Connecting People's Capacities

SNV Netherlands Development Organisation





The Potential for Mangrove Carbon Projects in Viet Nam

Richard McNally, Angus McEwin and Tim Holland

March 1st, 2010

This report was reviewed by Pham Trong Thinh, Chu Van Cuong, Jacob Olander, Phuong Vu Tan and Adrian Enright, but any errors in content are the responsibility of the authors.

TABLE OF CONTENTS

LIST OF FIGURES, TABLES AND MAPS

EXECUTIVE SUMMARY

Mangrove forests have been destroyed at an alarming rate globally, far faster than terrestrial forests. A recent assessment by Spalding, et al (2010) estimated that close to one-quarter of the original mangrove cover has been lost as a result of human intervention - mainly due to urban development or expanding aqua- and agriculture. This decline has had detrimental a impact on both the environment and on people, who benefit from mangrove ecosystem services like carbon sequestration, fish habitat provision and storm protection. A growing awareness of the seriousness of this problem has precipitated worldwide efforts towards mangrove conservation and restoration. This trend exists in Viet Nam as well, where large scale destruction of mangrove areas has been witnessed as a result of the Viet Nam-American War, mounting population pressures and the expansion of shrimp aquaculture, necessitating the introduction of nationwide mangrove rehabilitation programs.

The importance of mangroves in providing ecological services has been highlighted in discussions on global climate change, in particular with reference to Reduced Emissions from Forest Degradation and Deforestation Plus (REDD+). Mangroves have a relatively high Greenhouse Gas (GHG) removal capacity and thus higher potential to earn carbon revenues. The aim of this paper is to examine the potential for mangrove carbon projects in Viet Nam.

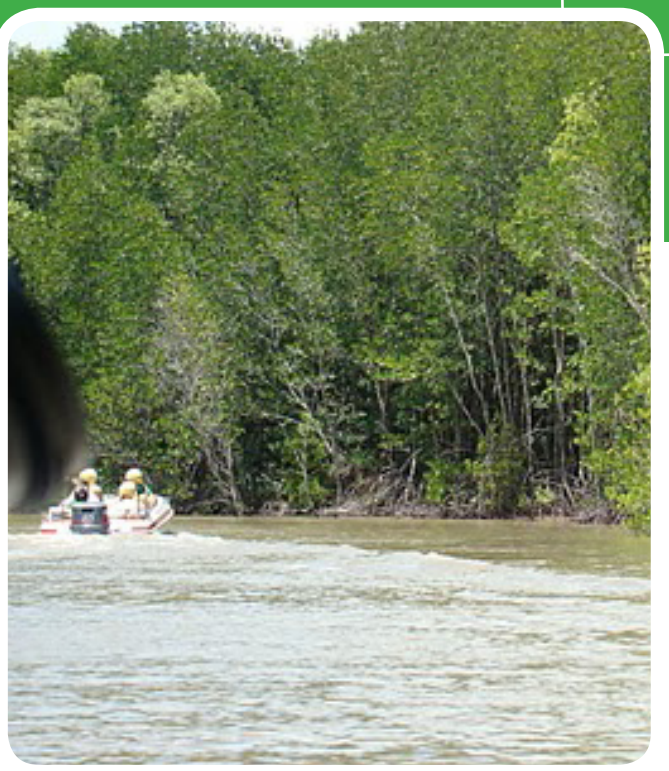
The following conclusions have been reached:

1. For mangrove projects to be successful, the benefits to individual households and communities of protecting mangrove forests must be sufficient to outweigh the opportunity costs. Much of this will

depend on the carbon revenue earned per hectare and the number of hectares of mangrove forest allocated per household. This will tend to be higher for REDD+ than A/R. Mangrove forests have an advantage over other forest types in that they have a low timber value and a relatively high value in terms of non-timber forest products and other environmental services. They also have a relatively high GHG removal capacity.

2. At the current price of temporary certified emissions reductionss (tCERs) and given the availability of eligible land, it is not recommended that an A/R CDM mangrove project be undertaken in Viet Nam. The VCS A/R approach is more attractive due to simpler methodological and technical requirements, land eligibility, higher prices, ability to deal with impermanence and the inclusion of more carbon pools.
3. The decision to pursue mangrove protection and/or restoration needs to be made in the context of the non-carbon benefits of mangrove forests, in particular storm protection and as fishery nurseries. Further valuation of these critical ecological services needs to be carried out.
4. VCS-REDD+ offers potential for mangrove protection in Viet Nam. The avoidance of planned deforestation (APD) due to land re-zoning or planned development, such as conversion of mangrove forests for shrimp aquaculture, offers the greatest potential. Further assessment and evidence of historical and current deforestation and degradation of mangroves are needed.
5. To bypass the restrictively narrow project-level eligibility criteria and accounting, a sector-wide approach with government-led programmatic activities is recommended to conserve and restore mangroves. Funding may come from REDD+ partnership or ODA commitments, both for performance-based mitigation and for adaptation. This idea should be explored as a follow-up to this report.
6. The calculation of GHG removal requires a suite of scientific data including species-specific data. Information on the biology of mangrove forests in Viet Nam, particularly the GHG removal capacity of mangrove species common in Viet Nam, needs to be collected.
7. There is an immediate need to collate information on mangrove areas in Viet Nam by location, ownership, species and status (including age), as well as data on intertidal mudflats suitable for mangrove plantations and their classification and management framework.
8. Most of Viet Nam's mangrove forests are protected forests managed by Forest Management Boards. An important issue for all mangrove carbon projects is management with regards to land tenure, community collaboration and sharing of benefits. There have been several projects in Viet Nam focusing on community-based management of mangroves, including valuable lessons learnt which can be built upon.

SECTION 1:



INTRODUCTION: MANGROVES IN VIET NAM

Despite their importance to economies and to coastal stability, mangrove forests have been destroyed worldwide at alarming rates in recent decades. It is estimated that global mangrove forests are being lost three to four times faster than land-based forests[1]. The world has lost over 3.5 million hectares of mangroves over the last 25 years, or almost twenty percent of the 1980 extent of cover[2]. A large proportion of the world's mangroves are found in South and Southeast Asia. From a global perspective, Southeast Asia is well endowed as it supports the world's largest area of mangroves, originally extending over 6.8 million hectares and representing 34-42 percent of the world's total[3].

In 1943, there were approximately 408,500 hectares of mangroves in Viet Nam, most of which (329,000 ha) were found in the south[4]. However, the area of mangrove forest has since declined significantly, primarily due to ongoing population pressure and, more recently, from the expansion of shrimp aquaculture. Data on the extent of mangrove forests in Viet Nam is scarce, with estimates from different institutions ranging widely. The Forest Inventory shows that the area of mangroves in Viet Nam was reduced to 290,000 hectares in 1962 and again to 252,000 in 1982[5], and that by 2000, only 155,290 ha remained. Only 21 percent of this was natural, while the remainder was

1 *Spalding, M., M. Kainuma and L. Collins (2010). World Atlas of Mangroves. Earthscan.*

2 *Food and Agriculture Organisation (FAO) (2007). Mangroves of Asia 1980-2005 (Country Reports). Forest Resource Assessment Programme, Working Paper 137.*

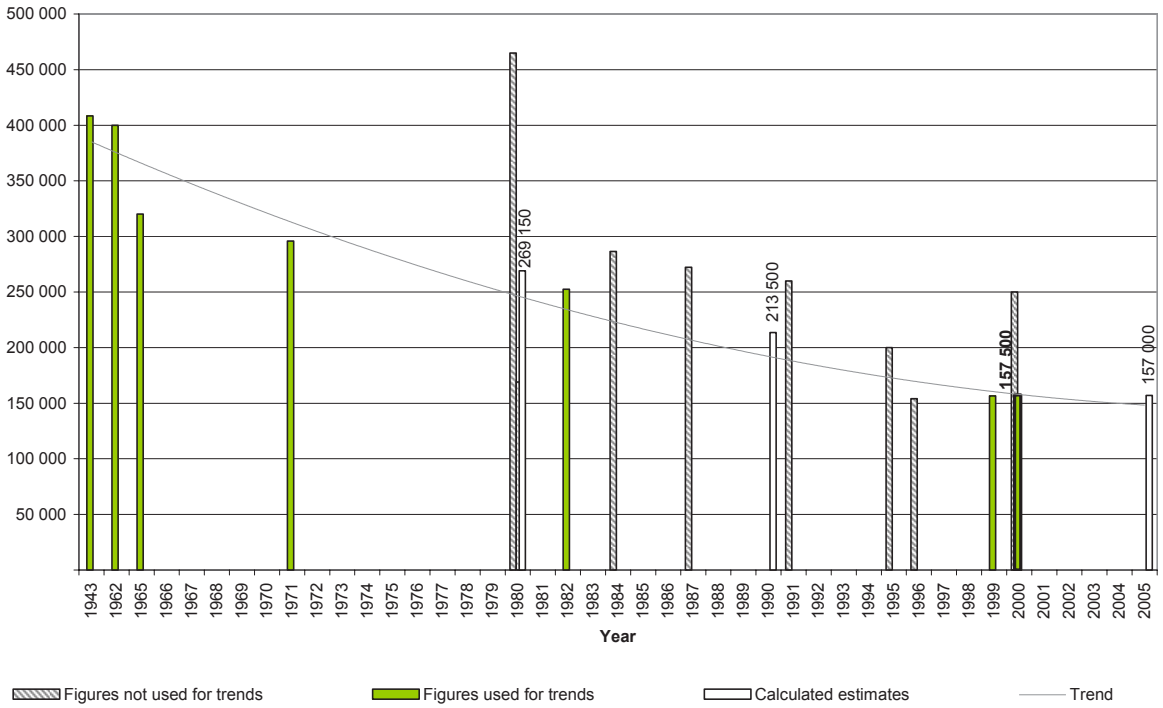
3 *Giesen, W., et al. (2006). Mangrove Guidebook for Southeast Asia. FAO and Wetlands International.*

4 *Do Dinh Sam, et al. (2005). Viet Nam report on review of national data and information on mangrove forest. UNEP Global Environment Facility, South China Sea Project.*

5 *United Nations Environment Programme (UNEP) (unpublished). National Strategic Action Plan for Conservation and Sustainable Development of Viet Nam Coastal Wetlands in Period 2004-2010 (Draft). Hanoi : UNEP Global Environment Facility, South China Sea Project, 2004. .*

planted and usually of a lower quality[6]. A recent review estimated that in 2005 there were a total of 157,500 hectares of mangroves in Viet Nam[7] *[see Figure 1]*.

Figure 1: Trends in mangrove area cover in Viet Nam, 1943-2005(ha)



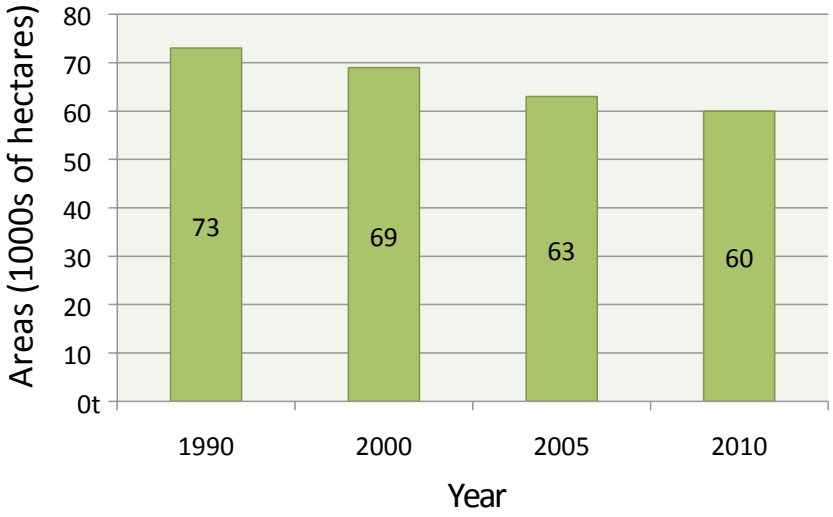
Source: FAO, 2007

According to national statistics on forest lands, pursuant to Decision No. 1267/QĐ-BNN-KL, dated 5 May 2009, the total area of natural mangrove forests in Viet Nam at the end of 2008 stood at only 59,760 hectares, a decrease of 787 ha from 2007 [see Figure 2]. This implies approximately a further 100,000 total hectares of mangrove plantations.

