to support the government to design and implement high quality blue carbon policies, projects and credits. The report assesses the potential of a blue carbon market in Vietnam, including assessing emissions/carbon accounting for mangroves, peatlands, wetlands, seagrass and tidal marshes. It analyses the existing legal framework, as well as opportunities and challenges for the general carbon market and blue carbon in Vietnam, providing recommendations for how Vietnam should move forward with this market.

Our report shows that Vietnam has strongly committed to implementing a 'net zero' emission goal by 2050. Forestry and blue carbon ecosystems in Vietnam play an important role in mitigating greenhouse gas emissions, maintaining ecosystem services, and mitigating the impacts of climate change, particularly in coastal areas. Recent government policies on the domestic carbon market open up opportunities to create additional sources of finance for forestry, through mechanisms for exchanging and trading emissions reduction results and carbon credits. However, a number of obstacles currently impede the effective design and implementation of a blue carbon market in Vietnam, including: a lack of clear emission quotas for diverse sectors; a lack of oversight of how to include forest carbon and blue carbon activities in the legal framework; insufficient clarity on who owns carbon rights; and weak capacity to implement blue carbon projects. As well as improving the legal framework, it is also critical to improve blue ecosystem inventories. Currently, the Vietnamese government only pays attention to mangrove areas; the forest inventory system overlooks the high potential of seagrass and tidal marsh areas. Improving these national database and monitoring systems could generate additional benefits from a blue carbon market, while promoting biodiversity conservation and improving local livelihoods.

1 Introduction

The carbon market has grown quickly since the Paris Agreement was signed by over 190 parties in 2015. Between 2020 and as in November 2021, the voluntary carbon market (VCM) grew by about 30% in terms of the volume of transaction volumes, while transaction values increased by roughly 60%. Since 2020 and for the first time, the total value of the VCM now exceeds USD 1.3 billion (Forest Trends 2021; World Bank 2022a) and demand for carbon credits via the VCM could reach USD 50 billion by 2030 (Climate Focus 2021). 'Coastal blue carbon' is associated with tidal wetlands – particularly mangroves, saltmarshes, and seagrass meadows – and it plays an important role in mitigating climate change (Hilmi et al. 2021). While these ecosystems cover just 0.2% of the world, they are carbon storage hotspots, since soils in these areas sequester 10 times more carbon than terrestrial ecosystems. It is estimated that, annually, around 0.2–0.24 Gt of CO_2e are released due to ecosystem conversion and degradation (IFC 2023). This in effect amounts to 3–19% of global deforestation, and comes with economic damages to the value of USD 6–42 billion annually (IFC 2023). It is also estimated that, globally, the restoration and conservation of mangroves, saltmarshes and seagrass meadows has potential to offset 0.5 to 1.38 $GtCO_2$ annually (IFC 2023). Although blue carbon is included in the VCM, there are only a few mangrove-based carbon projects registered against carbon standards. About 23 blue carbon projects are currently being implemented globally; these projects are associated with mangrove restoration and conservation. Most of these projects generate annual carbon credits of less than 50,000 tCO_2e, however a few generate carbon credits of over 1 million tCO_2e annually (IFC 2023). While blue carbon is seen as critical for climate change mitigation, unleashing its potential has been hampered by valuation and governance, and there is a need for policy reform at both global and national levels (Hilmi et al. 2021).

Blue carbon credits have great potential for Vietnam, with its long coastal area. It is estimated that Vietnam's wetland forests cover an area of 237,481 ha, of which about 150,000 ha is mangroves (Cuc Kiem Lam 2023). However, these areas have been exposed to different threats and mangrove area has reduced significantly from 405,000 ha in 1943 to about 157,000 ha in 1999 (Do et al. 2005). As part of its Nationally Determined Contribution, Vietnam is now preparing to develop a domestic carbon market and expects to include carbon credits from 'coastal blue carbon'. However, the forestry carbon market, and particularly the coastal blue carbon market, is quite new to policymakers and stakeholders at all levels.

This report has been prepared at the request of the Government of Vietnam, notably from the Ministry of Agriculture and Rural Development (MARD), with a view to provide information on the general carbon market, but with a particular focus on blue carbon, to support the government to design and implement high quality blue carbon policies, projects and credits. The report is structured into four main parts. After the introduction, the research team briefly describe the research approaches applied in this study. The third section then assesses the potential for a blue carbon market in Vietnam, including assessing emissions/carbon accounting for mangroves, peatlands, wetlands, seagrass and tidal marsh areas. The fourth section then analyses the existing legal framework together with carbon market and blue carbon projects in Vietnam, before providing recommendations for how Vietnam should move forward with this market.

2 Methodology

Policy analysis: Policy analysis focuses on existing policies and legal frameworks that are relevant to the carbon market in general, and forestry carbon programmes and trading in Vietnam. These policies include: (i) laws, for example the Environment Protection Law 2020, and Forestry Law 2017; (ii) decrees guiding implementation of environment protection and forestry laws; and the decree on the piloting of emissions reduction in the North Central region; (iii) decisions of the Prime Minister on the REDD+ programme, climate change, and green growth strategies; and (iv) REDD+ based studies. This policy analysis provides a description of the existing legal framework on carbon market operations, and policy gaps for future interventions.

Document review: The research team reviewed journal articles and technical reports from research organizations, governmental agencies and international organizations. This review focuses on blue carbon ecosystems, technical interventions relating to Vietnam's NDC (Nationally Determined Contribution) and carbon standards, as well as the measuring, reporting and verification of forestry-based carbon activities.

Online survey: An online survey was sent to 28 coastal provinces to explore their perspectives on the potential and challenges of the carbon market in general, and a blue carbon market in particular. In total 8 provinces took part in this survey.

In-depth interviews were held with key stakeholders to better understand the policy context and gaps in relation to the carbon market, with a focus on forestry and blue carbon. Five individual interviews were organized with senior officers of: (1) the Department of Climate Change of the Ministry of Natural Resources and Environment; (2) the Department of Forestry; (3) the Department of Science, Technology and Environment, of the Ministry of Agriculture and Rural Development; (4) the Ministry of Finance; and (5) the Ministry of Planning and Investment.

A national consultation workshop was organized on 12 June 2023 in Ho Chi Minh City where more than 92 representatives from international, national and provincial organizations working on blue carbon in Vietnam met to exchange perspectives on the blue carbon market.

3 The potential for a blue carbon market in Vietnam

The Intergovernmental Panel on Climate Change (IPCC) defines blue carbon as "all biologically-driven carbon fluxes and storage in marine systems that are amenable to management" (IPCC 2013). The focus has been on coastal zones and their rooted vegetation, notably tidal marshes, mangroves and seagrasses, as described in the IPCC Wetland Guideline (Table 1).

The following section discusses these three ecosystems (tidal marsh, mangrove and seagrass) in more detail.

Table 1. Management activities in coastal wetlands

Activity	Subactivity	Vegetation types affected
Activities relevant to CO_2 emissions and removals		
Forest management practices in mangroves	Planting, thinning, harvest, wood removal, fuelwood removal, charcoal production[1]	Mangrove[2]
Extraction	Excavation to enable port, harbour and marina construction and filling or dredging to facilitate raising the elevation of land	Mangrove, Tidal marsh, Seagrass meadow[4]
	Aquaculture (construction)	Mangrove, Tidal marsh
	Salt production (construction)	Mangrove, Tidal marsh
Drainage	Aquaculture, forestry, mosquito control	Mangrove, Tidal marsh
Rewetting, revegetation and creation[3]	Conservation from drained to saturated soils by restoring hydrology and reestablishment of vegetation	Mangrove, Tidal marsh
	Reestablishment of vegetation on undrained soils	Seagrass meadow[4]
Activities relevant to non-CO_2 emissions		
Aquaculture (use)	N_2O emissions from aquaculture use	Mangrove, Tidal marsh, Seagrass meadow
Rewetted soils	CH_4 emissions from change to natural vegetation following modifications to restore hydrology	Mangrove, Tidal marsh

1 Including conversion to Forest Land or conversion from Forest Land to other land uses.
2 It is *good practice* to report mangroves in the appropriate national land-use category according to the national forest definition and to consider when forest management practices may occur on mangroves classified under land-use categories other than Forest Land (similar types of examples in inventory reporting include wood harvest from orchards or other perennial Cropland or harvest of trees from Wetlands).
3 The term revegetation is used to refer to practices within the framework of UNFCCC reporting.
4 Countries need to report on emissions from extraction and revegetation only if necessary data are available

Source: IPCC (2013)

3.1 Mangrove forests

The area of mangrove forests in Vietnam decreased significantly between 1943 and 2010, from 408,500 ha in 1943 (Do et al. 2005) to 94,276 ha in 2010 (MARD 2011). The government has since launched a large number of mangrove protection, restoration and plantation programmes, leading to an annual increase of mangrove area of around 5,400 ha (Prime Minister 2021c). In 2020, Vietnam's total mangrove area covered 147,797 ha, with the Mekong River Delta accounting for about 55% of this, followed by the Southeast (23%) and Northeast (13%) (Table 2, MARD 2021). The latest forest data (for 2022) reports the total area of 'wetland forests' as 237,481 ha (MARD 2023a), however, this category includes mangrove areas and Melaleuca forests. According to all interviewed government officials, mangrove area in 2022 remains the same as it was in 2020.

Table 2 shows that mangrove is not well distributed across Vietnam and although the overall national mangrove area increased between 2010 and 2020, not all regions experienced this increase. Notably, mangrove areas in the Northeast and Red River Delta regions have significantly declined.

Mangroves cover a relatively small area in Vietnam, accounting for 3% of total forest cover, but they are rich in biodiversity. Vietnam's mangroves are made up of 36 true mangrove species, which belong to 20 genera of 14 families, and 77 associate mangrove tree species (Do et al. 2005). As for true mangrove species, there are 16, 23 and 33 species in the North, Central and South respectively. Mangroves in North and Central Vietnam are generally quite small and most mangrove forests are designated for coastal protection. Key mangrove species are distributed as follows (Do et al. 2005):

- In the North, there are 16 mangrove species; the predominant mangrove species are *Kandelia obovata (Trang), Rhizophorastylosa (Duoc voi), Avicennia marina (Mam bien), Sonneratia caseolaris (Ban chua) and Bruguiera gymnorrhiza (Vet du)*. Of these, Kandelia obovata is widely distributed and is the key species for reforestation.
- In the central regions, 23 mangrove species can be found; the main species are *Kandelia obovata (Trang), Avicennia marina (Mam bien), Sonneratia caseolaris (Ban chua)* and *Rhizophora stylosa (Duoc voi)*. As in the northern region, *Kandelia obovata* and *Avicennia marina* are commonly found in coastal areas.
- In the southern regions, mangrove comprises of 33 species; common species are *Rhizophora apiculata (Duoc), Bruguiera sexangula (Vet khang), Ceriopsdecandra (Da quanh), Lumnitzera racemosa (Coc vang), Avicennia officinalis (Mam den)* and *Excoecaria agallocha (Gia)*. In this region, over 80% of mangrove forest is dominated by *Rhizophora apiculata*.

Mangrove species in the South, particularly in the Mekong, have better growth performance. Dominant species are *Rhizophora apiculata (Duoc doi)* which is found to cover about 80% of mangrove forests, followed by *Avicennia alba (Mam trang), Avicennia officinalis (Mam den), Bruguiera gymnorrhiza (Vet khang), Bruguiera parviflora (Vet tru), Ceriops tagal (Da voi), Ceriops decanda (Da quanh)* and *Nypa fruticans (Dua nuoc)* (Do et al. 2005).

As for the carbon stocks of mangroves, several mangrove carbon studies have indicated that

Table 2. Mangrove forest distribution across Vietnam by eco-region (2010–2022) (unit: ha)

Region	2010	2015	2020
Northeast	20,830	20,872	19,601
Red River Delta	14,823	14,300	9,576
North and South Central	3,308	1,976	2,232
Southeast	17,715	14,575	34,499
Mekong River Delta	37,600	66,005	81,889
Total	**94,276**	**117,727**	**147,797**

Source: MARD (2011, 2016 and 2021).

mangrove carbon stocks vary greatly by species and region, ranging from 172 to 524 tCO_2e/ha. The lowest carbon stocks are found with *Lumnitzera racemosa* (106 tCO_2e/ha), *Kandelia obovata* (169 tCO_2e/ha) and *Ceriops decandra* (183 tCO_2e/ha). This is followed by *Avicennia officinalis* which holds 282 tCO_2e/ha of carbon and *Avicennia alba* (370 tCO_2e/ha); while the highest mangrove carbon stocks can be found in *Senneratia caseolari* (524 tCO_2e/ha) and *Rhizophora apiculata* (513 tCO_2e/ha) forests. The total average weighted carbon stock for mangrove forests in the North (including mangroves in Northeast, North and South-Central Coast regions) is estimated at 129 tCO_2e/ha, while for the South (Southeast and Mekong River Delta) it is estimated at 236 tCO_2e/ha. The national average mangrove carbon stock is 213 tCO_2e/ha (Vu et al. 2015).

Mangroves also show fast performance compared to mainland forests. The carbon sequestration rate of mangroves depends on several factors, including species, age, planting density and site conditions. In the Red River Delta, the estimated carbon sequestration rate is 22.9±4.2 tCO_2e/ha/year for a pure plantation of *Senneratia caseolari*, 16.4±3.2 tCO_2e/ha/year for a pure plantation of *Kandelia obovata* and for mixed forests of *Senneratia caseolari* and *Kandelia obovata* it is 11.4±2.6 tCO_2e/ha/year (Vu and Pham 2020). In the South, the average annual carbon sequestration rate for key mangrove species is estimated to be 24.5 tCO_2e/ha/year (see Table 3).