6 *Do Dinh Sam, et al. (2005). Viet Nam report on review of national data and information on mangrove forest. UNEP Global Environment Facility, South China Sea Project.*

7 *Food and Agriculture Organisation (FAO) (2007). Mangroves of Asia 1980-2005 (Country Reports). Forest Resource Assessment Programme, Working Paper 137.*

Figure 2: Area of natural mangrove forests in Viet Nam, 1990-2010 ('000 ha).



Source: FIPI[8]

The total area of mangrove forest is increasing gradually, but this is only due to new forest plantations, while natural forests with high levels of biodiversity continue to decline. Statistics indicate that 62 percent of the existing mangrove forests are monoculture, newly-planted and poor in biomass and biodiversity. Primary mangrove forests have nearly vanished[9].

Mangrove biodiversity is relatively high in Viet Nam, where 28 different species currently grow, with *Rhizophora spp* and *Bruguiera spp* being the most common genera. This may in fact be a conservative estimate, as a recent assessment carried out in Kien Giang identified a number of new species and found a total of 27 mangrove species in that province alone[10]. The main mangrove species in the Ca Mau Peninsula are *Rhizophora apiculata* (syn *R. conjugata*), *Bruguiera gymnorrhiza, Ceriops decandra* (syn *C. roxburghiana)* and *Lumnitzera littorea* (syn *L. coccinea*)[11]. *Sonneratia spp, Rhizophora stylosa* and particularly *Kandelia* (candel and obovata) are common species in the Northern provinces, with *Kandelia* spp generally growing in a thick hedge and reaching a maximum height of three meters, while the other species are generally taller.

In Viet Nam, the largest coverage of mangroves occurs in the South, and is associated with the Dong Nai and Mekong River estuaries, as well as further south on the Ca Mau Peninsula. The other main areas of mangrove growth are found in the Northeastern provinces of Quang Ninh, Thai Binh and Nam Dinh, the latter two being associated with the estuaries of the Red River and Thai Binh Rivers. Along the central parts of the country are also scattered thin patches of mangrove growth. There the coastline is generally very rocky and affected by strong water activity and low tidal fluctuations. In the central zone, these

8 *Data source: National Forest Resource Assessment 2001-2005, Forest Inventory and Planning Institute (FIPI). Reviewed in FAO (2010). The given 2010 figure is an estimated projection.*

9 *Ministry of Natural Resources and the Environment (MoNRE) (2009). Gap Analysis of Terrestrial Protected Area System in Viet Nam (Draft Report). Viet Nam Environment Administration, Biodiversity Conservation Department, October 2009.*

10 *GTZ (2010). Assessing Mangrove Forests, Shoreline Condition and Feasibility of REDD+ for Kien Giang Province, Viet Nam (Technical Report).*

11 *Food and Agriculture Organisation (FAO) (2007). Mangroves of Asia 1980-2005 (Country Reports). Forest Resource Assessment Programme, Working Paper 137.*

narrow strips of mangroves are generally found only along riverbanks and estuaries. The seaward extension of mangroves is limited by inundation, since no mangrove species can survive continual or repeated inundation of the crown.

Coastal dynamics imply an ever changing coastline, with large areas subject to erosion and others to the process of accretion. Mangroves, which root in mudflats and alluvial deposits, are under threat from increased or changing erosion patterns, whilst new areas for planting are available due to the process of accretion (Maps 2a and 2b)[12]. This process can be seen in Map 1 of Tra Vinh Province, below. Data from the past decade has shown that within the coastal province of Ca Mau, more than 600 hectares of land has eroded, with strips of land as wide as 200 metres lost in some locations. At the same time, in one district in the province, an estimated 138 hectares of mudflats have been generated each year for the past 60 years, due to the process of accretion. In the area as a whole, however, there is more erosion than accretion, and so the total area available to mangroves has declined. In Kien Giang Province, as well as the Mekong Delta, active and severe erosion was observed along 30 kilometres (17 percent) of the mainland coast, with a coastal retreat of around 25 metres per year at the examined site. This process directly affects 19 villages[13].

Map 1: Highlighting erosion and accretion in Tra Vinh Province

12 *Do Dinh Sam, et al. (2005). Viet Nam report on review of national data and information on mangrove forest. UNEP Global Environment Facility South China Sea Project.*

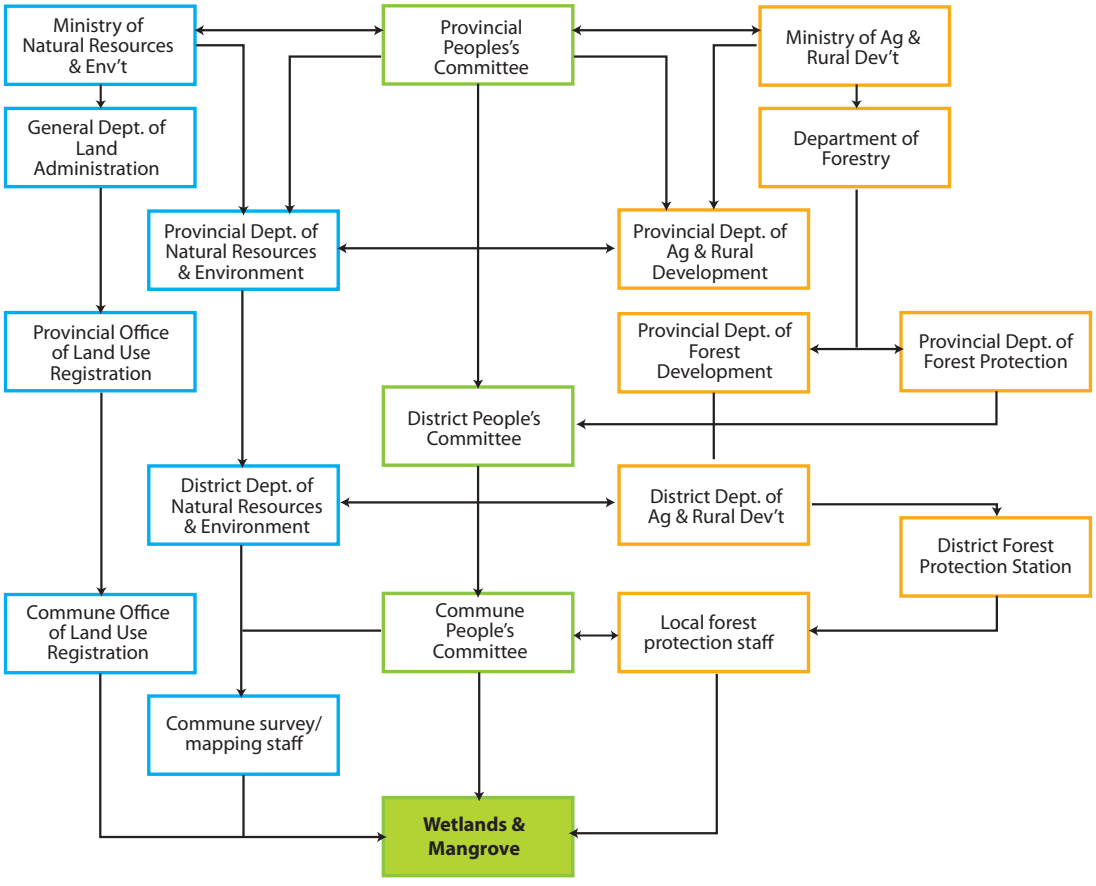
13 *GTZ (2010). Assessing Mangrove Forests, Shoreline Condition and Feasibility of REDD+ for Kien Giang Province, Viet Nam (Technical Report).*

Over the longer term, the sea level in Viet Nam is expected to rise significantly, thereby affecting the salinity and hydrology systems of prospective tidal flats, which may in turn affect the viability of certain species.

1.1 Mangrove forest allocation and management

The central land management agency is the Ministry of Natural Resources and Environment (MONRE), with the General Department of Land Administration functioning as its advisory body. The administrative bodies at the provincial level are the provincial Department of Natural Resource and Environment (DONRE), which contains the Office of Land Use Rgistration. At the communal level stand land administration officials. The state administration of forest and forestry land is carried out through the Ministry of Agriculture and Rural Development (MARD). The Directorate of Forestry is the Ministry's agency advising the state minister and implementing state management tasks in respect to forestry issues nationwide, including the administration of mangrove forests. Mangrove forests are part of the general forest ecosystem and thus there is no separate administration for mangrove forest at any level (central, provincial or district). The government structure encompassing the management of mangrove is depicted in Figure 3. A noted issue is the occasionally overlapping mandates between MONRE and MARD, which can create problems in the sector's overall management.

Figure 3: Government institutional structure for mangrove management[14]



14 *Hawkins, et al. (2010). Roots in the water: Legal Frameworks for Payments for Mangrove Ecosystem Services in Vietnam. Washington, DC: Forest Trends.*

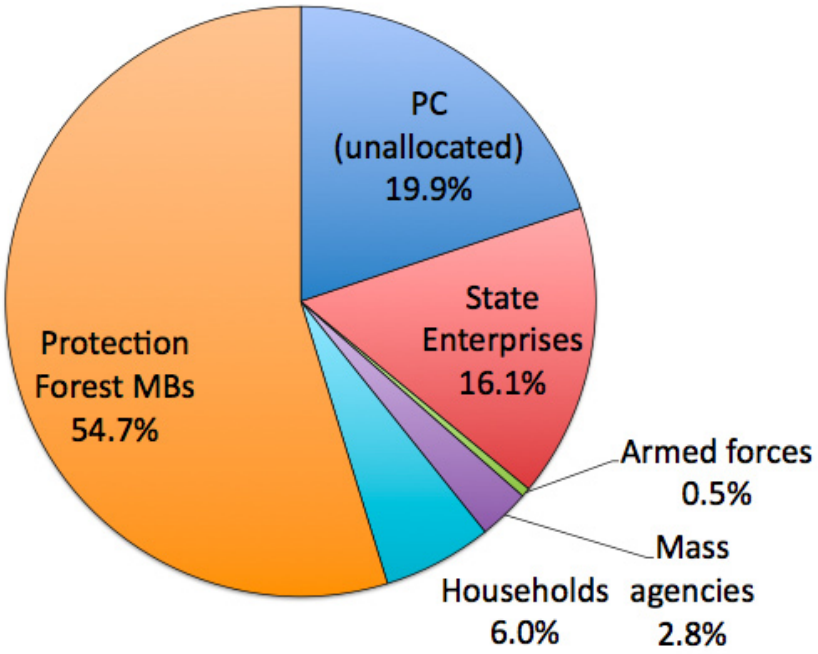
In Viet Nam, the state maintains ownership of all land, although individuals can acquire long-term rights to manage and use forest land. There is an overriding policy that allocates forest land to households and other entities. Individuals and households receive a Red Book (so called for the red cover of the certificate) for the forest land allocated to them; this land use rights certificate then remains valid for a given period, often fifty years.

Since 2000, the National Assembly has passed a number of laws with implications for how forests are owned and managed in Viet Nam. The most notable include the Land Law (Decision *13/3003/QH11*, dated 26 Nov. 2003) which made steps to clarify the framework for forestry land tenure and created for the first time the opportunity to allocate forestry land use rights to communities as well as to individual households; and the Forest Protection and Development Law *(Decision 29/2004/QH11, dated 3 Dec. 2004)* which recognised distinct categories of forest ownership, with varying forest management rights and responsibilities.

The use rights received depend on the classification of the allocated forest land. For example, people who receive forest land for plantations can plant and harvest trees. When natural forest is allocated, the harvesting of only a limited number of trees is allowed, depending on the quality and protection level of the particular forest.

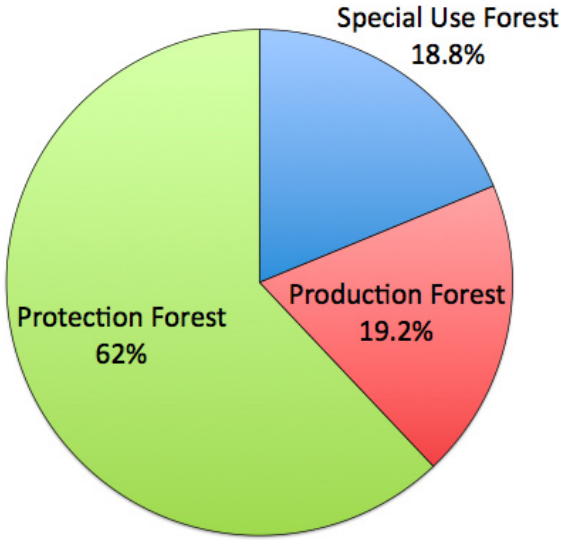
According to national statistics on forest and forest land, pursuant to Decision *No. 1267/QĐ-BNN-KL*, dated 5 May 2009, mangrove forests are held chiefly by Protection Forest Management Boards (PFMBs), by the local People's Committees (land yet to be allocated) or by State Enterprises [see Figure 4].

Figure 4: Ownership allocation of mangrove forests in Viet Nam, 2008 (%)



According to the Vietnamese forest classification system, in Viet Nam the country's mangrove forests are predominantly 'protection forests' [see Figure 5][15]. This means the forest land cannot be allocated to communities through the granting of Red Books, which consequently limits opportunities for local ownership. However, there are plans, such as the 661 Program, which pay households to protect the forest.

Figure 5: Classification of mangrove forests in Viet Nam, 2008 (%)



1.1.1 Local ownership

As shown in Figure 4, just 3,580 hectares of mangrove forest are actually owned by households. However, large areas remain unallocated, and these are primarily owned by the People's Committees. Households, individuals, and village communities can also participate in the management of special-use, protection, and production forests under contract from the forest owners (state forest enterprises or management boards). Forest Management Boards can contract local people to assist with forest protection; under these contracts, households are allocated a number of hectares to protect and are paid a small annual salary per hectare. This is currently the case in Con Gio Mangrove Biosphere Reserve.

There are a number of models of local mangrove ownership currently being pioneered in Viet Nam, in regards to co-management in particular. Said models have been initiated by CARE in Thanh Hoa[16] and by GTZ in Soc Trang[17]; both follow a co-management approach, which is an intermediate form of tenure between full state control and full community control. In Thanh Hoa, the focus was on planting mangroves and in Soc Trang on local resource use and rehabilitation. In Thanh Hoa, CARE put their experience in community-based approaches to use by establishing a management board to oversee community planting, maintenance and management of mangroves.

Both projects mentioned above, although operating in very different physical

15 *Decision No. 1267/QĐ-BNN-KL, Dated 5 May 2009.*

16 *From http://www.careclimatechange.org/videos/vietnam*

17 *From http://czm-soctrang.org.vn/en/home.aspx*

environments, aim to provide local communities with a strong incentive to conserve mangroves while complying with Vietnamese law. In both cases, negotiations between local communities, people's committees and local forestry department offices have been conducted to define the rights, roles, and responsibilities of local communities in managing mangroves, as well as to share the benefits[18].

In Kien Giang, a different model has been applied. There, supporting policies, based on Decision 51, allow Forest Protection Management Boards to enter into long-term contracts with individuals and households in order to protect and use the forest. Under such policy, those who have entered into the contracts must maintain seventy percent of the contracted land under forest cover, and can use the remaining thirty percent of the land and surface water for agriculture, aquaculture, and other income-generating activities. The policy is being piloted in An Minh and An Bien Disctricts in Kien Giang Province, and could provide a model for replication elsewhere.

There are many ongoing efforts to include communities in forest management, including innovative models that could be replicated elsewhere. However there are some fundamental issues which need to be resolved when looking at the possibility of devolving carbon payment benefits to the local community from mangrove protection. Critical issues include:

- The willingness of the local People's Committee to transfer ownership and power over mangrove areas to local people, particularly when competing with other potentially lucrative uses of the tidal flats, such as renting or selling to clam farmers or other aquaculturists;
- The allocation of limited areas of mangrove forest among large numbers of households, especially in densely populated coastal areas where many households currently use mangrove , thereby favouring community rather than household allocation;
- The need to provide sufficient incentives per hectare of forest to the local management team to ensure that the mangroves are adequately protected and tended to. These incentives would be based both on CER revenue sharing and on rights to other benefits from the mangroves, such as deadwood and aquatic products;
- The exclusion of certain households from mangrove areas, generally arising from an effort to have clearly defined beneficiaries. This can affect those who are traditional users of the area and those who need to go through the mangroves to access the bare intertidal flats and fishing grounds. This may particularly be a problem for the landless poor.

1.1.2 Mangrove production forests

Approximately 19 percent of mangrove land is classified as production forest. Records from mangrove forests indicate declining production of timber, firewood and charcoal between 1975 and 2000 [Table 2]. These products mainly come from the mangrove plantations in the Mekong Delta. Timber is primarily used for house construction and/or fuel for the local population. *Rhizophora* timber is well-suited for charcoal production, while the bark of *R. apiculata* and *R. stylosa* is used for tannin production.

18 Notes from workshop: "Reviewing results from mangrove co-management projects and implications for scaling up."

Table 1: Utilisation of mangrove forests in Viet Nam, 1975-2000[19]

Year	Utilisation		
	Timber (m^3)	Firewood (m^3)	Charcoal (tonnes)
1975	25,787	35,011	669
1981	20,662	174,026	2,162
1983	10,826	51,909	2,641
1991	30,903	272,610	830
1993	16,207	176,150	343
1995	15,000	100,000	368
1998	15,911	311	-
2000	17,357	-	-

1.2 Loss of mangrove forests

Throughout the world, mangroves have been exploited for wood and timber, and have also been cleared to reclaim land for agricultural, residential and industrial purposes, as well as salt production, and more recently, for aquaculture. In some cases, the reclaimed land has proved unsuitable or the use unsustainable, leading to the abandonment of the land[20].

Mangroves in Viet Nam have likewise been destroyed by large scale land re-zoning at the provincial and district levels to make way for developments and investments in aquaculture. The total area of sea and brackish water aquaculture in Viet Nam has spiked, from less than 400,000 hectares in 2000 to over 700,000 in 2007[21] [see Figure 6]. In recent years, clam farming on mudflats has also emerged as a driver for mangrove clearance.

Mangrove forests are also threatened by 'death from a thousand cuts' as individual households clear small areas for shrimp or clam farms or decide to cut down trees for firewood and/or timber. This does not lead to outright removal of the mangroves but their gradual degradation curtails their ability to grow. This has been clearly highlighted in Kien Giang, where surveys show that nearly 77 percent of the mangrove shoreline has been damaged by cutting[22].

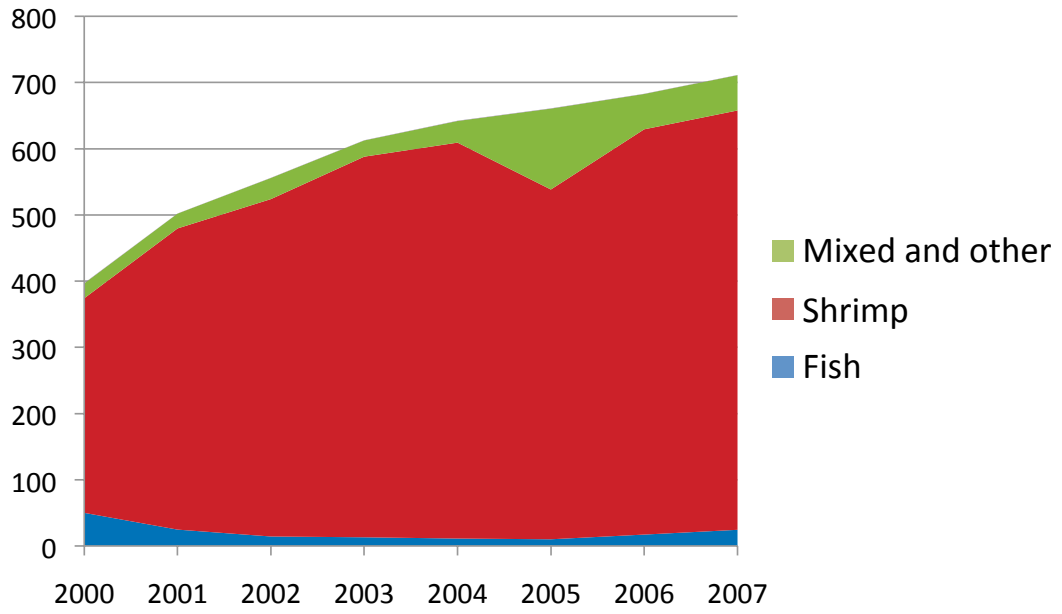
19 *Do Dinh Sam et al. (2005). Viet Nam report on review of national data and information on mangrove forest. UNEP Global Environment Facility, South China Sea Project.*

20 *Field C. D. (2000). "Mangroves." Reprinted from Seas at the Millenium: An Environmental Evaluation, Sheppard, C. R. C., ed. Vol. 3, Global Issues and Processes, Pergamon.*

21 *Viet Nam General Statistics Office 2010*

22 *GTZ (2010). Assessing Mangrove Forests, Shoreline Condition and Feasibility of REDD+ for Kien Giang Province, Viet Nam (Technical Report).*

Figure 6: Area of sea and brackish water aquaculture in Viet Nam, 2000-2007 ('000 ha)



A 2006 study in Tra Vinh Province found that mangrove deforestationsince 1965 has been significant and that much of the lost natural forests had been replaced with plantation forests[23]. The original drivers of loss were chiefly conversion to land for agriculture and later, to aquaculture. This trend was played out throughout much of the country.

1.3 Intertidal mudflats

In addition to areas of mangrove forest, Viet Nam has expanses of intertidal mudflats, some of which are suitable for mangrove, particularly in delta areas. These mudflats are currently bare, though they may be on the seaward side of existing mangrove forests. In some locations near estuaries, the area of mudflats is increasing each year due to accretion - a process than can be aided by mangrove forests. In one district of Ca Mau Province, an average area of 138 hectares is created per year, extending into the South China Sea (based on sixty years of recorded data)[24]. This can also be seen in Map 2a of this report, which shows relatively large areas of land at the tip of Ca Mau accreting between 1995 and 2005.