Estimating mangrove carbon stock is quite complicated and costly. Basic carbon estimates are based on tree biomass. A number of studies have developed allometric equations for above-ground tree biomass (AGB) estimates, using several prediction variables, such as diameter at breast height (DBH), total tree height (H) and basic wood density (WD). Mangrove biomass performance largely depends on the specific site conditions and species. Komiyama et al. (2008) improved mangrove biomass estimates by solving site- and species-specific challenges. They reviewed 72 articles regarding mangrove biomass estimates and developed specific allometries for estimating tree AGB and BGB for 10 specific mangrove species, and a common allometry for those species. Common equations were assessed and compared with different equations prepared by different authors. These common equations showed a good fit with the models, with relative errors of less than ±13% (Komiyama et al. 2008).

Table 3. Estimated carbon stocks for key mangrove species in each eco-region

Species	Eco-region	Above-ground carbon stock (tCO_2e/ha)	Above-ground carbon sequestration (tCO_2e/ha/year)
Rhizophora apiculata	Southwest	448.1	17.4
		337.4	21.0
	Southeast	238.2	14.5
Avicennia alba	Southwest	187.8	16.9
		307.4	17.6
Avicennia officinalis	Southwest	189.2	9.5
Lumnitzera racemosa	Southeast	70.3	4.7
Ceriops decandra	Southeast	121.5	4.1
Senneratia caseolaris	Southwest	350.7	17.6
Kandelia obovata	North Central	100.8	9.3
	Red River Delta	126.3	16.4

Source: Vu et al. (2015)

Table 4. Regional allometries for tree biomass estimates of diverse mangrove species

Above-ground tree weight (W_{top} in kg)	Below-ground tree weight (W_R in kg)
Avicennia germinans $W_{top} = 0.140DBH^{2.40}$ $r^2 = 0.97$, n = 45, D_{max} = 4 cm, Fromard et al. (1998)[a] $W_{top} = 0.0942DBH^{2.54}$ $r^2 = 0.99$, n = 21, D_{max}: unknown, Imbert and Rollet (1989)a *A. marina* $W_{top} = 0.308DBH^{2.11}$ $r^2 = 0.97$, n = 22, D_{max} = 35 cm, Comley and McGuinness (2005) *Laguncularia racemosa* $W_{top} = 0.102DBH^{2.50}$ $r^2 = 0.97$, n = 70, D_{max} = 10 cm, Fromard et al. (1998)[a] $W_{top} = 0.209DBH^{2.24}$ $r^2 = 0.99$, n = 17, D_{max}: unknown, Imbert and Rollet (1989)a *Rhizophora apiculata* $W_{top} = 0.235DBH^{2.42}$ $r^2 = 0.98$, n = 57, D_{max} = 28 cm, Ong et al. (2004) *Rhizophora mangle* $W_{top} = 0.178DBH^{2.47}$ $r^2 = 0.98$, n = 17, D_{max}: unknown, Imbert and Rollet (1989)a *Rhizophora* spp. $W_{top} = 0.128DBH^{2.60}$ $r^2 = 0.92$, n = 9, D_{max} = 32 cm, Fromard et al. (1998)[a] $W_{top} = 0.105DBH^{2.68}$ $r^2 = 0.99$, n = 23, D_{max} = 25 cm, Clough and Scott (1989)a *Bruguiera gymnorrhiza* $W_{top} = 0.186DBH^{2.31}$ $r^2 = 0.99$, n = 17, D_{max} = 25 cm, Clough and Scott (1989)a *Bruguiera parviflora* $W_{top} = 0.168DBH^{2.42}$ $r^2 = 0.99$, D_{max} = 25 cm, n = 16, Clough and Scott (1989)a *Ceriops australis* $W_{top} = 0.189DBH^{2.34}$ $r^2 = 0.99$, n = 26, D_{max} = 20 cm, Clough and Scott (1989)a *Xylocarpus grnatum* $W_{top} = 0.0823DBH^{2.59}$ $r^2 = 0.99$, n = 15, D_{max} = 25 cm, Clough and Scott (1989)a Common equation $W_{top} = 0.251pD^{2.46}$ $r^2 = 0.98$, n = 104, D_{max} = 49 cm, Komiyama et al. (2005) $W_{top} = 0.168pDBH^{2.47}$ $r^2 = 0.99$, n = 84, D_{max} = 50 cm, Chave et al. (2005)	*Avicennia marina* $W_R = 1.28DBH^{1.17}$ $r^2 = 0.80$, n = 14, D_{max} = 35 cm, Comley and McGuinness (2005) *Bruguiera* spp. $W_R = 0.0188(D^2H)^{0.909}$ r^2: unknown, n = 11, D_{max} = 33 cm, Tamai et al. (1986) *Bruguiera exaristata* $W_R = 0.302DBH^{2.15}$ $r^2 = 0.88$, n = 9, D_{max} = 10 cm, Comley and McGuinness (2005) *Ceriops australis* $W_R = 0.159DBH^{1.95}$ $r^2 = 0.87$, n = 9, D_{max} = 8 cm, Comley and McGuinness (2005) *R. apiculata* $W_R = 0.00698DBH^{2.61}$ $r^2 = 0.99$, n = 11, D_{max} = 28 cm, Ong et al. (2004) c.f., $W_{stilt} = 0.0209DBH^{2.55}$ $r^2 = 0.84$, n = 41 *Rhizophora stylosa* $W_R = 0.261DBH^{1.86}$ $r^2 = 0.92$, n = 5, D_{max} = 15 cm, Comley and McGuinness (2005) *Rhizophora* spp. $W_R = 0.00974(D^2H)^{1.05}$ r^2: chưa biết, n = 16, D_{max}= 40 cm, Tamai et al. (1986) c.f., $H = D/(0.02D + 0.678)$ *Xylocarpus granatum* $W_R = 0.145DBH^{2.55}$ $r^2 = 0.99$, n = 6, D_{max} = 8 cm, Poungparn et al. (2002) Common equation $W_R = 0.199p^{0.899}D^{2.22}$ $r^2 = 0.95$, n = 26, D_{max} = 45 cm, Komiyama et al. (2005)

D_{stilt}: the weight of prop root of R. *apiculata*.
[a] After Saenger (2002), Table 8.3 on p. 260. D_{max}: the upper range of samples.

Source: Akira et al 2008. Reprinted from https://www.sciencedirect.com/science/article/abs/pii/S0304377007001829 with permission from Elsevier.

Table 5. Allometric equations for above-ground biomass (AGB) estimates of mangroves in southern Vietnam

Species	Density (trees/ha)	Allometric equation	DBH range (cm)	Sources
Ceriops zippeliana	13,500±1,500	$AGB = 0.2079*DBH^{2.407}$ (r^2=0.97)	1.27–7.48	Binh and Nam (2010)
Ceriops tagal	NA	$AGB = 0.856*DBH^{1.53}$ (r^2=0.92)	1.9–9.4	Nam (2010)
Avicennia alba	2.900–10,400	$AGB = 0.1292*DBH^{2.4137}$ (r^2=0.94)	2.9–29.9	Binh and Nam (2010)
Rhizophora apiculata	NA	$AGB = 0.3482*DBH^{2.2965}$	3.2–30	Nam and Thanh (2010)
Lumnitzera racemosa	7.310±1.329	$AGB = 0.075*DBH^{2.3721}$ (r^2=0.99)	1.8–12.2	Nam (2011)

Source: Vu et al. (2015)

In Vietnam, several studies were conducted to develop allometric equations for estimating mangrove tree biomass. These were mainly implemented in the southern region and used DBH as a variable for biomass estimates (see Table 5).

Looking at coastal blue carbon ecosystems, mangroves have high potential to generate carbon credits. The Government of Vietnam has approved a project on the 'Protection of coastal forests to respond to climate change and promote green growth' for 2021–2030 (Prime Minister 2022a).

Table 6. Estimated carbon credit potential from mangrove conservation and restoration activities

No.	Carbon credit type	Assumptions	Estimated carbon credits (Mt CO_2e)
1	Carbon stocks conserved in existing mangroves	Existing mangroves are protected; the average carbon stock being conserved is 55 tC/ha (or 201.6 tCO_2e/ha).	32.3
2	Annual carbon sequestration from existing mangroves	Existing mangroves are protected; average carbon sequestration for mangroves in the South (60% of the total area) is 24.5 tCO_2/ha/year; and for mangroves in the North (30% of the total area) it is 15.6 tCO_2/ha/year.	3.9
3	Annual carbon sequestration from reforestation	A total of 9,800 ha of mangrove is newly planted as per the plan; the carbon sequestration rate is estimated at 17.8 tCO_2e/ha/year.	0.2
4	Annual carbon sequestration from restored mangroves	A total of 6,800 ha of mangrove is improved and enriched; the (additional) increased rate of carbon sequestration is about 20% of the carbon sequestration rate for mangrove reforestation.	0.02

Source: Authors' own estimations

This project aims to: (1) conserve coastal forests, especially protection and special-use forests; (2) reforest 9,800 ha of mangroves for sea-wave prevention; and (3) restore 6,800 ha of poor mangrove forests. However, a detailed plan for the conservation, reforestation and restoration of mangroves is not yet available at provincial level. The carbon credit potential of this mangrove conservation and restoration is estimated in Table 6.

3.2 Tidal marshes

In Vietnam, coastal vegetation (e.g., seagrasses, salt marshes and particularly mangrove forests) plays a key role in protecting coastlines. Natural resource management has been recognized as having climate change mitigation potential since the 1990s in Vietnam, but other biogenic coastal ecosystems, including seagrasses and nearshore corals have not (Veettil et al. 2021).

The term 'tidal marshes' is not officially used in Vietnamese land-use classification. There are also no official and accurate data records on this ecosystem. Vietnam's land-use classification uses the term 'wetland'; this includes 'inland wetland' and 'coastal wetland'. Key coastal wetlands are primarily in Red River and the Mekong River Delta; these are distributed as follows (Vietnam Environment Protection Agency 2005):

- **In the Red River Delta:** Estuarine wetlands cover 229,762 ha of this area. 125,389 ha of this area is saltwater wetland, of which 22,487 ha is coastal wetland and 102,482 ha is estuarine waters. Coastal wetlands are primarily found at the estuaries of Nam Trieu, Cam, Lach Tray (Hai Phong Province), Van Uc (Thai Binh Province), Ba Lat (Nam Dinh and Thai Binh Province), Lach Giang (Nam Dinh Province) and Day River (Nam Dinh and Ninh Binh Province). In Cat Ba (Hai Phong Province), the main island's western coast includes 40 hectares of alkaline-acid alluvial soils; these came from tidal marshes reclaimed using sea dykes, when two-crop rice fields were developed (Nguyen et al. 2010).
- **In Mekong Delta:** Saline coastal wetlands make up about 1.6 Mha and can be found along the East Sea coastline, to the southwest of the Ca Mau Peninsula and the Gulf of Thailand. Of this area, about 0.9 Mha are permanently flooded wetlands, and 0.7 Mha are seasonally flooded.

The wetland covered by mangroves contains high organic carbon content. Key soil types in the mangrove forests are salic fluvisols and protothionic gleysols. The average soil organic content in soils under the mangrove forest in Quang Ninh (Northeast) is 2.4% at a depth of 0–100 cm, and bulk density is 0.64 gram/cm^3; estimated soil carbon stocks at a soil depth of

100 cm is about 157 tC/ha. In the central region (Thanh Hoa Province), soil carbon stocks in mangrove forests are estimated to be 53 tC/ha at a depth of 0–100 cm and in Ca Mau Province, soil carbon stocks are estimated between 242 and 356 tC/ha at a depth of 0–100 cm (Do et al. 2005). Compared to biomass carbon stocks in mangrove forests, organic carbon stock stored in soils under the mangroves is around 2.4 to 3.4 times higher.

Tidal marshes also have blue carbon potential associated with the conservation of wetlands and forests. Mangrove loss and land-use change are the main drivers for carbon reduction in wetland areas. Soil carbon stocks in coastal wetland areas in the Red River Delta are estimated at 3.5 MtC at a depth of 0–100 cm (or 12.9 $MtCO_2e$) and for coastal wetland areas in the Mekong River Delta at the same soil depth, these are estimated at 478.4 Mt C (or 1,754 $MtCO_2e$). Assuming that the carbon offset potential of tidal marshes is 0.07 to 0.1 tCO_2/year (Hoegh-Guldberg et al. 2019), the annual carbon offset is between 0.13 and 0.18 Mt CO_2e. This means that wetland conservation and avoided wetland degradation can help to conserve a significant carbon budget stored in the wetland areas.

3.3 Seagrass meadows

Seagrass beds are considered ecosystem engineers (Castilla 2001; Lin and Zhang 2015) with important roles in the marine environment. They are efficient natural carbon sinks capturing carbon dioxide in the air through photosynthesis, and storing organic carbon (C_{org}) within sediment and their biomass; this allows them to mitigate climate change (Fourqurean et al. 2012; Greiner et al. 2013; Macreadie et al. 2019; Williamson and Gattuso 2022). There has been significant assessment of C_{org} content and stocks in seagrass meadows for many countries; some global studies have also been developed to assess blue carbon, e.g., the Blue Carbon Initiative. That said, there is limited information available on this blue carbon habitat when it comes to Vietnam, and Southeast Asia more broadly (Stankovic et al. 2021).

With a 3,260 km long coastline that has both warm and cool waters, Vietnam's seagrass species are highly diverse as well as having high plasticity within species boundaries (Nguyen et al. 2022). Seagrass was found to be distributed across several coastal sites in Vietnam; the current estimate of total seagrass area is 15,637 ha (Trinh and Takeuchi 2019), with 14 species[1] of seagrass found nationally (Cao et al. 2012).