The issue of ownership and management of the newly created land would become central to any potential carbon project in these areas. The mudflats are used by local communities - particularly the poorest households - as a free and open-access place for collecting aquatic products such as crabs. The planting of mangroves is not likely to displace these activities, and indeed may increase the value of the area for aquatic collection. However, it is also possible that there would be some trade-offs between the two activities. Another competing use for these mudflats has emerged in the last decade in the form of clam aquaculture. In this case, bare areas of mudflats or those within mangrove forests are leased from local authorities by local businessmen. The seaward edge of these mudflats is not suitable for other types of aquaculture (such as shrimp), since the

23 *Phan Minh Thu and J. Populus (2006). "Status and changes of mangrove forest in Mekong Delta: Case study in Tra Vinh, Viet Nam." Estuarine, Coastal and Shelf Science 71 (2007): 98-109.*

24 *Phuong, Vu Tan (2004). National Report on Mangroves in the South China Sea. UNEP Global Environment Facility, South China Sea Project. Research Centre for Forest Ecology and Environment (RCFEE)*

areas are not sufficiently protected, but in many cases these areas are still suitable for harvesting clams. Shrimp aquaculture is better positioned behind sea dykes or behind mangrove forests.

Mudflats serve as an essential natural habitat with high ecological importance. Therefore, the necessary ecological impact assessment must be conducted, and care must be taken prior to any planting.

1.4 Mangrove Planting

The environmental, social and economic impacts associated with the decline and degradation of mangrove forest ecosystems has been recognised and has led to a greater appreciation of their importance and value. Accordingly, local and international institutions in many parts of the world are undertaking legislative, management, conservation and rehabilitation efforts aimed at mitigating the negative impacts of previous coastal development and reversing the dominant trend of mangrove loss.

This increasing awareness of the value of mangroves has prompted a worldwide move to plant new areas[25]. The number of mangrove rehabilitation programs worldwide is extensive. In the 1990s, Viet Nam replanted more mangroves than almost any other country[26], with the government sponsoring replanting and rehabilitation of mangroves for several decades. Afforestation efforts begun in 1975 after the unification of the country, and were repeated in the early 1990s, when the government rehabilitated nearly 53,000 hectares.

In addition, various foreign NGOs have supported mangrove rehabilitation projects, with roughly 14,000 hectares planted from 1991 to 2002 in eight provinces (Quang Ninh, Hai Phong, Ninh Binh, Thanh Hoa, Nghe An, Ha Tinh, Thai Binh and Nam Dinh)[27]. Many more hectares have been planted by organisations such as CARE and the Red Cross in the last eight years. Much of this has been aimed at providing storm protection and livelihood benefits. The plantations are usually predominantly of the Kandelia obovata species, planted in narrow strips (100-1,000 metres wide) along the coastline in front of sea dykes.

Additionally, the World Bank Coastal Wetlands Protection and Development Program planted 4,662 hectares of mangrove and a further 1,214 hectares of scattered trees in the southern Mekong Delta provinces between 2004 and 2007.

Viet Nam has developed and is currently implementing the MARD Project on Mangrove Forest Restoration and Development for the period of 2008-2015. The Ministry of Agriculture and Rural Development has plans to plant 100,000 hectares of mangrove forest between now and 2015 to help compensate for the losses of the of the last six decades.

25 *Field, C.D. (1998). "Rehabilitation of Mangrove Ecosystems: An Overview." Marine Pollution Bulletin Vol.37, No. 8-12: 383-392.*

26 *Field C. D. (2000). "Mangroves." Reprinted from Seas at the Millenium: An Environmental Evaluation, Sheppard, C. R. C., ed. Vol. 3, Global Issues and Processes, Pergamon.*

27 *Food and Agriculture Organisation (FAO) (2007). Mangroves of Asia 1980-2005 (Country Reports). Forest Resource Assessment Programme, Working Paper 137.*

SECTION 2:

ASSESSMENT OF CARBON MANGROVE PROJECT POTENTIAL

2.1 Mangroves and carbon storage

Mangroves absorb a significant amount of carbon into the plant biomass through net primary production. Importantly, they also sequester some of this carbon in the soil for long periods of time[28]. In the context of CO2 sequestration, the relevant carbon sinks to consider are:

- Carbon buried in sediments – locally or in adjacent systems - generated by annual turnover of small litter such as flowers, fruits, leaves, twigs and small branches;
- Net growth of forest biomass, both above- and below-ground, during development, e.g. after (re)planting;

The first process represents a long-term carbon sink, while the second should be considered relevant only on the shorter (decennial) term. Only the latter (i.e. living biomass) is considered by the small-scale CDM methodology applicable to mangroves (AR-AMS3) while annual turnover is also considered in large-scale A/R CDM methodologies and in the Voluntary Carbon Standard (see sections below).

There is significant interest in mangroves as a result of their high carbon content. A recent study was carried out to measure carbon storage (above- and below-ground, including soils) in mangroves across a broad zone (spanning 30° of latitude and 73° of longitude) of the Indo-Pacific region[29]. It was found that the total carbon storage is very high relative to most forest types, with a mean value of 1,043 and range of 437 to 2,186 Mg C ha-1 (metric tonnes of carbon per hectare per year). The largest values

28 *Ong, J. E., W. K. Gong and B. Clough (1995). "Structure and productivity of a 20-year-old stand of Rhizophora apiculata mangrove forest." Biogeography 22: 417-424.*

29 *Notes from a workshop session: "Exceptionally high carbon storage in Indo-Pacific mangroves: Implications of sea level rise, land use, and global carbon markets" which presented the findings of a study estimating mangrove carbon in Indo-Pacific mangroves, carried out by Daniel Donato, J. Boone Kauffman, Daniel Murdiyarso, Melanie Stidham, and Sofyan Kurnianto. It was part of the ESA 95th Annual Meeting.*

were a result of the combination of large-stature forests (trunk diameters up to two metres) and areas with organic-rich peat/muck soils up to five metres deep and in some cases more. It was discovered that the above-ground carbon mass varies widely depending on stand composition and history, and also that the below-ground pools compose a large portion of ecosystem carbon storage in most sites[30]. The study also noted that although these values are considerable it is not clear what would be the loss of carbon as a result of mangrove removal or conversion, particularly below ground. This is an important consideration regarding the potential for REDD+ and mangroves.

2.1.1 Initial estimates within Viet Nam

Other estimates for mangrove species have been produced from measurements in Thailand, Malaysia, and Viet Nam. These relate primarily to above-ground biomass for *Rhizophora apiculata [see Table 3 and Figure 7]*. It can be seen that in Ca Mau Province, at the southern tip of Viet Nam, a 35-year old-stand has an above-ground biomass (AGB) of 326.9 t DW ha-1 (tonnes of dry weight per hectare); to convert this value to a carbon equivalent, it is divided by roughly two.

Table 2: Above-ground biomass figures for Rhizophora apiculata

Place	Age	AGB (t DW / ha)	Source
Ca Mau, Viet Nam	5	41.9	Tan (2002)
Ca Mau, Viet Nam	10	143.4	Tan (2002)
Ca Mau, Viet Nam	15	202.8	Tan (2002)
Ca Mau, Viet Nam	25	277.6	Tan (2002)
Ca Mau, Viet Nam	35	326.9	Tan (2002)
Thailand	3	65.4	Alongi (2009)
Thailand	25	344.0	Alongi (2009)
Thailand	15	159.0	Christensen
Malaysia	5	106.4	Alongi (2009)
Malaysia	18	352.0	Alongi (2009)
Malaysia	85	576.0	Alongi (2009)
Malaysia	20	114.0	Ong et al. (1995)

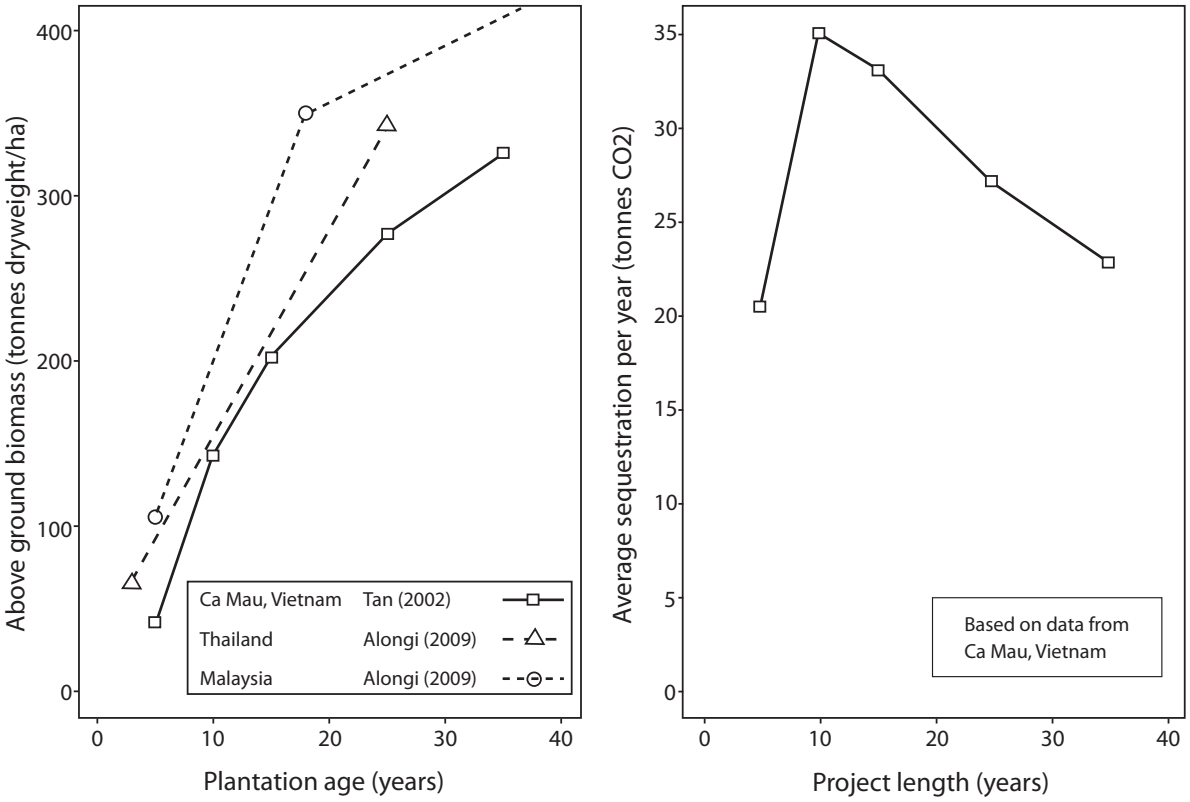
30 *Ibid.*

GTZ has just completed an assessment of the carbon content of the mangrove forests in Kien Giang Province. The study found a range of AGB from a low of 10 t DW ha-1 in riverine and upper intertidal scrub vegetation to a high of 424 t DW ha^{-1} in multi-stemmed R. apiculata plantations[31], with the mean AGB at 126 t DW ha^{-1} [32]. When compared to terrestrial tropical forest biomass, this average is slightly lower (IPCC default value of 180 t DW ha^{-1}). However, the fact that many of the mangroves are in a degraded state and that the below ground biomass, including soil carbon, is much higher for mangrove forest, likely implies higher carbon values for well managed mangrove forests. There continues to be a lack of data on below-ground biomass, as well as the impact of degradation and deforestation on this carbon pool.

The carbon sequestration or GHG removal capacity of mangrove forests varies considerably depending on a number of factors, including species and site location and importantly, the frequency and duration of tidal inundation. At least one study indicates that productivity of restored mangrove stands (both above- and below-ground) is similar to those of natural stands, and any variability is more likely to be related to environmental conditions rather than to the natural or replanted status[33].

Further studies estimating carbon biomass of mangroves are needed for a range of different species and carbon pools.

Figure 7: Above ground biomass and average sequestration for Ca Mau Province, compared to sites in Thailand and Malaysia



31 *GTZ (2010). Assessment of Mangrove Forests, Shoreline Condition and Feasibility for REDD+ in Kien Giang Province, Viet Nam (Technical Report). Rach Gia.*

32 *Ibid.*

33 *Laffoley, D.A. and G. Grimsditch, eds (2009). The management of natural coastal carbon sinks. Gland, Switzerland: IUCN, 53.*

Using the figures for above ground biomass, rough estimates can be made of average sequestration rates. This is illustrated in Figure 7. On the left is the information from Table 3 depicting the increase over time in AGB of three different mangrove /plantations in Viet Nam, Thailand and Malaysia. In the Ca Mau plantationViet Nam, this growth is non-linear, with the most rapid increases occurring in the earlier years. This highlights how the project lifespan will have an effect on the level of sequestration when averaged annually. The figure on the right, calculated from the data shown on the left, shows how the average annual sequestration changes with different project lengths. An average value based on a 30-year time span has been used to derive a value of 24 tCO2e/ha (tonnes of carbon dioxide equivalent per hectare) sequestration per year for Viet Nam of above ground biomass. It is assumed that the below ground biomass is one-third the above ground biomass[34]. This is higher than many terrestrial forests as mangroves tend to have large root structures and hence a higher proportion of underground biomass. Accounting for underground biomass as well gives an estimate of 32 tCO2e/ha

2.2 The Clean Development Mechanism – Afforestation/ Reforestation

The Clean Development Mechanism (CDM) assists in the development of projects that reduce greenhouse gas emissions into the atmosphere by establishing a market where governments can pay for carbon emission reductions. Afforestation and reforestation (A/R) projects remove carbon dioxide from the atmosphere and store it in carbon pools through the photosynthesis of the planted trees. Planting mangroves could offer the potential to sequester carbon and tap into this carbon market.

2.2.1 Definitions for using CDM in the forestry sector

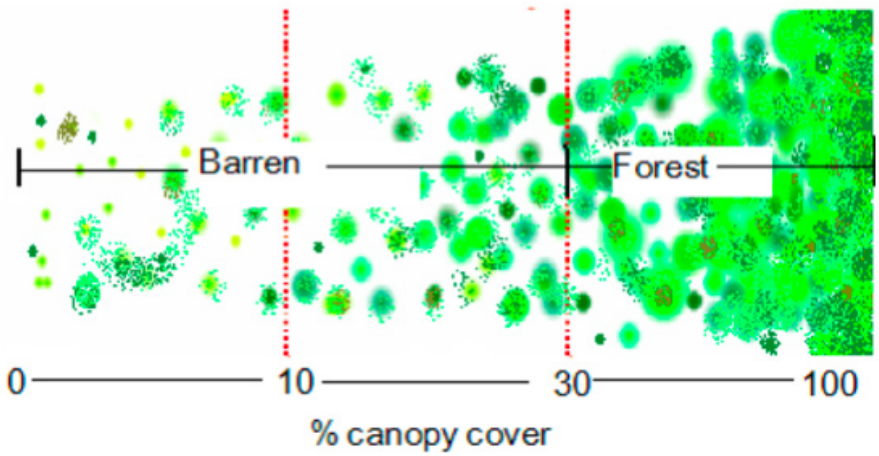
To be eligible under CDM, A/R project activities need to result in forests that are in accordance with the definition set by the host-country Designated National Authority (DNA). The DNA of Viet Nam has determined that the definition of a forest in Viet Nam is an area[35]:

- of at least 0.5 hectare; with
- a minimum crown cover of 30% *[see Figure 8]*; and
- a minimum tree height at maturity of 3 metres.

34 This value is used in the Riau A/R CDM project, which is discussed further in Box 2 in section 3.2.3.

35 See the official CDM definition of VN forests at http://cdm.unfccc.int/DNA/ARDNA.html?CID=233

Figure 8: A/R crown cover definition[36]



This official definition of a forest by the DNA is important as it is also referred to by the Voluntary Carbon Standard (VCS), discussed below. Some species of mangroves may not meet Viet Nam's official definition of 'forest.' *Kandelia obovata,* for example, grows more like a hedge and may just reach the threshold height of three meters.

Participants in A/R projects must also demonstrate that the proposed land is eligible. The CDM Executive Board has developed *Procedures to demonstrate the eligibility of lands for A/R CDM project activities* (EB 35, Annex 18). In order to demonstrate that the land is 'eligible', project proponents must:

a. Demonstrate that the land at the moment the project starts does not already contain forest, by providing transparent information that:

   i. Vegetation is below the forest threshold (tree crown cover or equivalent stocking level, tree height at maturity in situ, minimum land area) adopted for the definition of forest by the host country under decisions16/CMP.1 and 5/CMP.1 as communicated by the respective DNA;

   ii. All young natural stands and all plantations on the land are not expected to reach the minimum crown cover and minimum height chosen by the host country to define forest; and

   iii. The land is not temporarily unstocked, as a result of human intervention such as harvesting or natural causes.

In order to demonstrate that the A/R project is an eligible activity, proponents must:

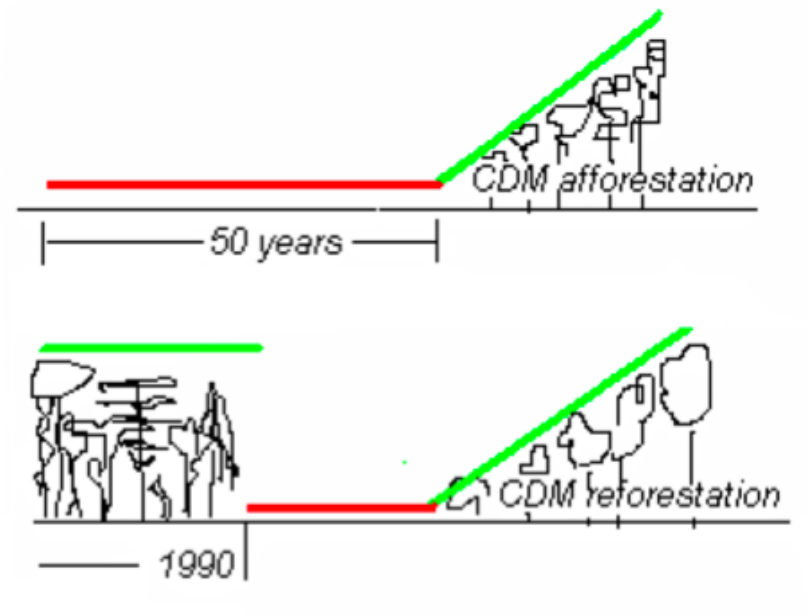
b. Demonstrate that the activity is a reforestation or afforestation project activity:

   i. For reforestation project activities, demonstrate that the land was not forest by demonstrating that the conditions outlined under (a) above, also applied to the land on 31 December 1989.

   ii. For afforestation project activities, demonstrate that for at least 50 years vegetation on the land has been below the thresholds adopted by the host country for its definition of forest.

36 *Vu Tan Phuong, et al (2007).*

Figure 9: Definitions of afforestation and reforestation under A/R CDM[37]



In Viet Nam, much of the suitable tidal flat area has supported mangroves at one time or other. This will make it more difficult to find bare sites that have not been forested with mangroves at any point since 1990. It is noted that each year in some provinces, significant areas of new intertidal mudflats are created due to accretion. There should, therefore, be areas available for A/R CDM mangrove projects, though these areas may be small in size.

As discussed in previous sections, the current data on mangrove cover is of poor quality, often because the information collected is outdated and there are discrepancies in measures between agencies. Also, the coastal dynamics of erosion and accretion play a key role and make estimation of total mangrove areas still more difficult. In order to fully understand the potential for mangrove A/R in Viet Nam, it would be necessary to carry out further assessment of the potentially eligible land. To assess areas of accretion, the focus should be on delta regions.

2.2.2 A/R CDM methodologies

There are currently 17 approved methodologies under the CDM for A/R project activities, six of which are small-scale (less than 16,000 tCO2e per year). To date, the most applied A/R CDM methodology by far has been *AR-AMS1: Afforestation and reforestation on grasslands or croplands* (small-scale). A/R on degraded land and implemented for industrial and/or commercial use have also been applied in eight projects. There are currently a total of 56 A/R projects at various stages of development in the CDM pipeline, only 15 of which are registered and none of which have yet been issued Certified Emission Reductions[38] (CERs) *[see Table 4]*.

37 *Vu Tan Phuong, et al. (2007). Reducing greenhouse gases through reforestation: – Use of CDM in the forestry sector – the Viet Nam experience. Hanoi: International Symposium on Biodiversity and Climate Change – Links with Poverty and Sustainable Development, 22-23 May 2007.*

38 *A CER is equivalent to one tCO2e in reduced or absorbed GHG emissions.*

Table 3: A/R CDM project pipeline[39]

CDM Statistics	Afforestation	Reforestation
Projects	9	49
At Validation	5	31
Average CERs/year	46,000	89,000
Registration Requested	1	2
Registered	3	16
CERs Issued	0	0
Rejected	2	4
Start to Registration (days)	656	561
% Registered	33%	33%

In Viet Nam, only one A/R CDM project has been registered: the Cao Phong Reforestation Project (CDM 4020) [see Box 1].

Box 1: The Cao Phong Reforestation Project

Through the application of AR-AMS1 methodology, this project established 365 hectares of tree plantations on previously degraded grass and shrub land in Cao Phong District of Hoa Binh Province. The tree species planted were mostly Acacia *mangium* but also included small numbers of *Acacia auriculiformis*. The trees were planted for wood production on a fifteen-year rotation. The forest plots are located in five discrete blocks in one district, stretching across several communes. The land was cleared for agriculture before in the 1980s, and land use rights for the project area were allocated to about 320 individual households in the locality as determined by the local authorities, to be used as "production forest land". These households will be responsible for planting, management, protection and monitoring under guidance from the Forest Development Fund (FDF), and will share in the economic gains of the project in the form of sales of thinned and harvested timber, as well as CER revenues.

The project received support from private donation and Japan International Cooperation Agency (JICA), and has been implemented in cooperation with Viet Nam Forestry University (VFU), the Research Center for Forest Ecology and Environment (RCFEE), and the Department of Forestry under the Ministry of Agriculture and Rural Development (MARD). The project was registered in April 2009 and expects to sequester an average of 2.665 ktCO2e per year, including actual GHG additions in the year when the site is cleared for plantation and in the years of thinning. This is equivalent to an average of approximately 7.3 tCO2e per ha per year. The project successfully applied for a renewable 16-year crediting period.

39 *United Nations Environment Programme (UNEP) (2010). CDM JI Pipeline Analysis and Database, www.cdmpipeline.org*

2.2.3 A/R CDM and mangroves

A/R CDM projects can either be small scale or large scale, which will determine the requirements they need to meet in order to receive carbon credits. Small-scale methodologies have been developed to remove some of the onerous requirements inherent in the large-scale approach.
To be eligible to apply for small-scale methodologies, A/R projects must:

- Be developed or implemented by low-income communities and individuals, as determined by the host Party; and
- Result in greenhouse gas (GHG) removals of less than 16 kilo-tonnes of CO2 per year.

Many coastal provinces in Viet Nam face economic difficulties associated with limited agricultural land, declining fishery resources, natural disasters and increasing populations. As a perceived free access resource, mangrove forests are often used by the poor, who depend on them for fuel wood and aquatic resources. As such, the first CDM criteria for small-scale projects should be easily met.