The average value of total carbon stored (Ndimele et al. 2018) within seagrass meadows in Southeast Asia is 121.95 ± 76.11 Mg ha^{-1} (average ± SD), and the total C_{org} stock of seagrass meadows in this region was 429.11 ± 111.88 Tg (Stankovic et al. 2021). Regional seagrass meadows are able to accumulate 5.85–6.80 Tg C $year^{-1}$, equivalent to USD 214.6–249.4 million. At their current rate of decline (2.82%), seagrass meadows emit 1.65–2.08 Tg of CO_2 $year^{-1}$; economically these losses equate to USD 21.42–24.96 million (Stankovic et al. 2021). Currently, national policies and commitments to nationally determined contributions in most countries do not include blue carbon ecosystems as climate mitigation measures (Zischg 2023), despite these ecosystems potentially contributing up to 7.03% of emissions reduction goals by 2030 (Stankovic et al. 2021).

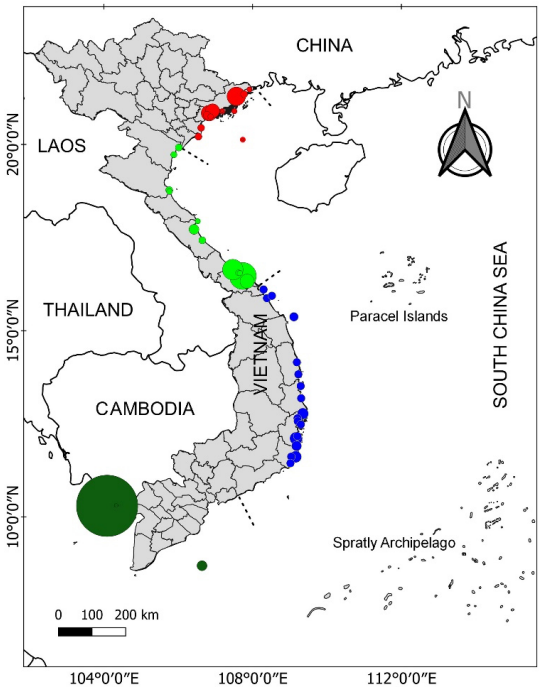

Figure 1. Seagrass distribution across Vietnam
Note: Colours indicate the four regions seagrass is distributed in. Source: Nguyen et al. 2022

1 The 14 seagrass species are: *Cymodocea rotundata, Cymodocea serrulata, Enhalus acoroides, Halodule pinifolia, Halodule uninervis, Halophila beccarii, Halophila decipiens, Halophila minor, Halophila ovalis, Ruppia maritima, Syringodium isoetifolium, Thalassia hemprichii, Thalassodendron ciliatum* and *Zostera japonica.*

Numerous studies have documented a significant decline in seagrass coverage in Vietnamese waters. In 1990, the estimated total of Vietnamese seagrass area was about 29,162 ha (Trinh and Takeuchi 2019); however, Vo et al. (2020) indicate that over the last three decades 186.2 ha (equivalent to 35.8%) of original seagrass beds at Van Phong Bay were destroyed in typhoons and because of aquaculture. Vietnam's seagrass area was significantly reduced during 1990–2019 when 51% of seagrass was lost due to tourism, urbanization, fishery farming and water pollution (Nguyen et al. 2021).

Chen et al. (2016) also found that total seagrass area in Cam Ranh Bay declined by around 25% (66 ha) between 1996 and 2015, mainly due to coastal development and infrastructure construction. For some areas with a large area of seagrass, like Khanh Hoa's coastal area, there was a reduction in submerged aquatic vegetation (including seagrass) of 74.2%, yet less than half of these losses were compensated for by increases elsewhere (Tran et al. 2020).

Recently, a variety of methods are in use to measure seagrass carbon fluxes and storage; these include the measuring of fluxes in oxygen and carbon dioxide, primary production and remote sensing (Macreadie et al. 2019). It is rare that Vietnamese research on carbon storage in seagrasses and other marine plants is published, however a few examples can be found. Cao et al. (2013) calculated Corg in seagrass in Tam Giang-Cau Hai Lagoon (central Vietnam, region 2) through dissolved oxygen (DO) content in a light–dark ex situ experiment with *Halodule pinifolia*. They estimated that in the rainy season the lagoon's seagrass ecosystem produced 25.71 tons of C day−1, which changed to 28.93 tons day−1 in the dry season. That said, the lagoon has seven seagrass species and *H. pinifolia* is not dominant, so this estimate could be biased.

Seagrass carbon storage capacity was evaluated using biomass calculations in one study at Thi Nai Lagoon (region 3); this estimated the total amount of organic carbon and carbon dioxide fixed by seagrass beds at 136.7 and 501 tons ha^{-1}, respectively (Cao and Nguyen 2017). Meanwhile, Stankovic et al. (2021) found total C_{org} (within biomass and sediment) in Vietnam's seagrass beds amounted to 133.16 ± 36.97 Mg ha^{-1}. Comparing Southeast Asian countries, this was higher than found with seagrass beds in Indonesia, Malaysia and the Philippines, but similar to values found in Myanmar and Thailand (Stankovic et al. 2021). Local and regional seagrass Corg variation is subject to differences in seagrass community complexity, fine sediment fraction and seawater depth (Monnier et al. 2022; Stevenson et al. 2022), as much as sediment run-off, and primary production (Serrano et al. 2021).

The average estimated total blue carbon stock held in Vietnamese seagrass was between 2.06–2.95 Tg; and seagrass ecosystems are able to accumulate 25.18–29.28 Gg C_{org} $year^{-1}$. Comparing this with values in the region, C_{org} stocks in Vietnam's seagrass beds were much lower than in the Philippines (259.17–425.21 Tg) or Indonesia (62.08–107.50 Tg); yet higher than in Malaysia (0.005–0.25 Tg) or Myanmar (0.02–0.04 Tg) (Stankovic et al. 2021). Differences in blue carbon stocks across countries are influenced by the total C_{org} found in seagrass beds, as well as the area of seagrass beds. This means that while Vietnam has higher Corg in seagrass bed sediment and biomass, blue carbon stocks in Vietnamese seagrass ecosystems are lower than Indonesia or the Philippines as Vietnam's seagrass area is much smaller (44 and 139 times, respectively) (Stankovic et al. 2021).

Southern Vietnam's seagrass beds span 10,832.1 hectares (ha). However, a total of 2,562 ha (or 19.1%) of seagrass coverage has been lost between over the period of 2000 and 2019. Phu Quoc Island has the largest seagrass area at 10,313 ha; here, five species were found in 2019 (Trinh and Takeuchi 2019) before the seagrass area dropped to 7,579 ha (Nguyen et al. 2021). *Halophila major* is the predominant species in almost all off-shore islands and open-water areas (Nguyen et al. 2021).

In northern Vietnam, seagrasses are mainly distributed around Cat Ba Island, in a narrow range around tidal marshes (within mangroves) in Gia Luan, and in aquaculture ponds in Phu Long. A small area of seagrass is also distributed around Long Chau Island (offshore) and Van Boi (southeast of Cat Ba Island) where there are coral reefs and live coral cover is relatively high (Figure 1). Just two species of seagrass have been identified in Cat Ba Island – *Ruppia Maritima* and *Halophila beccarii*. Neither species are included in the Red Data Book of Vietnam,

Table 7. Seagrass distribution changes in the Vietnam

Distribution sites	1990	2000	2010	2019
Phu Quoc iIsland	14,738	12,731	11,855	10,313
Tam Giang – Cau Hai Lagoon	6,897	9,959	3,580	2,141
Van Phong Bay	2,220	1,735	1,325	704
Cam Ranh Bay	1,832	1,334	1,127	870
Thuy Trieu Lagoon	1,447	1,335	1,254	895
Cu Mong Lagoon	1,058	441	687	350
My Hoa – My Tuong	466	407	330	233
Hon Khoi	410	154	176	73
Hon Tre	94	104	56	58
Total	**29,162**	**28,200**	**20,390**	**15,637**

Source: Trinh and Takeuchi (2019)

despite *Halophila beccarii* being classified as 'endangered ' in the IUCN Red List of threatened species, 2011 (Doan and Tran 2018).

As for the South, seaagrassseagrass is found mainly on the island of Phu Quoc Island and is distributed across seven sites, namely Bai Bon, Bai Dam, An Thoi, Bai Dai, Bai Thom, Bac Bai Vong and Mui Da Chong. According to the Kien Giang Department of Natural Resources and Environment (2020), seagrass density here is 626.6 plants/m^2, with coverage between 30 and 70% and an estimated mass of 0.82 total dry matter per hectare (tdm/ha). It is estimated that seagrass carbon stock here is 0.39 tC/ha. The potential carbon credits from conserving this existing seagrass area (and the total carbon stocks stored in the seagrass meadow) are about 15,000 tCO_2e. The carbon offset rate is estimated between 0.28 to 0.37 tCO_2/year (Hoegh-Guldberg et al. 2019).

Lap An Lagoon, Thua Thien Hue hosts about 22.05 hectares of seagrass in the southern, eastern and southwestern parts of the lagoon, as well as in areas closed to aquaculture. These areas are currently seen as low priority for protection (Ha et al. 2021); however, the ecosystems are threatened and exposed to a high risk of destruction (Le 2023).

In Ha Long Bay, Quang Ninh Province, two common inter-tidal northern Vietnamese seagrass species, *Halophila ovalis* and *Zostera japonica*, were found widely (Tu et al. 2003). In 2013, seagrass *Halophila major (Zoll.) Miquel* was reported for the first time in Vietnam; it was found growing nearshore alongside other species, 4–6 m deep at Tre Island, Nha Trang Bay (Nguyen et al. 2013).

In Truong Sa archipelago, there are eight seagrass species (including one new record), spanning a total distribution area estimated at 1,190 ha, with total biomass reserves reaching 7,417.2 tons dry, which equates to 11,432.8 tons of CO_2 (Cao et al. 2020).

Cam Ranh Bay has a significant area of seagrass that is highly diverse. However, it has been seriously degraded due to aquaculture and socioeconomic development; between 1998 and 2002 around 20–30% of the total area was destroyed (Chen et al. 2016). Dominant species *Enhalus acoroides* has almost disappeared here due to anthropogenic activities (Chen et al. 2016). In Cam Ranh Bay, total seagrass area declined by around 25% (66 ha) between 1996 and 2015, due to coastal development and infrastructure construction (Chen et al. 2016).

Although the area of seagrass beds is declining in Vietnam's Marine Protected Areas (MPAs) (Horigue et al. 2012), there have been limited studies to understand this dynamic. Hoang et al. (2023) were the first to perform ecological assessments of seagrass beds in Ly Son, Nha Trang and Phu Quoc MPAs. Average coverage and shoot density were highest in Phu Quoc MPA (92.5 ± 6.6%, 6635 ± 5,111 shoot m^{-2}, respectively), while total dry biomass was highest in Ly Son MPA with 2000.3 ± 949.8 g DW m^{-2}. Loss of seagrass area between 2001 and 2018, amounted to 307.3 ha in Ly Son MPA, 268.4 ha in

Nha Trang MPA and 13,225.6 ha in Phu Quoc MPA (Hoang et al. 2023).

Few distinct models of seagrass ecosystem management exist. One project implemented by the Centre for Marine Life Conservation and Community Development (MCD), titled 'Strengthening marine ecosystems management and developing local community livelihood, responding to climate change', works across the communes of Giao Thuy-Nam Dinh, Nam Phu-Thai Binh, Phu Long-Hai Phong, and Van Hung-Khanh Hoa. It is based on community-based livelihood and resource management models: co-management of protected areas that aims to sustainable use and develop marine resources within local regulations and management plans; and community models of sustainable fisheries, which supports coastal communities livelihoods through environment-friendly practices, without destroying marine resources/ecosystems. Developing local ecotourism models MCD diversifies livelihoods, increases communities' income, and reduces exploitation pressures on marine resources (MCD 2013).

Applying seagrass ecosystem management models like these can contribute to better management of how coastal resources are exploited and used, leading to increased climate change adaptation capacity. However, conservation models like these are few, and mainly implemented by domestic and international organizations as pilot projects.

Seagrass beds have been mapped and total cover has been estimated across the mainland. However, information on seagrass around offshore islands, for example around Gulf of Thailand archipelagos, is still lacking. It is, therefore, necessary to analyse and map seagrass beds around offshore islands in southern Vietnam. The use of remote sensing data is very efficient when determining seagrass bed coverage. However, to determine what species are present within seagrass beds, more in-depth methods are required. Long-term monitoring of seagrass beds is needed to extend our understanding of the development and decline of seagrass ecosystems. For species diversity, hybridization between *H. ovalis* and *H. major*, as has been found in Nha Trang Bay, needs further clarification through more plastid and nuclear DNA, leaf morphological dimension and microsatellite DNA loci. Seagrasses can help in the monitoring of heavy metal pollution in nearshore environments, as well as to bio-monitor metal and non-metal contamination in marine ecosystems. But in Vietnamese waters, only *E. acoroides* has been studied in detail. As such, studies need to include more species. Evaluating seagrass ecosystem services is also key to demonstrate their usefulness both to the ecosystem and to humans. Seagrasses sequester significant carbon and store it in sediments for a long time. There is still a need to evaluate the total C_{org} stocks of extensive seagrass beds in Vietnam. Sufficient genetic diversity appears to be important in evaluating the health of seagrass populations. Most studies in Vietnam focus on members of Hydrocharitaceae; thus more species of Cymodoceaceae and Zosteraceae must be included. Molecular studies on seagrasses' response to environmental changes, epigenetics and halobionts are also key for future planning.

4 Legal frameworks and existing projects relating to the carbon market and blue carbon in Vietnam

4.1 The legal framework on climate change

As a signatory of the UNFCCC, Vietnam has been proactively implementing numerous measures to mitigate climate change. Since 2010, the Government of Vietnam has issued several important policies around greenhouse gas (GHG) reduction and carbon market development. The government has also committed to invest in and protect, plant and restore mangroves, providing a designated budget for mangrove forest protection (payment for mangrove protection is 1.5 times higher than that paid for protection of compared to in land forests for forest protection payment). The country's nationally determined contribution (NDC) emphasizes the protection and development of mangroves as an important solution in responding to climate change, including climate change mitigation and adaptation.

The government implemented Decision 120/QD-TTg (2015) – a project on coastal forest development in response to climate change (2015–2020), with support from GCF (Green Climate Fund), World Bank, AFOCO (Asian Forest Cooperation Organization) and JICA (Japan International Cooperation Agency); as well as provided government budget support for forest protection and development (Decision 38, Decree 119). The Vietnamese government also recently issued a National plan to 2030 and implemented Decision 1662/QD-TTg approving a programme on 'Forest protection and development in coastal areas in response to climate change and green-growth promotion during 2021–2030'. These policies aim to protect

Table 8. Vietnam NDC-related coastal forest emission reduction measures

Policy and measure	Explanation
F2: Protecting coastal forests	**Expected Impact:** Reduce emissions from deforestation and forest degradation; conserve and improve forest carbon sequestration. **Interventions:** • Promote collaborative forest management between forest owners and local communities • Land allocation, forest allocation • Manage land conflicts • Control deforestation, forest conversion and forest degradation • Livelihood development
F3: Reforestation; **F4: Forest enrichment**	**Expected Impact:** Increase carbon sequestration; improve environmental services (soil and water protection, biodiversity protection) **Interventions:** • Identify suitable growing zones • Select suitable plants • Improve seedling quality • Improve technical measures and build capacity • Invest in afforestation and forest enrichment • Prioritize areas of high co-interest

Source: Vietnam NDC (2022)

Table 9. Summary of key climate change mitigation policies

Year	Policy and relevant contents	Implications for blue carbon
2017	*National REDD+ Action Programme* This policy replaces the National REDD+ Action Plan issued in 2012. Its objectives include: to increase forest cover to 42% by 2020, and to 45% by 2030; and to work towards emissions reduction targets set out in the Intended Nationally Determined Contribution (INDC). It also provides details of policies and measures for REDD+ implementation until 2030.	Development and protection of mangrove forests as part of REDD+ implementation.
2020	*Environment Protection Law 2020* Article 91 of the Law requires: • implementation of a national and sectoral GHG inventory every two years; • all sectors guide and implement GHG emissions reduction measures; and • development of domestic carbon market.	Investment from other sectors in blue carbon for GHG emissions reduction to meet emissions reduction targets.
2021	*National Green Growth Strategy* Focuses on emissions reduction, greening and application of clean technology in production; environmentally friendly development. Forestry and land-use targets include: stabilizing forest cover around 42–43%; investment in enhancing forest quality; reforestation; and sustainable management of forests, for reduced emissions and enhanced carbon sequestration.	Promote forestry development, including of mangroves, for carbon conservation and sequestration.
2021	*Vietnam Forest Development Strategy 2021–2030 with a vision until 2050.* This aims to sustainably develop and manage forest resources and contribute to socioeconomic development, ecological and environmental protection, water security, disaster mitigation, effectively respond to climate change, conserve natural resources and biodiversity, and provide various forest environment services.	Mangroves and wetland ecosystems are included in sustainable management for climate targets, including carbon emissions reduction and natural disaster reduction.
2015–2022	Project on *'coastal forest protection and development 2015–2020'* in response to climate change. In 2022, the Prime Minister approved a follow-up project on *'protection of coastal forests to respond to climate change and promote green growth' for 2021–2030'*.	The targets for coastal forest management and development until 2030 are: (i) conserve coastal forests, especially protection and special-use forests; (ii) reforestation of 9,800 ha of mangroves for sea-wave prevention; and (iii) restoration of 6,800 ha of poor mangrove forests. This means the generation of blue carbon credits from mangroves fully aligns with existing policies on mangrove management.

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Table 9. continued

Year	Policy and relevant contents	Implications for blue carbon
2022	*National Climate Change Strategy* Provides strategic actions for climate change and adaptation. It aims to achieve a 'net zero' emissions target by 2050 in line with Vietnam's commitment at the Conference of Parties (COP) 26.	Mangroves and wetland ecosystems are included in the development of sustainable forest management to mitigate natural disasters and reduce carbon emissions as well as enhance carbon sequestration.
2022	*Decree 06/2022/ND-CP (2022) guiding implementation of emissions reduction and carbon market development, as stated in Environment Protection Law 2020.* The regulations are as follows: • Emissions reduction, including implementation of a national and sectoral GHG inventory every two years. This sectoral GHG inventory follows IPCC guidelines, with sectors including agriculture, forestry and land use (AFOLU), energy, industrial processes and waste management. The ministries managing these sectors have full responsibility for guiding and implementing the sectoral GHG inventory. Inventory results are used to prepare the national GHG inventory report, in the form of a national biannual update report. • GHG mitigation actions that comply with mitigation measures stated in the NDC. The ministries managing the sectors are required to prepare and implement sector-based action plans in line with the NDC. The Decree provides emissions reduction targets by 2030 at national and sectoral levels. The overall emissions reduction objective at national level until 2030 is 563.8 Mt CO_2e, of which 268.5 Mt CO_2e (47%) is the emissions reduction target for Ministry of Industry and Trade (MOIT) for the energy sector; 129.8 Mt CO_2e (27%) for MARD for agriculture and forestry land uses ; 74.3 Mt CO_2e for Ministry of Construction, for the industrial processes sector; 53.7 Mt CO_2e for MONRE for the waste management sector; and 37.5 Mt CO_2e for Ministry of Transportation. • National MRV for mitigation actions must be developed by MONRE. The ministries managing the sectors are also required to prepare guidelines for implementation of MRV for each sector around planned GHG mitigation measures. The GHG mitigation results must be verified by a third and independent party, and eligible verification and validation bodies have to meet the requirements of ISO 14065. • Domestic carbon market development, including regulating participants joining this market, a roadmap for market development, exchange of GHG emission quotas and carbon credits in the carbon market, and line ministries' responsibilities for carbon market development.	Investment for emissions reduction can potentially be achieved through blue carbon projects. Carbon-based projects must apply an eligible methodology to be monitored, regulated and verified. Verified carbon credits can potentially be traded in the carbon market.

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Table 9. continued

Year	Policy and relevant contents	Implications for blue carbon
2022	*Nationally Determined Contribution (NDC)* This was first submitted to the UNFCCC in 2015 (INDC), then revised in 2020, before the latest revised version was submitted in 2022. It plans to unconditionally reduce 15.8% of GHG emissions by 2030 (conditional emissions reduction is 43.5%) compared to the business-as-usual (BAU) scenario. REDD+ is an important component of this contribution. In the land-use sector, mitigation options focus on protecting and conserving forests and forest land, and using them sustainably to increase carbon sequestration and forest certification. Vietnam's NDC includes several types of carbon-based activities: • Forest conservation: This aims to: protect existing coastal forests to reduce emissions from deforestation, forestry conversion and degradation; conserve forest carbon stocks; and enhance carbon removal. Planned activities are: application of community-based forest management among carbon-based forest management entities, state forest companies and local communities; livelihood development for local people; and improved land-use planning. These activities are considered to have high potential for emissions reduction and removals enhancement, since the pressure from deforestation and forest degradation is high, especially in the Mekong Delta. • Reforestation: This intervention aims to increase carbon sequestration from converting non forestland to forests, and conserve biodiversity. This can be implemented through: suitability assessments to identify sites and select tree species; improve seedling production and investment; capacity development; and livelihood support for local communities. This option is considered to have low potential, as there is limited available non-forest land. • Enhancing forest carbon stocks: This will help increase carbon sequestration, conserve carbon stocks in forest biomass and wetlands, conserve biodiversity, and improve community-based co-climate benefits. Interventions focus on: enhancing poor forests by enrichment planting and shifting from pure plantations to multi-layered plantations for improved coastal protection capacity and biodiversity; capacity development for forest management entities; and livelihood support to local communities. This activity is considered to have high potential as a large area of forest is in poor quality condition. • Replication of agroforestry practices: This can contribute to increasing carbon stocks and improving incomes among local communities. Silvo-fishery practices can be applied in managed forest areas and additional trees can be planted on agricultural lands. Successful agroforestry models will be replicated according to the specific eco-regions. This option is considered to have moderate potential.	GHG mitigation measures are applicable to blue carbon, including mangrove and wetland management and development. In addition, the blue carbon ecosystems contribute to mitigating climate change impacts, especially in coastal areas.

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Table 9. continued

Year	Policy and relevant contents	Implications for blue carbon
2022	*Decree on piloting payment for emissions reduction in the North Central Region* This legal framework applies to the FCPF emissions reduction programme to comply with the emissions reduction purchase agreement (ERPA) between MARD (Ministry of Agriculture and Rural Development) on behalf of the government and forest owners, and the World Bank Group as the carbon fund owners. Under the ERPA, Vietnam agreed to transfer 10.3 Mt CO_2e of emissions reduction results (including carbon removals) to the carbon fund, at a price of 5 USD/tCO_2e. The agreement provides clear arrangements for emissions reduction results payment; payment is managed and distributed through the Vietnam Forest Protection and Development Fund at central and provincial level. The first measuring, monitoring and reporting was completed and this report was verified and validated by an independent third party.	This first policy on payment for emissions reduction was implemented under REDD+. It includes mangrove protection for avoided deforestation and forest degradation. This serves as a government-approved pilot model for future blue carbon projects in Vietnam.
2023	*NDC implementation action in agriculture and rural development* Provides an action plan on the implementation of GHG mitigation measures in crop, livestock and LULUCF. In LULUCF, mitigation measures focus on emissions reduction from deforestation and forest degradation, conserved forest carbon stocks, and enhanced carbon removal.	Mangroves and other forest-based GHG mitigation measures are included. GHG mitigation includes forest conservation for reduced deforestation and degradation; and increased carbon sequestration through reforestation and forest restoration.
2023	*Carbon Market Development Roadmap* This is under preparation for a domestic carbon market. This market aims to promote emissions reduction activities to achieve the planned national and sectoral emissions reduction targets. Three phases for carbon market development are planned: (i) legal framework finalization (2023–2024); (ii) piloting market operation (2025–2027); and (iii) official market operation, linking to the international market (from 2028 onwards).	Carbon credits for general forest-based carbon projects are included in the NDC target and carbon market. Blue carbon projects will also be accepted for carbon trading.

Sources: Prime Minister (2015, 2017, 2021a, 2021b, 2022a, 2022b, 2022c and 2022d); Vietnam National Assembly (2020), Socialist Republic of Vietnam (2022); MARD (2023b)

existing forests, establish a new coastal forest area of 20,000 ha (9,800 ha of which are mangroves) and undertake enrichment planting of 15,000 ha, mobilizing international resources. Most mangrove protection and development projects do not mention specific amounts for emissions reduction and carbon absorption, except for GCF-funded projects and Vietnam's NDC. Table 8 illustrates two major policy measures on mangroves that are identified in Vietnam's latest NDC.

Blue carbon ecosystems are governed by numerous government agencies (Table 10).

As multiple government agencies are involved in managing blue ecosystems, related legal regulations and policies are subject to contradictions and overlaps. While a large number of policies are in place, such as enhancing marine protected area management and strengthening law enforcement on protecting and restoring mangrove ecosystem services, there are very few policies on seagrass and tidal marsh management specifically. Specifically, the UNEP/GEF project 'Reversing environmental degradation trends in the South China Sea and Gulf of Thailand' includes specific action plans for mangroves, seagrasses, coral reefs, coastal wetlands, the protection of fisheries resources, and prevention of pollution originating from inland sources (Prime Minister 2013); while Prime Minister Decision No. 1570/QD-TTg dated 6 September 2013 approving the

Table 10. Key actors involved in blue carbon ecosystem management

Key actors	Responsibilities
Ministry of Agriculture and Rural Development (MARD)	MARD plays a primary role in managing agriculture, fishery and forestry, including mangroves, tidal marshes and wetlands in national parks.
Ministry of Natural Resources and Environment (MONRE)	MONRE is responsible for administration and management of (land- and marine-based) environmental and natural resources; this includes wetland and marine conservation. It guides ministries, ministerial-level agencies, government-attached agencies, People's Committees of 28 coastal provinces and centrally-run cities, and relevant agencies and organizations, to implement the objectives, tasks and solutions of the climate change and coastal management strategy .
Ministry of Foreign Affairs	Presides over and coordinates work regarding external information, treaties, international agreements and strategic forecasts, around international issues related to the exploitation and use of natural resources and the protection of marine and island environments; promotes Vietnam's effective participation in relevant international forums, and accedes to international treaties on the sustainable exploitation and use of natural resources and protection of marine and island environments; protect s the national sovereignty, sovereign rights and jurisdictions over seas and islands into external activities on the exploitation and use of natural resources and protection of marine and island environments.
Provincial government agencies	People's Committees of central-affiliated coastal cities and provinces have the following responsibilities: a. formulate, promulgate and organize implementation of legislative documents on the management of natural resources and environment of sea and islands; b. organize implementation of the strategy for exploitation and sustainable use of natural resources, protection of sea and island environments; sea-use planning and plans; general planning for the exploitation and sustainable use of natural resources in littoral zones; formulate, approve and organize implementation of general planning for natural resources and environment in littoral zones; c. organize the implementation of scientific research activities, including fundamental investigations and statistical reports on natural resources and the environment of sea and islands; d. issue, re-issue, extend, amend, supplement, return and revoke permits; e. establish and manage coastal area protection corridors; document and manage natural resources and the environment of islands within authorities; f. build and manage information systems and databases of local marine and island resources and environment; g. control sea and island environment pollution; manage incidents of oil and toxic chemical spills; manage sea dumping; h. carry out propagation of sea and islands; disseminate and educate around laws on management of natural resources and environment of sea and islands in localities; i. investigate, inspect and settle complaints and denunciations around the management of natural resources and protection of sea and island environments; j. periodically report on activities around the management of natural resources and protection of sea and island environments to the Ministry of Natural Resources and Environment.
Ministry of Transportation	Assumes primary responsibility for (and coordinates with relevant agencies in) promoting development of the blue seaport system, establishing particularly sensitive marine areas; forecasting and proposing solutions to adapt to changes in maritime routes in the region.
Ministry of Finance	Has authority to balance recurrent expenditures in the state budget, regarding the implementation of activities on the sustainable exploitation and use of natural resources, and protection of marine and island environments.