The GHG removal capacity of a forest varies greatly. However, using the average sequestration value of 32 tCO2e/ha per year estimated from Ca Mau, Viet Nam and assuming linear growth, then to classify as small-scale, a mangrove project needs to be below 500 hectares in size.

The most suitable and applicable approved methodology for small-scale mangrove forest projects is AR-AMS3: *A/R project activities implemented on wetlands*. The following eligibility criteria apply:

a) Project activities are implemented on wetlands; i.e. land that is covered or saturated by water for all or part of the year and that does not fall into the categories of forest land, cropland, grassland or settlements.

b) Project activities are implemented for afforestation or reforestation through assisted natural regeneration, seeding or tree planting on degraded wetlands, which may be subject to further degradation and have tree and/or non-tree components that are declining or in a low carbon-steady state. 'Degraded wetlands' in this definition refers to degradation only with respect to vegetation cover.

c) Project must have no impact on hydrology; degraded intertidal wetlands such as mangroves are eligible according to this criteria.

d) This methodology is not applicable to wetlands where the predominant vegetation is composed of herbaceous species in their natural state.

e) Project activities are implemented on lands where the area used for agricultural activities (other than grazing) within the project boundary before the advent of the project were not greater than 10% of the total area.

f) Project activities are implemented on lands where the displacement of grazing animals does not result in leakage[40].

g) Project activities are implemented on lands where less than ten percent of the total surface area is disturbed as a result of preparing the soil for planting.

It should be possible in many sites in Viet Nam to demonstrate that vegetation is degraded, particularly on bare, intertidal mudflats. It should also be possible, if necessary, to demonstrate that anthropogenic influences are leading to or are perpetuating degradation.

40 *Leakage is defined as any increase in greenhouse gas emissions that occurs outside a project's boundary (but within the same country), and is measurable and attributable to the project activities. Its effects on all carbon pools shall be assessed and significant effects taken into account when calculating net emission reductions.*

The carbon pools considered and accounted for by this methodology are above- and below-ground biomass (i.e. the living biomass of trees). Annual turnover and the resultant burial of mangrove carbon in sediments are not included. If it can be demonstrated that there is no leakage, then this factor does not need to be calculated. A project may utilise several separate discrete blocks of land.

For the small-scale methodology, additionality can be proven by demonstrating that any one of a number of barriers is present:

1. *Investment*– lack of access to capital
2. *Prevailing practice* – first of its kind in the country
3. *Ecological conditions* – degraded soil, typhoons
4. *Social conditions* – increasing population pressures, widespread illegal practices (i.e. forest exploitation)
5. *Institutional* – risks related to changes in government policies or laws; lack of enforcement of legislation relating to forest or land use (i.e. illegal cutting of trees and clearance of land)

Proving additionality under *AR-AMS3* is relatively simple and flexible and is not expected to present a problem. Viet Nam

One issue which needs to be considered in the context of Viet Nam is governmental plans for mangrove replanting. The Ministry of Agriculture and Rural Development has plans to plant 100,000 hectares of mangrove forest by 2015. Each province has to submit its plans and a decision will

be made on which areas and how much of the available budget will be provided. Some provinces have already submitted plans, while others are still considering options. For project REDD+, it is therefore important to choose areas which will be additional to the government scheme. Taking a broader perspective, however, it is possible that the presence of a government scheme - despite posing problems with additionality for A/R CDM projects - may open more opportunities for sectoral approaches, or partnerships between government programs and carbon finance.

Currently, there is one A/R mangrove project in the world: the Riau Islands Project, which at the time of writing was under validation [See Box 2].

Box 2: The Riau Islands Project

One project in Indonesia (CDM 6314) has applied *AR-AMS3* methodology. The project is a small-scale and low-income community-based mangrove afforestation project on the tidal flats of three small islands around Batam City, in Riau Islands Province, off eastern Sumatra.

The Riau Islands Project intends to plant mangroves in four areas around three islands that have not previously been forested with mangroves (afforestation). In total, the area planted will be 115 hectares. The species to be planted are *Rhizophora mucronata* and *Rhizophora apiculata* (*Rhizophora* species are also common in southern Viet Nam). For the implementation of this project, a local team of forty people was mobilized, made up of local residents with low income.

The project assumes no leakage in accordance with the methodology. Verification is planned for every five years. Monitoring will be based on maps and physical measurements at sample plots (20 square metres in size). To estimate CO2 fixation of the plantation, biomass is typically estimated using wood density and stand volume. In contrast to terrestrial forests, however, stand volume data for the above calculations of mangrove do not exist. Instead, a species-specific biomass growth model equation was employed for the estimation of CO2 fixation in the newly-afforested mangrove forest.

This thirty-year project is expected to absorb a net average of 3.821kt CO2e of GHG per year, equivalent to 32.2 tCO2e per hectare per year over the crediting period.

AR-AMS3 is only applicable to small-scale projects (less than 16,000 tCO2e per year). For larger-scale projects, a corresponding methodology must be applied, which generally requires more onerous assessment and demonstration of additionality and GHG removal.

For large-scale mangrove forests, *AR-ACM1: Afforestation or reforestation on degraded land* is the most suitable approved methodology. This methodology is applicable to project activities with the following conditions:

a. The project activity does not lead to a shift of pre-project activities outside the project boundary; i.e., the land under the proposed A/R CDM project can continue to provide at least the same amount of goods and services as in the absence of the project activity;

b. Lands to be reforested are severely degraded (due to such agents as soil erosion, landslides, or other physical constraints as well as anthropogenic actions) and the lands are still degrading;

c. Environmental conditions or anthropogenic pressures do not permit significant encroachment of natural tree vegetation;

The applicability conditions of *AR-ACM1* outlined above limit the types of sites at which mangrove A/R CDM activities can be undertaken. Condition (a) may exclude some sites where the bare mud-flats are currently supporting clam farming or the collection of aquatic products. However, such collection activities might not be inhibited by mangrove plantation.

Conditions (b) and (c) imply that mangrove A/R CDM projects can only be undertaken at sites where the existing mudflats are severely degraded. There is a Tool to determine what constitutes a ‘degraded’ site. This condition might limit large-scale mangrove projects to sites where soils have been degraded by aquaculture. Condition

(c) may be difficult to meet given that on suitable tidal flats, mangroves will usually volunteer unless there are human factors preventing their growth.

For large-scale projects, the *"combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities"*[41] must be applied, including identification of credible alternative land use scenarios (including the project being undertaken, but not as a CDM project). It may be found that for some sites, at least partial forestation of the site would have occurred anyway (which will reduce the 'additional' GHG absorption that can be claimed by the project).

Project proponents must also demonstrate prior consideration of the CDM (i.e. that CDM benefits were an integral part of the decision to invest in the project) and undergo investment analysis, barrier analysis (potentially), and common-practice analysis.

Under *AR-ACM1*, the carbon pools include not only above- and below-ground biomass but also dead wood, litter and soil organic carbon (SOC). The science for calculating such carbon pools is not yet well-developed. However, as highlighted in Section 3.1, there are ongoing studies to estimate the value of carbon pools, such as SOC. This information and field sampling could be used to calculate the value of other carbon pools, which in the case of mangroves could be important.

Based on an estimated CO2 fixation factor of 24 tCO2e per hectare per year for mangrove forests, a forest larger than 667 hectares would sequester more than 16 ktCO2e per hectare per year and would be classified as large-scale, and thus not be eligible for application of *AR-AMS3*. Under *AR-ACM0001*, a project may utilize several separate discrete blocks of land. However, finding suitable areas of 'degraded' intertidal mudflats of sufficient size may be a limiting factor.

Ex-ante calculation of the GHG removal rates (CO2 sequestration) of the species to be planted relies on the availability of peer reviewed local or national studies on that particular species. As highlighted, this information exists for certain species in Viet Nam, and in the absence of such data, conservative default values taken from global databases or literature can be used. However, efforts should still be undertaken to collect site-specific data.

2.2.4 Financial feasibility

Financial feasibility of an A/R CDM project depends on the revenue earned from Certified Emission Reductions (CERs), as well as other financial benefits versus the costs incurred in developing and managing the project. Clearly, the benefits need to outweigh the costs.

Temporary CERs

CERs are issued by the CDM Executive Board once emissions from validated and registered projects have been verified. In the case of forestry projects, the achieved emissions reduction (or GHG removal) is not considered to be permanent, as carbon stocks can be lost and released into the atmosphere if and when the forests are eventually cut down. As such, A/R CDM projects can earn only temporary (tCERs) or long-term CERs (lCERs). tCERs expire at the end of the commitment period subsequent to when they were issued, while lCERs expire at the end of the crediting period (thirty years or 3x20 years). Temporary CERs generally trade at about one-third of the price of CERs.

CER revenue

The carbon revenue earned depends on:

(i) The net GHG absorbed by the mangrove forest, and

41 *From http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-02-v1.pdf*

(ii) The price received per tCER or lCER.

The net level of GHG absorbed by a mangrove forest is difficult to estimate and will be specific to the species, the location of the site and the planting density, in addition to other factors. However, it is a critical factor in the expected tCER revenue of a project. If we use the best available information for Viet Nam, shown in Table 3, on average we find that the value of around 32 tCO2e per hectare per year.

The CER price is set by the global carbon markets. As of October 10, 2010, the price per CER is approximately USD $22 though the price varies with market conditions and depends on arrangements with CER buyers. The value of tCERs is considerably lower than the price of permanent certificates, currently around USD $4-5[42]. Projects may be able to earn more than the market price if they can be demonstrated to have additional community and environmental benefits. There is currently some uncertainty about the value of CERs post-2012 as the Kyoto Protocol commitment phase comes to an end. However, most experts believe that the CDM or some version of it will continue post-2012 and some buyers are already buying post-2012 CERs.

Project costs

Project costs will comprise design, development, implementation and operational costs, as well as the CDM transaction costs. They can also include payments to communities to nurture and protect mangroves.

CDM transaction costs are one-time, up-front payments for applying for and gaining CDM registration of the project. They differ depending on the project but are around US$160,000, including CDM consultants, validation and registration fees. Verification costs approximately US$14,000 every five years, or US$42,000 for a 16-year project.

Project development costs include project management during the design of the project, negotiating approval from the various approval agencies, consultation with the local communities, establishment of the local management team and training. The up-front costs for planning and implementing will be at least US$130,000. In addition, there will be further costs associated with project implementation, such as seedling and planting costs, as well as the land costs (dependent on the size of the planned forest) – this is likely to be roughly US$1,500 per hectare over the first three years[43]. Ongoing costs will be incurred for project management (salaries) and perhaps periodic inter-planting – a further US$30,000 per year. Part of the ongoing costs could be used as payments to the communities. The assumed costs and benefits are highlighted in Table 5.