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Table 10. continued

Key actors	Responsibilities
Ministry of Planning and Investment	Assumes primary responsibility for (and coordinates with the Ministry of Finance, the Ministry of Natural Resources and Environment and relevant agencies in) defining tasks for using investment capital from the state budget, and attracting other domestic and foreign capital sources; prioritizes and promptly allocates resources to accelerate the implementation and promote the effectiveness of activities and solutions on the sustainable exploitation and use of natural resources, and protection of marine and island environments.
Ministry of Public Security	Assumes primary responsibility for (and coordinates with the Ministry of Natural Resources and Environment and concerned ministries, sectors and localities in) preventing and combating violations in natural resource exploitation and the polluting of marine and island environments; ensures national security and order, through participates in protecting national security and defence, sovereignty, sovereign rights and jurisdiction and national interests at sea.
Ministry of Defence	Coordinates with relevant ministries, branches and localities participating in protecting security and safety, for basic investigations, scientific research and activities around resource exploitation and use in seas (both distant and adjacent waters), and integrates these activities into national defence protection and sea security activities, upholding independence, sovereignty, sovereign rights, jurisdiction and national interests at sea.
Ministry of Industry and Trade	Coordinates with the Ministry of Natural Resources and Environment and relevant agencies to implement policies on new energy development, renewable energy, and economical and efficient use of energy for marine economic development; develops coastal industries that are efficient and environmentally friendly.
Ministry of Internal Affairs	Assumes primary responsibility for (and coordinates with the Ministry of Natural Resources and Environment in) strengthening frameworks at central and local levels to ensure integrated and unified state management of marine and island natural resources and environments; promulgates administrative boundaries at sea.
Ministry of Science and Technology	Assumes primary responsibility for (and coordinates with the Ministry of Natural Resources and Environment and concerned ministries, sectors and localities in) formulating and organizing implementation of the national science and technology programme on seas and islands; this guides basic investigations of marine and island natural resources and environments in the context of emerging challenges in marine environmental security, and implementation of other scientific and technological activities.
Ministry of Culture, Sports and Tourism	Develops and replicates models for sustainable tourism and community tourism at sea and in coastal areas, and promotes the development of ecotourism routes in a number of offshore islands.
Ministry of Construction	Assumes primary responsibility for (and coordinates with relevant agencies in) developing coastal green cities and coastal ecological urban areas associated with the formation of strong marine economic centres; implements investment in construction and the development of smart technical infrastructure for coastal cities and islands.
Ministry of Information and Communication	Assumes primary responsibility for (and coordinates with the Central Committee's Publicity and Education Commission, the Ministry of Natural Resources and Environment and relevant ministries, branches and localities in) formulating programmes, projects and activities around marketing and raising awareness among the international community on Party and State guidelines and policies on seas and islands, protection of Vietnam's legitimate rights and interests in the East Sea, and the potential advantages of sustainable development in Vietnam's marine economy.

Sources: Vietnam National Assembly 2015; Prime Minister 2023

strategy on sustainable exploitation and use of natural resources and protection of the marine environment until 2020, with a vision until 2030, regulates objectives on protecting marine resources, which includes seagrass and tidal marshes (Prime Minister 2013).

Policies relating to seagrass: There is no national policy on managing seagrass, but they are included as part of the marine conservation areas of national parks. A local-level example of this is the seagrass beds of Phu Quoc National Park, which are currently managed by Kien Giang Province. In 2020, Kien Giang Province adjusted the area of Phu Quoc National Park to include areas where seagrass is distributed, but few activities are underway to conserve and restore this seagrass meadow. Issued in 2017, the Fisheries Law makes provisions for the growth and protection of aquatic resources – marine conservation included – for the sustainable development and international integration of fisheries (Government of Vietnam 2017). A strategy was approved in 2014 to manage the country's special-use forests, marine reserves and internal water reserves until 2020, with a vision toward 2030 (Government of Vietnam 2014). Since 2005, a total of twelve marine protected areas (MPAs) have been formed and operational; these are found across 10 provinces/cities. This means that 35 main seagrass beds are currently not being protected. Significant areas of seagrass – including Tam Giang-Cau Hai Lagoon in region 2, and beds along the Khanh Hoa coastline (region 3) – remain under threat. Established in 2007 as an International Union for Conservation of Nature (IUCN) category-II park, the Phu Quoc MPA (region 4) protects seagrass and coral-reef-based ecosystems (Kien Giang PCC 2007). However, Tran et al. (2022) found fish protection was ineffective since the functional composition of fish communities was similar between protected and unprotected areas. Further action is needed to optimize MPA design and management so as to meet conservation goals for seagrass meadows. More potential marine protection areas that include important seagrass beds should be added to the Vietnamese MPA system.

Models for seagrass ecosystem management: Management models relating to Vietnam's seagrass ecosystems are on the whole integrated into broader coastal management models. The integrated coastal zone management model of Tran (2010) separates out the western coast (Tonkin Gulf); northern coast (Quang Ninh–Ninh Binh); northeastern coast sub-region (Quang Ninh–Hai Phong); and coastal area of Hai Phong. Three integrated management models used for the Tonkin Gulf include: (i) managing and rational use of natural resources, and conserving nature and biodiversity; (ii) managing and preventing pollution, natural disasters and environmental incidents; and (iii) strengthening institutions and policies, including raising awareness around the protection of environmental natural resources. Natural, cultural and biodiversity conservation focuses on (i) biodiversity conservation, with focus on species diversity, and rare and endangered species; (ii) protection and restoration of habitats and ecosystems, focusing on mangroves, coral reefs, seagrass beds and sandy beaches; (iii) protection of natural landscapes including islands, peninsulas, estuaries and coastal zones; (iv) planning, construction and management of nature reserves, including natural heritage sites, biosphere reserves, wetlands of national and international importance, marine protected areas, natural wonders and natural landscapes (Tran 2010; Tran et al. 2020).

Elsewhere we see other examples of seagrass ecosystem management included in integrated coastal zone management programmes. One example is the integrated coastal management model of North Central and Central Coast regions until 2010 with a vision until 2020, in line with Decision No. 158/2007/QĐ-TTg. This Decision aimed to strengthen management, protection and utilization of natural resources and environment protection for the sustainable development of provinces and cities, and provide a model for community-based, co-management of marine resources and coastal ecosystems, mainly through piloting model projects implemented by domestic and international organizations (Government of Vietnam 2007). Other coastal provinces have now trialled co-management and eco/community tourism models in their marine protected areas (e.g., Quang Ninh, Nam Dinh, and Quang Nam provinces) as well as co-management of aquatic resources (e.g., Quang Ninh, Nam Dinh, Thanh Hoa, Ha Tinh, Thua Thien Hue, Quang Ngai and Binh Thuan provinces). Successful models like Cu Lao Cham Marine Protected Area's co-management model, implemented from 2011, have been documented and expanded. This effective co-management model saw coordination between local communities and management authorities, with sharing

management responsibilities contributing to the protection of coral and seagrass ecosystems (Tran 2010; Hoang et al. 2020). Local authorities are now leaning towards more integrated sea and island management; but roles and responsibilities are still undefined within current planning and management practices, and ecosystem-specific management models are still lacking, including for seagrass.

Tidal marshes: Managing these areas is complicated as they fall under national wetland parks (i.e., Xuan Thuy, Mui Ca Mau) and provincial authority management. Tidal marshes are briefly referred to in policies on fishery farming, forestry, tourism and conservation, but there are no specific management guidelines on how to protect these areas.

4.2 The carbon market

Potential carbon-based payments can come from both compliance and voluntary carbon markets.

Compliance carbon markets are usually regulated by a country, and are established and operated with the aim of fulfilling emissions reduction commitments outlined in the country's NDC. This can be done in the form of a carbon tax and/or emissions cap. Typical compliance carbon markets include California's carbon market, Colombia's carbon tax, Australia's Emissions Reduction Fund, New Zealand's Emissions Trading System, the Saitama Emissions Trading System, Tokyo Trade and Quotas, Korea's Emissions Trading System and China's Emission Trading System. Mandatory carbon markets are regulated by countries and are only operated domestically. These regulations comprise emissions reductions, emission quotas (permitted emission levels), carbon offsets and trade (emissions) or regulations on emission payments (possibly taxes and fees). The markets cover a range of mitigation activities, such as energy efficiency, fuel switch, renewable energy, forestry, transport and waste treatment. With carbon tax regulations, countries can stipulate a payment level for a unit of emissions (usually USD/ton CO_2), depending on the emissions reduction target. Currently, about 20 countries apply a carbon tax and the tax rate is different from country to country, ranging from USD 5 to 138 per ton of CO_2 (World Bank 2022a). In Vietnam, the domestic carbon market is under development.

Voluntary carbon markets (VCM) operate against carbon standards, such as the Verified Carbon Standard (VCS), Gold Standard, American Carbon Registry, Climate, Community and Biodiversity (CCB) and Plan Vivo. Some voluntary regional standards also exist, including Climate Action Reverse (applicable to the United States, Canada and Mexico), JCM (between the Japanese government and Southeast Asian countries), the carbon market established under the Kyoto Protocol (CDM, JI), the REDD+ Environmental Excellence Standard (TREES) and the American Carbon Registry (applicable to United States and Canada). Carbon transactions and prices on the voluntary carbon market between 2010 and 2021 show increasing trends in transaction values, but decreasing prices. As for the emissions reduction and removal credits generated from forestry-based activities, the carbon price varies from USD 3.9 to 4.4/tCO_2e. The price is around USD 7.7–9.7/tCO_2e for removals produced from afforestation and reforestation. Specifically, carbon prices observed for 2020–2021 indicate that emissions *reduction* is priced quite low, around USD 1.6–1.7/tCO_2e but is priced about USD 8/tCO_2e for emissions *removal* credits, as generated from afforestation, reforestation, soil enhancement, carbon capture and storage technology (Donofrio et al. 2021).

For the forestry sector and blue carbon projects, potential finance to fund blue carbon projects could come from:

- **REDD+ based programmes** like the UN-REDD programme, FCPF and LEAF. In the UN-REDD programme, payment for REDD+ results is operated by the Green Climate Fund. REDD+ countries can apply for payment under the GCF pilot REDD+ payment programme. FCPF is another programme providing payment for emissions reduction results. Vietnam currently has an agreement with the Fund to transfer 10.3 Mt CO_2e, with a payment revenue of USD 51.5 million. The FCPF programme will end in 2025 and it is not clear if the programme will be continued in any way.
- **Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA)**: The International Civil Alleviation Organization (ICAO) set up CORSIA to achieve carbon neutrality for its operations. CORSIA provides global market-based measures and

cooperative actions, aligning with national and/or regional regulations for emissions reduction from international aviation. Planned emissions reduction measures include carbon offsetting, improvements of technology and operations, and sustainable aviation fuel. This scheme is designed to be implemented in three phases: a pilot phase (2021–2023), Phase I (2024–2026) and Phase II (2027–2035). For 2021–2026, participation in CORSIA is voluntary, and as of May 2023, 124 states have joined this scheme (ICAO 2019).

- **Other initiatives:** In addition to governmental efforts to reduce GHG emissions, the private sector plays an important role in emissions reduction, contributing to achievement of the climate targets set out in the Paris Agreement. Science Based Target Initiatives (STBi) encourages companies of all sectors and sizes to take actions for emissions reduction; about 4,000 companies have participated in this scheme. STBi provides guidance on how to reduce emissions in transparent and evidence-based manner, including in Forest, Land and Agriculture (FLAG) (Science Based Targets 2022).

Blue carbon transactions: Blue carbon is currently traded on the VCM, however there are only a small number of mangrove-based carbon projects registered against carbon standards. Just 23 blue carbon projects are underway; these projects are associated with mangrove restoration and conservation. Most of these projects generate an annual carbon credit of less than 50,000 tCO_2e, and a few generate annual carbon credits of over 1 million tCO_2e (IFC 2023).

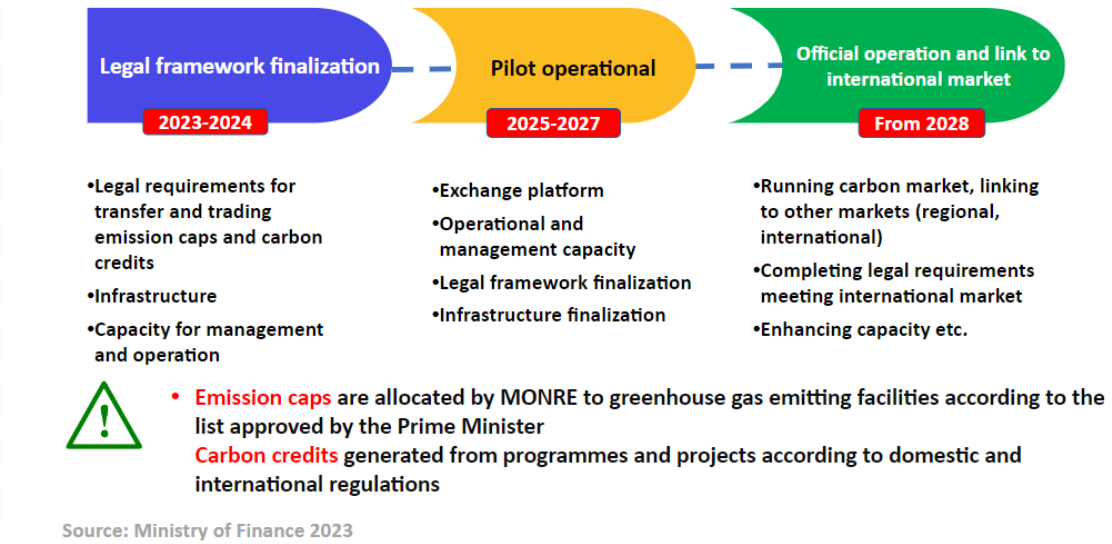
Vietnam has also recently developed national road map for carbon development (Figure 2).

4.3 Overview of forestry carbon standards

Numerous standards exist for the diverse activities associated with emissions reduction from deforestation and forest degradation, as well as carbon removals from reforestation and improved forest management (Table 11). Basic carbon standards cover the following: (i) eligible activities; (ii) carbon accounting methodology; (iii) displacement and reversals; and (iv) social and environmental safeguards.

4.4 Carbon standards that apply to blue carbon

According to the IFC (2023), 12 blue carbon projects are registered; of those, 9 projects applied the VCS (6 for VM0007 and 3 for VM0033) and three projects applied Plan Vivo. In addition, about 9 projects are under development. The following summarizes the carbon standards applied in blue carbon projects so far.



Source: Ministry of Finance 2023

Figure 2. Planned roadmap for carbon market development in Vietnam

Table 11. Key carbon standards for the forestry sector

Carbon standard	Description
Verified Carbon Standard (VCS)	Managed by Verra, which was founded in 2007. VCS accounts for most carbon transactions on the voluntary market (over 90%). Verra was also a founding member of the Initiative for Climate Action Transparency (ICAT), and manages the Climate, Community and Biodiversity Standard (CCB). Eligible projects for carbon trading include: • Afforestation, Reforestation and Revegetation (ARR) • Agricultural Land Management (ALM) • Improved Forest Management (IFM) • Reduced Emissions from Deforestation and Forest Degradation (REDD) • Avoided Conversion of Grasslands and Shrublands (ACoGS) • Wetlands Restoration and Conservation (WRC) Carbon credits are verified by a validation and verification body (VVB). This VVB is accredited by an International Accreditation Forum (IAF) member body, such as the American National Standards Institute (ANSI), the Organism Nacional Accreditation of Colombia (ONAC), or the Standards Council of Canada (SCC). Currently there are 20 VVBs in operation.
The REDD+ Environmental Excellence Standard (TREES)	Architecture for REDD+ Transactions (ART) manages and develops standards to achieve the environmental integrity needed for REDD+ emissions reduction (ER) at national and jurisdictional scale. The focus of 'The REDD+ Environmental Excellence Standard (TREES), version 2.0' is on activities associated with slowing down deforestation and forest degradation; this does not include removals from standing forests. GHG removals connected to reforestation, afforestation, enhancement of forest carbon stocks, and improved forest management will be included in a future version of this standard. TREES is being applied in Lowering Emissions by Accelerating Forest FiananceFinance (LEAF) and the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) of International Civil Aviation Organization (ICAO). However, CORSIA has not included activities related to emissions reduction and removals enhancement associated with forestry. Carbon credits are verified by a VBB, accredited by a member of the International Accreditation Forum (IAF) using ISO 14065. Currently, only Aster Global is accredited for LEAF. Eligible activities under TREES include all REDD+ activities, except removals from standing forest. This means mangroves, which are defined as forests, are included in the scope.
Gold Standard	The Gold Standard was established in 2003 by WWF and other international NGOs. Gold Standard has issued 173 million carbon credits connected to projects in 80+ countries. Gold Standard has a unique approach to land-use activities that sequester carbon or avoid GHG emissions, focusing only on mechanisms that can deliver environmental integrity. That means afforestation and reforestation projects are eligible under this standard. The standard is 'Land use & forests activity requirements version 1.2.1, 2020' and project types are 'Afforestation & Reforestation Projects (A/R) and Agriculture Projects (AGR)'.
Climate, Community and Biodiversity Standards (CCB)	The Climate, Community and Biodiversity Alliance (CCBA) established the CCB Standards which since 2014 have been managed by Verra. These standards identify land management projects that deliver 'net positive' benefits for climate change mitigation, local communities and biodiversity. They apply to any land management project, including those reducing GHG emissions from deforestation and forest degradation, or from avoided degradation of other ecosystems, as much as those that remove carbon dioxide by sequestering carbon (e.g., through reforestation, afforestation, revegetation, forest restoration, agroforestry and sustainable agriculture).
Plan Vivo	Plan Vivo's first standard was created in 2001. Plan Vivo is a body that certifies projects against the Plan Vivo Standard, focusing on community and smallholder land-use and forestry projects. Eligible projects are: • Protection: reducing deforestation and/or degradation of forests, wetlands or other natural ecosystems. • Restoration: tree planting, assisted natural regeneration, and management of wetlands or other natural ecosystems to restore ecological function. • Improved land management: improving forest or agricultural land management practices to increase carbon stocks and/or reduce greenhouse gas emissions.

Sources: Aster Global (2019); Gold Standard for the Global Goals (2020); ART (2021, 2022); Plan Vivo (2023); Verra (2023a, 2023b)

Table 12. Carbon standards applied by blue carbon projects under the voluntary carbon market

Carbon standard	Global standard application to blue carbon	Potential for application in Vietnam
Verified Carbon Standard (VCS)	• VM0007 REDD+ Methodology Framework (REDD+MF), v1.6 (2020) • VM0033 Methodology for Tidal Wetland and Seagrass Restoration, v2.0 (2021). • VM0033 replaces AR-AM0014, Afforestation and reforestation of degraded mangrove habitats, and AR-AMS0003, Afforestation and reforestation project activities implemented in wetlands	Applicable to conservation and restoration activities in mangroves, seagrass meadows and tidal marshes. Vietnam has experience in REDD+ implementation and this has high potential
Plan Vivo	• Target community-led projects that involve rural smallholders and communities dependent on natural resources for their livelihoods. • It currently has three approved approaches to issuing certificates. Until recently, Plan Vivo would certify projects that submitted their own or a Plan Vivo-approved approach to estimating climate benefits. • The approved approach is being revised, and projects will need to meet these methodology requirements when they become available.	No specific standards for blue carbon and the approved approach is under revision. This is more difficult to apply in Vietnam.

Source: Verra (2020, 2022, 2023a, 2023c)

Monitoring, Reporting and Verification (MRV)

MRV involves a process which involves *measuring* the amount of greenhouse gas (GHG) emissions reduced by a mitigation activity (as described in Table 1 and Table 13 below) over time, before *reporting* these findings to an accredited third party. This body then *verifies* the results before certifying them; only then can carbon credits be issued. The aim of MRV is to prove an activity has actually avoided or removed harmful GHG emissions, so actions can be converted into credits with monetary value. One credit equates to a ton of reduced GHG emissions; this is expressed in tons of CO_2 equivalent (tCO_2eq). These are the basic units traded in international carbon markets and used to fulfill countries' Nationally Determined Contributions (NDCs) under the Paris Agreement (World Bank 2022b).

Monitoring focuses on quantifying emissions and removals associated with interventions activities within the project boundary. This depends on the specific standards requirements.

Table 13. Monitoring, reporting and verification: Steps and process

Step	Explanation
Step 1. Determining a baseline or reference level against which performance is measured periodically	The assumptions upon which these baselines are established and the accounting methodologies used to calculate emissions reduction vary by sector and programme scale. However, all projects need to identify: • Project boundary: The spatial boundaries of a project must be clearly defined to facilitate accurate measuring, monitoring, accounting, and verifying of the project's emissions reduction and removal. • Intervention activities: The implementing activities that are eligible as required by the applied carbon standards within the project boundary to conserve carbon stocks, reduce emissions and increase carbon removals. • Carbon pools: Carbon pools for monitoring in the defined project boundary. It commonly requires the inclusion of carbon change in above-ground biomass (AGB) and below-ground biomass (BGB) for trees and non-trees; soils for terrestrial and wetlands; burning of woody biomass; combustion of fossil fuels; and use of fertilizers, for the development of a baseline and project timeline. Several pools for monitoring are optional or excluded, i.e., litter and wood products. • GHG gases: carbon accounting needs to quantify any significant changes in emissions of carbon dioxide (CO_2), nitrous oxide (N_2O) and methane (CH_4), relative to the baseline, that are reasonably attributable to the project activities; • Reference period: it needs to clearly state the start date and end date of the Historical Reference Period. Depending on the carbon standard, the baseline timeframe may vary. For example, in VM0007 standard, the historical reference period is the temporal domain from which information on historical deforestation is extracted, analysed and projected into the future. A historical reference period must be defined for all eligible REDD categories. The starting date of this period must be between 9 and 12 years in the past, and the end date must be within 2 years before project start date. • Project timeframe/crediting period: The project crediting period is the period of time for which GHG emissions reduction or removal generated by the project interventions. The project must have a robust operating plan covering this period.
Step 2. Data is collected and processed to calculate emissions reduction achieved against the baseline during the monitoring period	• Reference emission construction: All emissions and removals associated with land-use activities within the project boundary and reference period are required to be estimated using the selected carbon accounting methodology. These reference emissions can be updated during implementation, provided that improved data for calculation is available. • Project emissions and removals: emissions and carbon removals generated from intervention activities for a specific timeframe in the project area. The accounting methodology and procedures of emissions and removals monitoring need to be consistent with that used in the emissions and removals estimate in the reference period. • Leakage and/or emission displacement: The counting of emissions associated with project activity implementation that incurs outside the project boundary is also required for monitoring.

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Table 13. continued

Step	Explanation
Step 3. Emissions verification	Emissions reduction results are then compiled into a report that is subject to third-party verification by an entity accredited per the requirements of the standard being used. Verifiers often need to sift through large volumes of data, so well-documented results that thoroughly demonstrate accuracy, transparency and compliance with the standard can help smooth the process. All emissions and removals in the reporting period need to be calculated and reported as reporting plan. Depending on the standards and project plan, reporting can be implemented in specific time period (i.e., yearly or every two years). Reporting will cover the following: • Emissions by sources and removals by sinks associated with intervention activities; • Additionality that results from emissions reduction and removal; compared to reference emissions in the reference period; • Assessment of uncertainties in emissions and removals estimates; • Calculation of emissions reduction and removal amount, with a buffer as a reserve pool for risks around uncertainties, emissions displacement and reversal. In several carbon standards, a proxy factor for the risks for emission displacement and reversal is provided. • The reporting is required to comply with the provided template of the carbon standards and methodology applied. All data (activity data and emission factors) used needs to be complete, accurate, transparent and consistent. The activity data (such as land cover, land-use change) is required to be spatial data. Verification and validation are conducted by an independent third party accredited by the accreditation body, following the guidance of ISO 14095. Normally the carbon scheme owners assess the VVB for eligibility and then notify the eligible VVB to provide the assessment services. Several carbon standards provide clear guidance on verifying and validating emissions reduction results and carbon credits. A number of criteria and indicators are provided as guidance for verification and validation processes. The main steps for verification and validation are: • Review all monitoring reports, including all data and information related to the report, for example, methodology for activity data generation, land cover and land-use change maps, development of emission factors, methods and results of emissions and removals calculation, uncertainty analysis, leakage and emissions displacement risk assessment, and implementation of safeguards. • Communicate with project owners for clarification, questions and additional data and information. • Organize the field assessment and interview key stakeholders for additional information and data verification. Verification of data related to activity data and emission factors is required during the field assessment and a specific sampling methodology is applied. • Prepare assessment report and communicate with project owner. The report will cover all issues related to project implementation, carbon accounting methodology, results of verification and validation, and conclusion.
Step 4. Certifying and issuing emissions reduction	Once emissions reductions are verified, the standard-setter certifies them, signaling the applicable emissions reduction transaction registry to issue ERCs. The entire MRV cycle can take a year or more to complete.

5 Carbon market and blue carbon: Potential and challenges

5.1 Opportunities for the blue carbon market in Vietnam

The fact that Vietnam has requirements and commitments on climate change, emissions reduction, and policies that encourage the development of forest carbon markets, make for favourable conditions for carbon market implementation, according to coastal provinces surveyed online. Commitments that are becoming more stringent have created the conditions and legal framework for Vietnam's forest carbon market to develop and become known as a stable investment market.

Of the surveyed provinces, 50% believed the forest carbon market is expanding rapidly and that the number of buyers is gradually increasing. Vietnam having numerous programmes and projects relevant to the purchase of carbon credits was also considered to be advantageous; however, just 12.5% of respondents stated that parties contacted them directly to carry out projects.