42 *From http://www.carbonpositive.net/viewarticle.aspx?articleID=2152*

43 *This value is based on discussions with CARE about their costs in Thanh Hoa Province. It is slightly lower than their costs and higher than those estimated by the government.*

Table 4: Assumed costs and benefits of a mangrove carbon project in Viet Nam

Item	Value	
Costs: Independent of geographic size of project		
Set-up and project registration	$290,000 at start of project	
Verification	$14,000 every five years.	
Management	$30,000 annually	
Costs: Area-dependent (value per hectare)		
Planting	$900 in first year, followed by $300 in second and $300 in third (=$1,500 total)	
Maintenance (payments)	$15 per year	
Revenue: Potential credit generation		
CO_2 sequestration rate (per hectare)	Calculated from Tan (2002):[44]	
	years 1-5	20.45 TCO_2 / ha
	years 6-10	49.54 TCO_2 / ha
	years 11-15	28.99 TCO_2 / ha
	years 16-25	18.26 TCO_2 / ha
	years 26-35	12.03 TCO_2 / ha

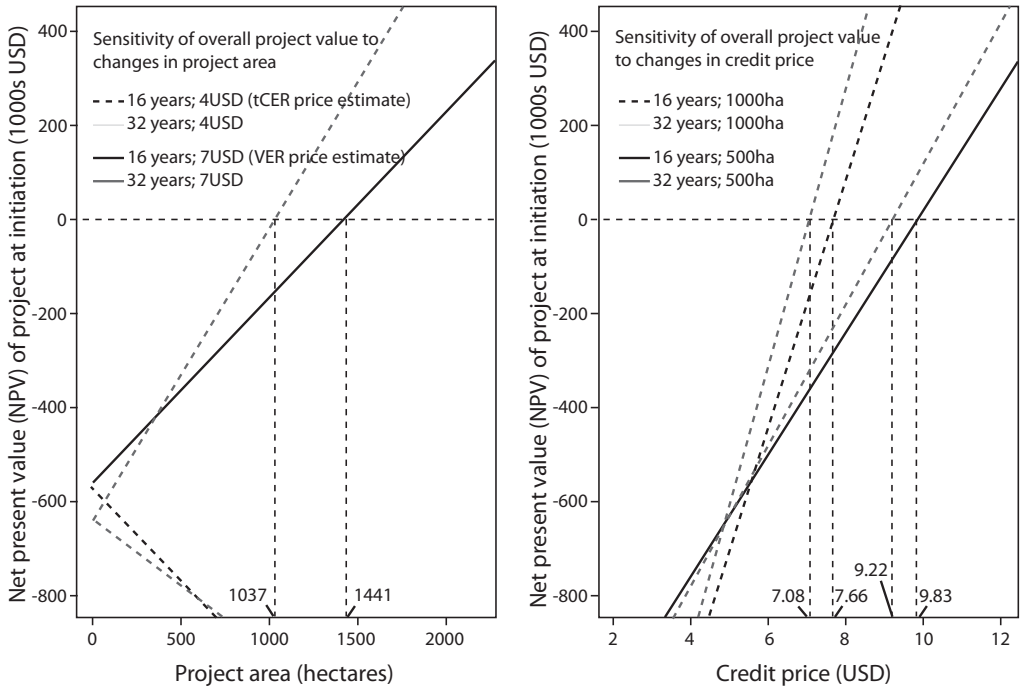
Indicative financial feasibility

The CER revenue of the project would need to be sufficient to justify up-front and ongoing project costs, as well as to provide incentives to the local management team.

Using the values in Table 5, an analysis was carried out to show the relative sensitivity of project profitability to changes in two key parameters: the project's geographic size, and the price of tCERs. In Figure 10, the plot on the left shows the change in project value relative to project area (with tCER price held constant), while the plot on the right shows the change in project value relative to the price of tCERs (with the project area held constant). Information is shown for projects with both 16-year and 32-year time parameters (which correspond with the likely crediting periods). The horizontal dotted line shows the 'break-even' point (a net present value of zero at the initiation of the project), with the vertical dotted lines indicating the value of project area or tCER price at the break-even point.

44 These figures have been amended to include values of underground biomass.

Figure 10: Sensitivity analysis to changes in carbon price and project area [Discount rate of 8% used for all analysis]



This financial analysis clearly calls into question the viability of carrying out A/R CDM mangrove projects at a price of US$4, as is illustrated by the graph on the left. However, if the price of the tCER was to increase to US$7, then projects of roughly 1,000 and 1,500 hectares would be financially viable based on 32-year and 16-year project projections, respectively. Conversely, looking at the graph on the right, it can be seen that tCER prices in the range of $7 to $10 would be required for financial viability of projects of 500 hectares and 1,000 hectares. The 'cut-off' for small-scale CDM projects is 16,000 tCO2e per year. According to the analysis above, it is unlikely that any mangrove carbon projects in Viet Nam could both meet the definition of small-scale and be financially viable.

It should be stressed that this calculation is based on a number of assumptions which will not hold true in many places, and it does not take into account the many risks of carrying out a CDM project, such as failing to become registered with the CDM, forest destruction by typhoons, planting failures, etc. On the other hand, it also does not account for other benefits of mangrove forestation, such as storm protection and benefits to fisheries. There is ample literature on the considerable economic benefits of mangroves. Particularly important in Viet Nam is their role as a buffer against storms. In replanting programs in Viet Nam, such as the CARE mangrove project in Thanh Hoa, communities have been mobilised due to their desire to buffer themselves against storms and typhoons which severely damaged the area in years previous[45]. Any mangrove carbon project developer should therefore choose sites where the mangroves provide clear alternative economic benefits and where there are high levels of interest and demand from the local communities and authorities.

Large-scale projects may allow economies of scale such that CDM transaction costs per hectare are reduced. Given that under

45 From ersonnel communication with Morten Thomson, CARE.

AR-ACM1 the carbon pools include not only above- and below-ground biomass but also dead wood, litter and soil organic carbon, the measured GHG absorption capacity per hectare is likely to be significantly higher than for small-scale projects where only above- and belowground biomass are included. Overall CER revenue would thus also be higher. In terms of financial feasibility, larger-scale projects should be encouraged as long as they can meet the other criteria.

The timing of both costs and benefits needs to be taken into consideration as well. Many of the costs are required upfront, whilst the benefits occur far into the future. This is an issue common to all CDM projects. One option is to sell the emissions reduction before verification. However, this poses risks for the buyers, which are reflected in lower prices. Other options include borrowing from the bank and/or partnering with agencies or buyers willing to partially subsidise the project.

2.2.5 Management and payment

Some of the mangrove land in Viet Nam is still unallocated, while other areas are managed by state entities and could be allocated to households. In practice, however, there may be difficulties in convincing state entities to allocate land to households and/or community groups. It is critical that local people receive adequate economic incentives. The issue of benefit to local communities is not clear and needs to be examined early on. As highlighted in section 2.2.1, new co-management models and new ownership and use arrangements (for example in Kien Giang) are being successfully piloted. Under new regulations, it is also possible for households and community groups to be allocated user rights. The Can Gio Biosphere Reserve in Ba Ria Vung Tau Province is one example where households are allocated land use rights over areas of mangroves in return for protection (and planting). Conditions differ among provinces and appropriate arrangements in each need to be determined.

Currently, under the 661 Program, payment contracts to communities for protecting forests are 100,000 VND per hectare per year (roughly US$5). This is deemed to be too little to provide an adequate economic incentive. In the financial analysis above, we assume higher payments to the communities, as well as to the management board.

If successfully established, a local management team must be able to adequately protect the forest from exploitation, cutting and clearing. The team would also be required to assist with monitoring. Monitoring of carbon must be done at least every five years. The capacity of local authorities and communities to organise and manage the project may be a limiting factor, but this could be overcome by partnering with local NGOs and research institutes.

Large-scale projects require larger areas of mangroves. It may be possible to combine several smaller blocks of land to reach a viable scale. However, in doing so, management of the project will become more complex, particularly if the various blocks of land are in different jurisdictions (districts or provinces), and if the socio-economic conditions in the communities differ.

2.2.6 A/R CDM Conclusions

- The prospects for A/R CDM mangrove projects in Viet Nam are limited. The fact that globally, only one mangrove A/R CDM project is currently in the CDM pipeline and that this one is yet to be validated implies this difficulty is shared by other countries.
- Given the current price of tCERs the project would not be financially viable. If the price of tCERs were to rise to closer to US$10, then projects of 500 hectares

or more would become financially viable. Expectations are for the price to increase. Also, premium prices could be gained through adhering to higher environmental and social standards, though this would also raise the costs in ways that were not factored into the calculations. The issue also exists of how to cover the upfront costs when many of the benefits accrue into the future. Selling earlier, receiving loans and or support from agencies or buyers are possible options to address this problem.

- Developing a project of over 1,000 hectares implies adopting a large-scale methodology which means facing many technical barriers. In addition, the issue of land availability becomes critical. Finding eligible sites for A/R CDM projects might pose a significant problem for large-scale projects, despite the fact that many areas have been deforested since 1990. In the case of A/R CDM, data on the available areas of degraded, unforested intertidal mudflats, rather than on current mangrove forest areas, is required . This data is likely to be limited in some of the provinces as new areas of intertidal mudflats are created each year due to accretion, and data collection is inconsistent. There also appears to be some uncertainty as to the interpretation of 'degraded land' under the CDM for intertidal mudflats. Given that discrete parcels of land can be bundled together, consideration should be given to introducing the project on a higher administrative scale such, as the commune, district or province level. To ensure additionality, the areas chosen should not correspond to the areas identified under the government's ongoing mangrove replanting program.
- Viet Nam has a wealth of experience in mangrove reforestation. The Mangrove Ecosystem Research Division of the National Hanoi University of Education is a valuable resource for the technical and management aspects of mangrove plantation, as well as international NGOs like CARE. If sites can be identified, this experience will help in ensuring the project is successfully implemented.
- There is uncertainty around the GHG removal capacity of mangrove forests of different species, yet these figures are a key determinant of potential carbon revenues. Information on long-term carbon sequestration is currently only available for one mangrove species in Viet Nam. Further studies need to be carried out to produce values for other species. For small-scale projects, the use

of default values and results of studies from other regions is also permitted.

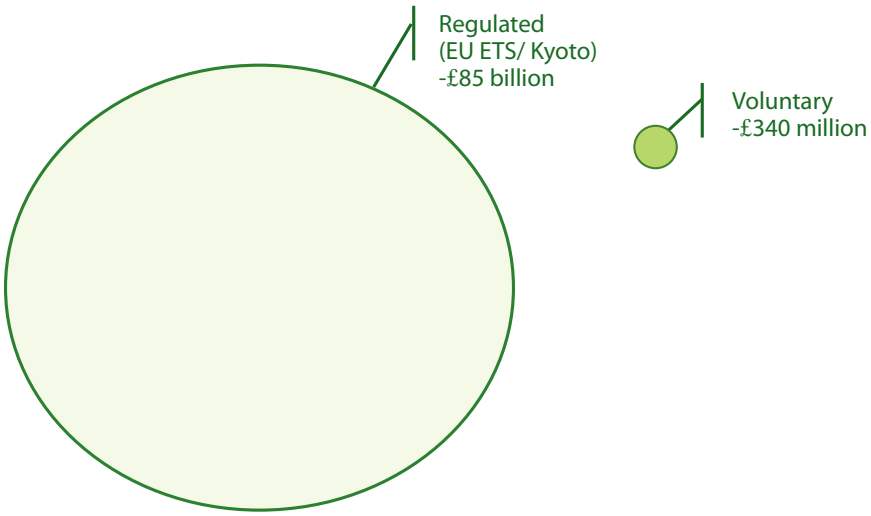
- An A/R CDM project will require the cooperation and support of local authorities as well as local communities. Land tenure arrangements and competing uses will affect the availability of suitable sites, particularly for large-scale projects. In addition, community cooperation, allocation of forest plots, sharing of benefits and local management capacity are all issues to be considered. Efforts should draw on innovative models of co-management and use rights and payment systems for mangrove protection and use currently being introduced in Viet Nam. Arrangements should be introduced on a case by case basis, responding to the particular situation in the different provinces.
- In order for projects to be financially viable, they may need to be large-scale; however, this may raise serious technical and methodological barriers. Applying a small-scale methodology would be fairly straightforward, yet such a project would need to be subsidised, at least at current prices. Given the fact that mangroves produce many more benefits than carbon, the A/R project could be considered as part of a larger multi-purpose mangrove planting project where other support is sought. Donor agencies or NGOs might be interested in partially supporting such a multi-purpose mangrove project.
- It is necessary to take into consideration the fact that there are likely to be changes in the A/R CDM scheme after 2012, with a possible move away from tCERs towards the buffer approach [see the VCS section below]. As such, and given the lack of financial feasibility on small sized areas, it would seem wise to postpone any A/R CDM project until the revised scheme and associated potential revenues are clearer.