5.2 Challenges for the blue carbon market in Vietnam

As the analysis in Section 3 shows, the legal framework for Vietnam's carbon market is not ready to support implementation of carbon projects in the forestry and land-use sector, including for blue carbon projects. Central government agencies interviewed also highlighted inconsistent data on mangroves and lack of data on tidal marshes and seagrasses, notably spatial data; this lack of data makes it challenging for the government to understand and manage these ecosystems effectively. The current legal framework is also not ready for carbon trading, due to lack of clarity around carbon rights, benefit sharing, and implementation of Article 6 of the Paris

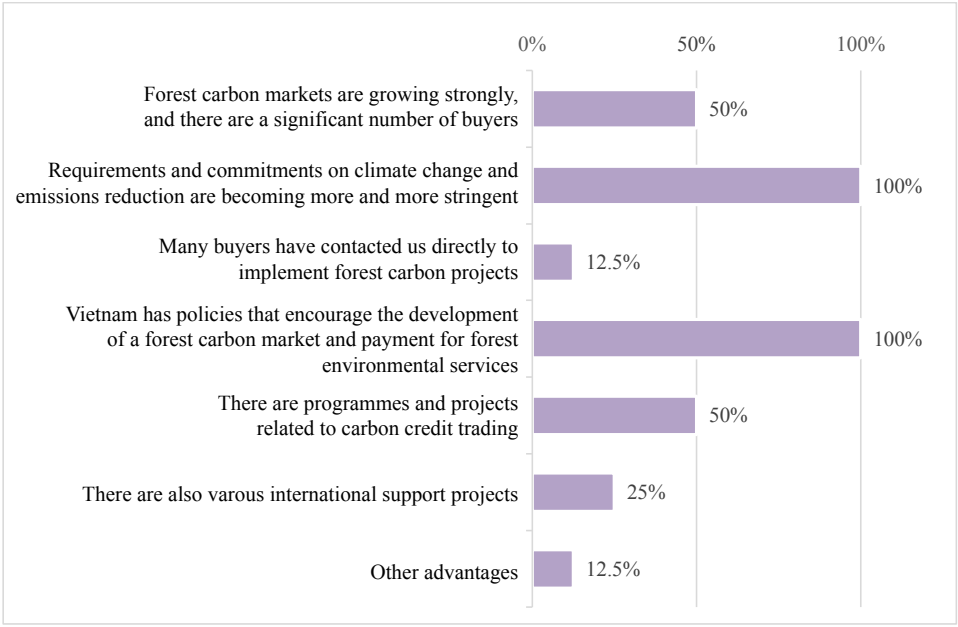

Figure 3. Coastal provinces' perspectives around the forest carbon market in Vietnam

Agreement; this has meant both central and provincial governments are reluctant to begin new carbon projects, including blue carbon projects. In the voluntary market, carbon standards set different technical requirements; this has also created technical challenges for government staff, who have limited capacity to establish projects, and perform monitoring, measurement and reporting. Low carbon trade prices have also discouraged local governments from entering the carbon market.

The two most significant challenges according to coastal provinces polled online are a lack of information, and technical issues like measurement, verification and reporting (Figure 4).

Stakeholders have limited knowledge and capacity around implementing forest carbon projects. Currently, 50% of provinces surveyed online have no forest carbon projects (Figure 5); half of the surveyed provinces also believe that relevant parties lack knowledge of the blue carbon market, making implementation difficult.

Financial constraints were cited as a challenge to implementing carbon-related projects by 62.5% of provinces surveyed. Financial incentives are insufficient to entice people to participate in forest carbon projects and programmes.

Nearly 40% of the provinces surveyed stated that Vietnam's policy framework is not yet ready to implement carbon payment projects. This is due to the fact that legal regulations and administrative procedures continue to overlap and be unclear. Regulations on carbon rights are still being discussed, and Vietnam is still working on perfecting the legal foundation to harmonize laws.

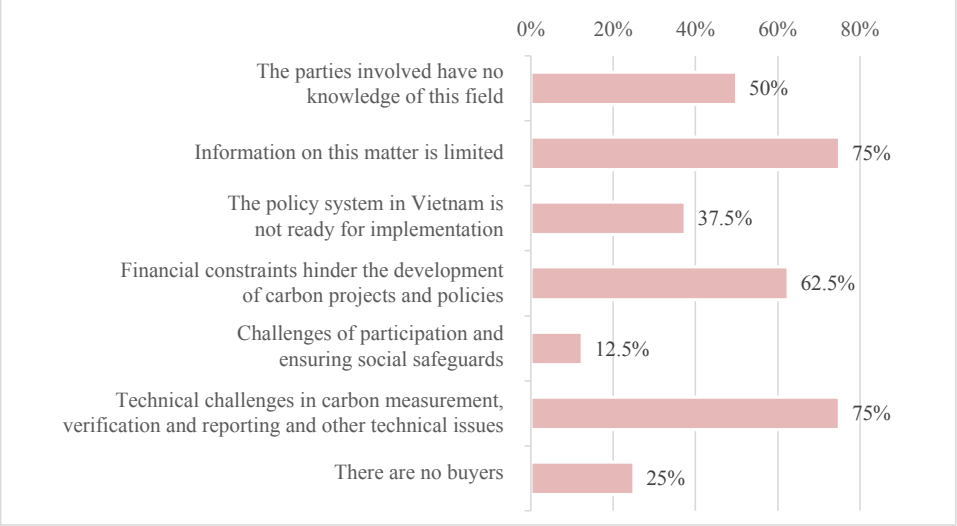

Figure 4. Coastal provinces' perspectives around the challenges of operating a forest carbon market in Vietnam

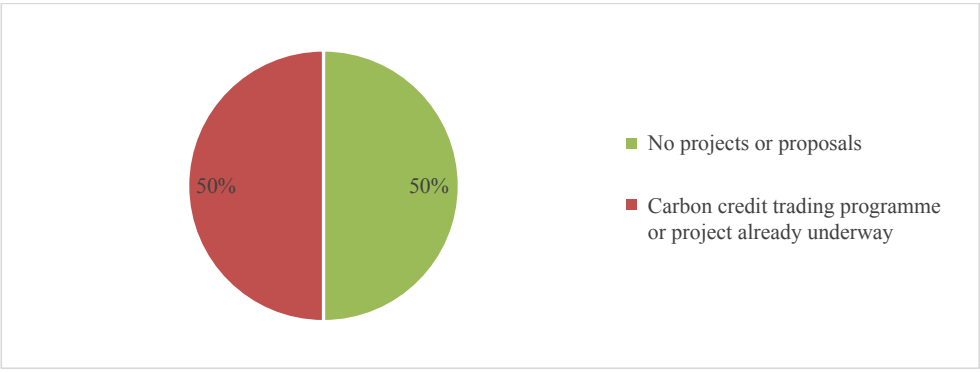

Figure 5. Percentage of surveyed provinces implementing forest carbon services

6 Conclusions and recommendations

Vietnam is strongly committed to implementing its 'net zero' emissions goal by 2050. Forestry and blue carbon ecosystems play an important role in Vietnam mitigating greenhouse gas emissions and maintaining ecosystem services to mitigate the impacts of climate change. Recent government policies to support a domestic carbon market open up opportunities to create additional financial sources for forestry, through mechanisms for exchanging and trading carbon credits. However, key policy gaps still need to be addressed for an operational carbon market for forestry and blue carbon projects, including:

Setting up emission quotas: Vietnam is currently developing its domestic carbon market based on the cap-and-trade system. However, emission quotas for different sectors are yet to be defined. This is fundamental base from which to regulate key emitting entities, so they can take action to reduce and exchange emission amounts that exceed their allocated emission quota; these are urgently required to fully put domestic carbon market in place.

Identifying eligible activities: Currently, the legal framework has not defined eligible activities, except for the FCPF REDD+ programme. A clear statement of eligible activities for inclusion in forest-based and blue carbon projects is important; without this clear legal framework, provincial authorities interviewed claimed they would not be in secure position to propose blue carbon projects. Defining eligible activities is also important because it relates to carbon accounting methodology requirements. Clarifying who owns carbon rights is also crucial to ensure both buyers and sellers can commit to implementing high quality and permanent blue carbon projects in Vietnam.

Investment requirements and participants: It is clear in current legal regulations (i.e., Forestry Law 2017, Decree 06) which participants are eligible to invest and collaborate in forest-based carbon projects. However, regulations and guidance are lacking on requirements for domestic and international private investors. This includes financial management, benefit sharing, tax, carbon titles, contribution of emissions reduction results to the NDC, and community and social responsibilities.

Carbon accounting methodology: There is a need to clarify carbon accounting for intervention activities connected to carbon conservation, emissions reduction and removals enhancement. As for REDD+, a clear methodology is provided by UNFCCC for the UN-REDD programme and for FCPF emissions reduction programmes. However, carbon accounting is absent for forestry and blue carbon when it comes to the planned mitigation measures stated in the NDC, and it is unclear what carbon standard is to be applied for forestry and blue carbon, so as to quantify carbon credits for the domestic carbon market. For the voluntary carbon market, carbon credit trading needs to comply with carbon standards. Domestic carbon standards need to have the same level of requirements as voluntary market carbon standards, and to be recognized by the carbon scheme owners (i.e., Verra, Gold Standard). Therefore, if Vietnam plans to develop its own carbon standards for forestry and blue carbon, it should aim to comply with international carbon accounting methodology to be considered a high carbon quality market. Vietnam could also adopt existing carbon standards being applied in the voluntary carbon market.

Verification and validation: It is important to verify and validate the emissions reduction and carbon credits generated by carbon-based projects. The Government Decree 06/2022/ND-CP on emission reductions and ozone protection provides general requirements for verification and validation, but it is not sector specific. Therefore, it is important to develop detailed requirements for verification and validation for carbon-based projects in forestry, to prove that results are reliable. It is also possible for accredited certification organizations to provide verification and validation services in Vietnam; this can help reduce the costs of carbon-based reporting.

Carbon registry platform: Emissions reduction and carbon trading need to be managed by a carbon registry platform. This helps to avoid double selling, promotes business between buyers and sellers, and enables the transparent reporting of a country's GHG mitigation. A suitable carbon registry platform should be developed, with different parts for sectoral and national management.

Improving stakeholder capacity: As carbon trading is a new area, it is important to develop stakeholders' capacity for carbon accounting and carbon credit management, in addition to preparing enabling conditions for carbon trading operations. This capacity building should focus on:

- Capacity building for management agencies at all levels. This should aim to provide understanding on the basic principles and requirements for carbon project development, carbon accounting, procedures for carbon trading and carbon credit management.
- Capacity building for technical staff of organizations and forest owners around carbon-based project development, development of carbon standards, and implementation of monitoring, reporting and verification.
- Capacity building for civil social organizations to provide a basic understanding of carbon-based projects, project implementation and monitoring.

As well as improving the legal framework, it is also critical to improve blue ecosystem inventories. Currently, the Vietnamese government only pays attention to mangrove areas, and the forest inventory system overlooks the high potential of seagrass meadows and tidal marshes. Improving the national database and monitoring system in Vietnam could generate additional benefits from the blue carbon market, while promoting biodiversity conservation and local livelihood improvements.

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Annex. Key laws relating to forestry carbon payments

I. Payment for forest environmental services, Forestry Law 2017

1. Definition of environmental services for carbon payments: Absorbing and storing of carbon in forests; reducing greenhouse gas emissions through limiting forest loss and degradation, sustainable forest management and green growth (Clause 3, Article 61).

2. Rules for forest environmental service payments (Article 62):
   - Users of forest environmental services shall pay relevant charges to their forest environmental service providers (Clause 2);
   - Charges for forest environmental services shall be paid directly or indirectly (Clause 3);
   - Charges for forest environmental services shall be added to the prime costs of goods or services (Clause 4);
   - Forest environmental services shall ensure transparency , democracy, objectivity and equality; as well as compliance with Vietnamese law, and international agreements to which the Socialist Republic of Vietnam is a signatory (Clause 5).

3. Providers (payees) of forest environmental services (Clause 1, Article 63):
   - Forest owners regulated in Article 8 include: (i) forest management units of special-use and protection forests; (ii) business entities, including enterprises, cooperatives, cooperative unions and other business entities that are established and operating in accordance with regulations of law; (iii) armed forces; (iv) research organizations; vocational education and training centres in forestry; (v) domestic households and individuals; (vi) communities; and (vii) foreign-invested enterprises whose land is leased out by the state for the planting and/or production of forest.
   - Organizations, households, individuals and communities that have been hired to protect and develop forests under agreements concluded with forest owners that are organizations established by the state;
   - People's Committees of communes and other organizations that the state assigns to manage forests.

4. Users (payers) of forest environmental services include:
   - Producers or traders causing significant greenhouse gas emissions that have to pay service charges for the absorbing and storing of carbon in forests (Clause 2, Article 63).

5. Carbon titles, as prescribed in Article 73. Forest owner rights which specifically relate to carbon benefits:
   - Enjoy increase in forest products from the natural/planted reserve or protection forest that he/she invests in (Clause 2);
   - Receive forest environmental services and enjoy benefits arising therefrom (Clause 4);
   - Cooperate and associate with both domestic and international organizations and individuals in forest protection and development (Clause 8).

II. Emissions reduction and carbon market development, Environmental Protection Law 2020

1. The reduction of greenhouse gas (GHG) emissions shall focus on (Clause 2, Article 91):
   - organizing reduction of GHG emissions and GHG absorption according to a roadmap and method for reducing GHG emissions that conforms with national conditions and international commitments;
   - inventorying GHGs, measuring, reporting and verifying reduction of GHG emissions at national, sector or field level, or relevant internal level;
   - inspecting compliance with regulations on inventorying of GHGs and reduction of GHG emissions, and implementation of the mechanism and method for cooperation in reduction of GHG emissions;
   - formulating and implementing the mechanism and method for cooperation in the reduction of GHG emissions, in accordance with regulations of law and international treaties to which the Socialist Republic of Vietnam is a signatory;
   - organizing and developing the domestic carbon market.

2. The Prime Minister shall promulgate a list of sectors and GHG-emitting facilities subject to GHG inventory and update it every two years according to: the ratio of GHG emissions to the total national GHG emissions; socioeconomic development conditions and situation; and consumption of fuels and energy, per unit of product or service by businesses (Clause 3 Article 91).

3. Responsibility of the Ministry of Natural Resources and Environment (Clause 4, Article 91):
   - compile and submit to the Prime Minister a list of sectors and GHG-emitting facilities subject to GHG inventory for approval; introduce the national GHG inventory system; and system for measuring, reporting and verifying reduction of GHG emissions;
   - prepare a national GHG inventory report every two years;
   - provide guidance on and organize verification of results of GHG inventory and plans to reduce GHG emissions with respect to sectors and facilities that are subject to GHG inventory.

4. Responsibility of ministries managing sectors subject to GHG inventory (Clause 5, Article 91):
   - organize GHG inventory and send inventory results to the Ministry of Natural Resources and Environment every two years by 31 January of the next reporting period, for consolidation and reporting to the Prime Minister;
   - formulate and organize implementation of the annual plan to reduce GHG emissions in the fields of energy, agriculture, land use, forestry, waste management and industrial processes;
   - provide guidance on technical processes and regulations regarding measurement, reporting and verification of the reduction of GHG emissions in fields and sectors under its management;
   - annually consolidate and report results of GHG emissions reduction within its management scope to the Ministry of Natural Resources and Environment before 15 January of the next reporting period, for consolidation and reporting to the Prime Minister;
   - provide guidance on the selection and application of technological and managerial methods to reduce GHG emissions, in conformity with the scale, industries and business lines under its management.

5. Responsibility of Provincial People's Committees (Clause 6, Article 91):
   - provide information and data in service of the national and sectoral GHG inventory to the Ministry of

Natural Resources and Environment, other ministries and ministerial agencies concerned; inspect the performance of activities under their management relating to GHG emissions reduction.

6. Responsibilities of GHG-emitting facilities on the list of facilities subject to GHG inventory (Clause 7, Article 91):
   - organize GHG inventory, build and maintain a database of GHG emissions and send inventory results to the Ministry of Natural Resources and Environment every two years by 1 December of the reporting period, for consolidation and reporting to the Prime Minister;
   - formulate and implement the annual plan to reduce GHG emissions; integrate the reduction of GHG emissions into its quality management programme, cleaner production programme and environmental protection programme;
   - prepare an annual report on reduction of GHG emissions; implement GHG emissions reduction plan using the measurement, reporting and verification system; and submit it to the Ministry of Natural Resources and Environment, other Ministries, ministerial agencies and provincial People's Committees concerned, by 31 December of the reporting period.

III. Regulation around emissions reduction, Decree 06/2022/ND-CP

Article 5: Entities for which GHG emissions mitigation is mandatory:

1. Establishments on the list of sectors and facilities emitting GHGs must make an inventory of GHG, promulgated by the Prime Minister;

2. The Ministry of Industry and Trade, the Ministry of Transport, the Ministry of Agriculture and Rural Development, the Ministry of Natural Resources and Environment, and the Ministry of Construction;

3. Organizations and individuals other than those prescribed in Clause 1 of this Article are encouraged to carry out mitigation of GHG emissions in a manner that is suitable for their conditions and activities.

Article 8: Intensification of GHG absorption

1. Organizations, households, individuals and communities that are assigned or leased forests or lands to plant forests by the state; that are in possession of self-recovered and developed forests; or that have had forests transferred, donated or inherited; according to the law shall be responsible for the formulation and implementation of stable forest management measures and protection, and increase of coverage, biomass and quality of the forests in order to intensify GHG absorption;

2. Entities specified in Clause 1 of this Article may participate in domestic and international carbon exchange and offsetting mechanisms, subject to the law and the international treaties to which the Socialist Republic of Vietnam is a signatory;

3. The Ministry of Agriculture and Rural Development shall take charge and cooperate with provincial People's Committees in:
   a. formulating goals and a roadmap for GHG absorption from stable forest management, protection and increase of coverage, biomass and quality of forests, together with industry-level plans for GHG emissions mitigation as prescribed in Clause 3 Article 12 hereof;
   b. collecting figures and calculating GHG absorption rates in forested ecological zones on the basis of forest survey and including them in the industry-level GHG inventory report as prescribed in Clause 3 Article 11 hereof;
   c. monitoring and assessing implementation of GHG absorption intensification operations including stable forest management, protection and coverage rates, biomass and qualities of forests on a national scale.

4. The Ministry of Natural Resources and Environment shall:
   a. make written responses to the submitedsubmitted earoundsprogrammes and projects regarding participation in carbon credit offsetting mechanisms relating to GHG absorption intensification operations, for the purpose of ensuring national goals around GHG emissions mitigation and international treaties to which Vietnam is a signatory;
   b. manage and monitor implementation of programmes and projects regarding participation in carbon credit offsetting mechanisms relating to GHG absorption intensification operations; and
   c. consolidate figures on GHG absorption at the national scale, and formulate GHG national inventory reports every two years.

IV. MRV system regulation, Decree 06/2022/ND-CP

Article 9: National MRV system

1. Supervision of compliance with regulations on GHG emissions mitigation shall be implemented via the national MRV system.

2. The Ministry of Natural Resource and Environment shall be in charge of the national MRV system and have responsibility to examine compliance with the regulations on MRV of GHG emissions mitigation specified in Article 10 hereof; as well as formulate and operate the national online MRV database.

Article 10: MRV contents

1. MRV requirements:
   a. Measurement must be carried out according to the MRV procedures established by competent authorities and ensure accuracy, transparency, continuity and consistency of measurement results. Measurement methods must be issued by competent state authorities, on the basis of UNFCCC regulations and considering conditions in Vietnam;
   b. Reports on GHG emissions mitigation must contain adequate and accurate information of measurement methods, operation figures, applicable emission factors, technology solutions, management approaches to GHG emissions reduction and mitigation results. Reporting must ensure the comprehensiveness of GHG emissions mitigation; and be formulated according to regulations on reporting templates, methodology and timelines,, as prescribed in the MRV procedures established by competent authorities;
   c. Verification of reporting on GHG emissions mitigation must be carried out by eligible units according to the processes prescribed by the Ministry of Natural Resource and Environment; and comply with detailed guidelines of the ministries prescribed in Clause 2, Article 5 hereof; GHG emissions mitigation results shall be announced by competent authorities.

4. Measurement of GHG emission mitigation:
   a. The facilities specified in Clause 1, Article 5 hereof shall carry out measurement of the GHG emissions mitigation results, according to the guidelines of ministries managing specific sectors;
   b. The ministries specified in Clause 2, Article 5 hereof shall organize the measurement of results at industry-level, including implementation of policies, regulations, strategies, programmes, plans and measures of other GHG emissions mitigation under their management.

3. Reporting GHG emissions mitigation:
   a. The facilities prescribed in Clause 1, Article 5 hereof shall formulate annual reports on the previous year's GHG emissions mitigation, according to Form No. 2 of Appendix III issued together with this Decree, and submit them to

the Ministry of Natural Resource and Environment, the ministries prescribed in Clause 2, Article 5 hereof, and professional agencies under the relevant provincial People's Committee before 31 March from 2027;

b. The ministries prescribed in Clause 1, Article 5 hereof shall formulate annual industry-level reports on GHG emissions mitigation, according to the Form No. 1 of Appendix III issued together with this Decree, and submit them to the Ministry of Natural Resource and Environment before 15 January from 2024;

c. The Ministry of Natural Resource and Environment shall have responsibility to review and prepare industry-level and internal reports on GHG emissions mitigation; and prepare a consolidated report on GHG emissions mitigation.

4. Verification of GHG emission mitigation:
   a. Internal verification of GHG emissions mitigation shall be carried out annually from 2026 by verifying units specified in Article 14 of this Decree, according to the MRV procedures established by the ministries prescribed in Clause 2, Article 5 hereof;
   b. Industry-level verification on GHG emissions mitigation shall be carried out annually from 2023 by the ministries prescribed in Clause 2, Article 5 hereof, and submitted to the Ministry of Natural Resource and Environment;
   c. Consolidation of reports on verification of GHG emissions mitigation shall be carried out by the Ministry of Natural Resource and Environment in cooperation with other ministries and central authorities, in order to formulate a national report on responding to climate change, and other national reports on climate change according to international commitments on implementation of the UNFCCC;
   d. Procedures for verification of GHG emissions mitigation shall be issued by the Ministry of Natural Resource and Environment.

Article 12. GHG emission quotas allocation

1. Based on the goals and roadmap for GHG emissions mitigation prescribed in Article 7 hereof, and GHG inventory results in the latest inventory period of the facilities specified in Clause 1, Article 5 hereof, the Ministry of Natural Resource and Environment shall propose to the Prime Minister the total GHG emission quotas, proportions of quotas for reserve, and quotas for auction for 2026 to 2030 and every year.

2. Based on the total GHG emission quotas prescribed in Clause 1 hereof, GHG inventory results in the latest inventory period, and implementation of GHG emissions mitigation by facilities, the Ministry of Natural Resource and Environment shall take charge of, and cooperate with relevant ministries in, formulating and promulgating a GHG emissions norm a for each product applicable to the bussinessbusiness entities that are allocated emission quotas, as specified in Clause 1 Article 5 hereof, from 2026 to 2030 and every year, for manufacturing or business facilities and organizations with allocated GHG emission quotas.

3. Funding for setting up the GHG emissions quotas , specified in Clause 2 hereof, shall be allocated from state budget resources as part of the state budget management division.

Article 14. Requirements for verification and validation body

1. Verification and validation body (VVB) conducts emissions mitigation (hereinafter referred to as 'appraisal organization') are organizations with verification capacity recognized by the UNFCCC; or that are certified to ISO 14065 standard on requirements for GHG verification by Accreditation Body, or other forms of accreditation ; or have a certified technician who has completed a course on GHG inventory for the respective sectors, as required by the UNFCCC .

2. The verifying unit shall carry out verification of GHG emissions mitigation according to the regulations of the Ministry of Natural Resources and Environment, and shall have responsibility for GHG emissions mitigation verification results.

3. Any unit that wishes to be listed on the official climate change website as a qualified verifying unit shall submit Form No. 3 in Appendix III hereof to the Ministry of Natural Resources and Environment and prove its capacity for GHG mitigation verification.

V. Regulations around carbon market development, Decree 06/2022/ND-CP

Article 16. Participants in domestic carbon market

1. The facilities prescribed in Clause 1, Article 5 hereof.

2. Organizations participating in domestic and international carbon exchange and offsetting mechanisms, according to the law and the international treaties to which the Socialist Republic of Vietnam is a signatory.

3. Other organizations and individuals relevant to investment in and trading of GHG emission quotas and carbon credits on the carbon market.

Article 17. Domestic carbon market development roadmap and timescale

1. The period up to the end of 2027:
   a. Formulating regulations on carbon credit management and exchange, and GHG emission quotas; formulating operation rules for the carbon trading exchange;
   b. Trialling carbon exchange and offsetting mechanisms in potential sectors and providing guidance on operation of domestic and international carbon exchange and offsetting mechanisms, in accordance with law and the international treaties to which the Socialist Republic of Vietnam is a signatory;
   c. Establishing and organizing trial operation of the carbon trading exchange from 2025;
   d. Carrying out activities to improve capacity and raise awareness about carbon market development.

5. The period from 2028:
   a. Organizing official operation of the carbon trading exchange in 2028;
   b. Prescribing carbon credit connections and exchange between domestic, regional and global carbon markets.

Article 19. Exchange of GHG emission quotas and carbon credits on domestic carbon market

1. Exchange of GHG emission quotas and carbon credits shall be carried out as part of the regulated carbon trading exchange and domestic carbon market.

2. Carbon credits and GHG emission quotas are allowed to be traded:
   a. GHG emission quotas prescribed in Clause 2, Article 12 are allowed to be traded via the carbon trading exchange; 1 GHG emission quota unit equals 1 ton of CO_2 equivalent;
   b. Carbon credits, collected from programmes and projects implemented under the that are part of carbon exchange and offsetting mechanisms, are allowed to be offset against GHG emission quotas on the trading floor; 1 carbon credit equals 1 ton of CO_2 equivalent;

Auctions, transfer, borrowing and return of GHG emission quotas, and use of carbon credits to offset against GHG emissions:

a. Facilities may auction to own more GHG emission quota units, in addition to their allocated GHG emission quotas, within the same commitment period;
b. Facilities may carry forward unused GHG emission quotas from the previous year to the following years, within the same commitment period;

c. Facilities may borrow and use allocated GHG emission quotas from the previous year to the following year, within the same commitment period;
d. Facilities may offset against GHG emissions exceeding allocated quotas by using carbon credits from projects and balancing mechanisms on the carbon exchange, within the same commitment period ; the amount of carbon credits for offsetting must not exceed 10% of the total GHG emission quota allocated to the facilities;
e. Allocated GHG emission quotas will be automatically withdrawn by the Ministry of Natural Resources and Environment when a facility stops operating, is dissolved or goes bankrupt;
f. The state encourages facilities to voluntarily return unused GHG emission quotas for the purpose of contributing to the achievement of national GHG emissions mitigation;
g. At the end of each commitment period, facilities must pay for GHG emissions exceeding allocated GHG emission quotas, after auction, transfer, loan and use of carbon credits for offsetting. Besides payment, the amount of GHG emissions exceeding allocated quotas will be balanced with GHG emission quotas allocated in the following commitment period;
h. The Ministry of Natural Resources and Environment shall provide guidance on auctions, transfer, borrowing, and return of GHG emission quotas.

Article 21. Responsibility for development of domestic carbon market

1. The Ministry of Finance shall be in charge of formulating and establishing the carbon trading exchange and promulgating financial management mechanisms for operation of the carbon market.

2. The Ministry of Natural Resources and Environment shall take charge and cooperate with the relevant ministers in organizing trial and official operations of the carbon trading exchange, including management and supervision of the carbon market; specify activities to connect the domestic carbon trading exchange with regional and global carbon markets; prescribe implementation of carbon credit balancing mechanisms; formulate marketing documents, and carry out activities to improve the capacity of carbon market participants.

3. Ministries, ministerial agencies and provincial People's Committees shall have responsibilities to cooperate with the Ministry of Resources and Environment and the Ministry of Finance in implementing the regulations prescribed in Clauses 1 and 2 of this Article, and activities for the purpose of fostering development of the carbon market; and undertake media campaigns to raise public awareness of the carbon market.

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