SECTION 3:

VOLUNTARY CARBON STANDARDS AND MANGROVES

In addition to the CDM 'compliance' market, there is a voluntary carbon market. Any emissions reduction credits created under this market do not count towards commitments of Annex 1 countries under the Kyoto Protocol. They tend to be bought as a preparation for the possibility of future compliance-based requirements (in the US, which is not a signatory to the Kyoto Protocol) and to offset personal and corporate emissions, for example from flights. These projects are often promoted as providing higher environmental or social co-benefits than projects in the compliance market. The voluntary carbon market is considerably smaller than the compliance market [see Figure 11]. There are a number of different standards which can be followed in order to generate emissions reductions. The process required and time it takes to move from project design all the way to verification is shorter and hence less costly than for the CDM market. The price of carbon credits from the voluntary market is below the price received from the compliance market, around US$7 to 8, though can be considerably higher depending on the additional environmental and social benefits.

Figure 11: Voluntary offset market



Source: Ecosystem Marketplace & New Carbon Finance "State of the Voluntary Market" 2009

A key role of the voluntary markets is to shape the development of methodologies and rules for offsets in future compliance markets. This has particularly been the case for Land Use, Land Use Change, and Forestry. The voluntary market has pioneered a range of land use projects from agro-forestry, re-vegetation and most recently, Reduced Emissions for Deforestation and Degradation (REDD+). This is reflected in the higher percentage of Land Use, Land Use Change and Forestry projects that make up the volumes in the voluntary carbon sector. The voluntary market is important for forest carbon projects.

In the voluntary market there also tend to be more direct linkages between the actual project and the buyer. There is more interest in projects that can showcase higher co-benefits. Consumer emphasis on these latter considerations explains the appeal of 'charismatic' projects such as renewable energy, energy efficiency and forestry/land use. Projects may also incorporate other social and environmental standards, such as the Climate, Community and Biodiversity (CCB) standard.

3.1 The Voluntary Carbon Standard

One of the pioneering standards in the area of forest projects has been the Voluntary Carbon Standard (VCS), which includes agriculture, forestry and other land uses (AFOLU) in the list of eligible project activities. Currently, the following four categories of AFOLU project activities are eligible under the VCS Program:

- Afforestation, Reforestation and Revegetation (ARR)
- Agricultural Land Management (ALM)
- Improved Forest Management (IFM)
- Reducing Emissions from Deforestation and Degradation (REDD+)

Except for ALM, all categories could apply to mangrove forests.

The Voluntary Carbon Standard 2007.1 provides general guidelines for developing VCS projects. *The Guidance for Agriculture, Forestry and Other Land Use Projects* provides more specific guidance to assist in the development of AFOLU projects. These documents make reference to external publications and guidance material, such as technical information and methods published

by the Intergovernmental Panel on Climate Change (IPCC).

The VCS has approved methodologies for different types of projects. One such methodology, *VM0003: Methodology for Improved Forest Management through Extension of Rotation Age*, applies to IFM-AFOLU projects. The VCS also has several proposed methodologies currently under development, including several related to IFM and REDD+. They should be available by the end of 2010. No methodologies relate specifically to mangroves or wetlands. Approved methodologies of the CDM are applicable under the VCS.

AFOLU projects must apply several tools to assist with the analysis and demonstration of compliance with guidance and methodologies. One such tool is the *Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities* (the Additionality Tool), which is very similar to the equivalent A/R CDM tool from which it was adapted.

While the VCS recognises elements of the approved A/R CDM methodologies, there are some key differences between the schemes:

- Registration with the VCS is less difficult and less time consuming, and transaction costs are lower.
- VCS forestry projects adopt a buffer approach to impermanence, which serves to reduce revenues per hectare (by about 20 percent - see end of Section 3.2).
- The VCS allows consideration of all carbon pools, even for small-scale projects, including above-ground and below-ground biomass, dead wood, litter, soil carbon and wood products.
- Under VCS, AFOLU projects can have a crediting period from 20 to 100 years (compared to 16 years on a renewable basis or 30 years on a one-off basis for A/R CDM projects).
- The VCS scheme is voluntary and is thus not limited to the terms of the Kyoto Protocol.

The eligibility criteria for land are also different:

- Projects on land that has been converted from 'native ecosystems' within the last ten years prior to the project start date are not eligible under the VCS, while under the CDM, land that has been 'forest' in the period since 1989 is not eligible for reforestation.
- Forest land converted to non-forest land within the ten year period preceding the project's start is eligible for ARR activities only to the extent that the ARR activity is a leakage prevention measure for a REDD+ or IFM project activity; this is independently verified.

There are also some technical differences:

- Project proponents may combine a variety of activities spanning the four AFOLU categories into a single VCS project, for instance ARR and REDD+.
- VCS places a greater emphasis on ensuring and demonstrating that projects have other environmental and social benefits.
- The Additionality Tool applies to AFOLU projects of all scales, rather than to just large-scale projects as in the A/R CDM (a simpler version applies to small-scale A/R CDM projects).
- The VCS also allows the use of elements of approved CAR Protocols.

A key difference is how the VCS deals with impermanence. The VCS approach for addressing non-permanence requires that projects maintain adequate buffer reserves of non-tradable carbon credits to cover unforeseen losses in carbon stocks. The number of buffer credits that a given project must deposit into the AFOLU pooled buffer account is based on an assessment of the project's potential for future carbon

loss. This provides a method for taking into account the risks of impermanence and sidesteps the issue of having temporary credits. Importantly, this allows credits from the forestry sector to be traded as in other sectors.

3.2 Eligible project activities under the VCS

The three categories of AFOLU project activities eligible under the VCS Program which are relevant to mangroves are ARR, REDD+ and IFM. Each is discussed in more detail below.

3.2.1 VCS - Afforestation, Reforestation and Re-vegetation

Eligible activities in the ARR project category consist of establishing, increasing or restoring vegetative cover through the planting, sowing or human-assisted natural regeneration of woody vegetation to increase carbon stocks in woody biomass and, in certain cases, soil. Examples of envisaged VCS ARR activities include: reforestation of forest reserves; reforestation or re-vegetation of protected areas and other high priority sites; reforestation or re-vegetation of degraded lands; and rotation forestry with long harvesting cycles[46].

Although similar to the A/R CDM, some of the differences between VCS and CDM make VCS ARR more attractive. This is due to the less cumbersome methodological and technical requirements, higher price, lower costs, ability to deal with impermanence and the inclusion of more carbon pools. A key point is the eligibility of land. Some land that is not eligible under A/R CDM may be eligible under VCS ARR as it only requires that land be bare ten years before the start of the project, compared to since 1990 for the CDM. This opens up new possibilities of land area in Viet Nam.

Clearly, the higher price is critical as can be seen from Figure 10 above. At a price of between US$7 and $8, the project can be financially viable at an area of approximately 1,000 hectares. The price could be considerably more if it chooses to integrate environmental and social standards. This could push the price above US$10, where an area of around 500 hectares would cover costs. It is therefore recommended that A/R projects follow the voluntary market and adhere to high environmental and social standards. There may be an issue of planting on intertidal mudflats. Clearly some assessment of the potential ecological impactneeds to be carried out.

3.2.2 VCS - Reduced Emissions from Deforestation and Forest Degradation

VCS-REDD+ is defined in the VCS *Guidance for AFOLU* as follows:

“Activities that reduce the conversion of native or natural forests to non-forest land, which are often coupled with activities that reduce forest degradation and enhance carbon stocks of degraded and/or secondary forests that would be deforested in absence of the REDD+ project activity. Activities that protect or reduce the conversion of planted forests are covered under the Improved Forest Management section of the VCS” (p. 12)[47].

The idea behind the REDD+ mechanism is to reduce emissions from the ongoing deforestation of native/natural forests. Thus the focus of VCS REDD+ is on native or natural forests as commonly accepted by the host country or using the FAO definition of natural forest: “A forest composed of indigenous trees not established by planting or seeding in the process of afforestation or reforestation”.

Regarding degraded forests, the key question is whether the degradation is caused by the forest being legally

46 *From http://www.v-c-s.org/docs/Guidance%20for%20AFOLU%20Projects.pdf*

47 *From http://www.v-c-s.org/docs/Guidance%20for%20AFOLU%20Projects.pdf*

sanctioned for logging or whether it is being logged and degraded illegally. If the forest was subject to legally sanctioned logging, then stopping the logging activity and protecting the forest is an eligible activity under VCS-IFM [see below]. If the logging activity is not sanctioned and is part of the cause of deforestation and degradation then it qualifies under VCS-REDD+ (but guidance is provided for the degradation component in the section VCS-IFM)[48].

A key issue for pursuing the REDD+ mechanism, plus a reason for high levels of interest, is that by stopping the conversion of already mature trees, the carbon content per hectare per year is higher than with ARR or IFM. Using the values from Tan (2002), if the project is able to protect a 15-year-old *Rhizophora apiculata* mangrove, the AGB is 202.8t per hectare year. The considerably higher carbon content translates into higher benefits and improves the financial feasibility of such interventions. However, the costs to prevent degradation and deforestation can also be considerable, though they differ from place to place. A thorough assessment of costs and benefits is needed before deciding where to intervene. If the appropriate areas are chosen (e.g. where there are more mature mangrove forests, planned deforestation or low-cost strategies for protection) then REDD+ projects should be financially more attractive.

VCS applies the internationally accepted definitions of what constitutes a forest, as discussed in an earlier section. This includes mangrove forests and 'secondary forests.' For VCS purposes, secondary forests are those that have been cleared and have recovered naturally or artificially and that are at least ten years old and meet, or have the potential to meet, the lower bounds of the forest threshold parameters at maturity.

There are areas of native natural mangrove forest in Viet Nam and also areas of secondary, replanted mangrove forest that are over ten years old. Detailed information on Viet Nam's mangrove forest resources, their status as native or regenerated and their age is limited and difficult to access. Further research is required to determine which areas of mangrove forest in Viet Nam would be eligible.

As for A/R CDM and VCS-ARR projects, the calculation of GHG removal by projects requires a suite of scientific data including species-specific data. In addition to demonstrating the baseline scenario and the expected GHG removal of the project as per VCS guidelines, projects must also account for leakage and the risks of non-permanence. The following REDD+ practices qualify as eligible activities under the VCS:

i. Avoiding planned deforestation (APD)

ii. Avoiding unplanned frontier deforestation and degradation (AUFDD)

iii. Avoiding unplanned mosaic deforestation and degradation (AUMDD)

All three REDD+ practices could apply to mangrove forests in Viet Nam. Some of these forests are subject to deforestation and degradation. Each will be examined in more detail.

(i) Avoiding Planned Deforestation (APD)

Perhaps this offers the most potential of the three REDD+ practices in Viet Nam. Planned deforestation of mangrove forests does occur when areas are re-zoned for aquaculture, agriculture or development. 'Conversion to other uses' was the main reason given for recorded losses of mangrove forest in 2008. In some cases, this re-zoning or development is decided at the provincial level with little consultation of the local communities, many of which depend on the mangroves for their livelihoods. APD is perhaps particularly well-suited for larger projects that operate at the level of an entire

48 *From http://www.v-c-s.org/docs/Guidance%20for%20AFOLU%20Projects.pdf*

administrative jurisdiction, such as district or province, thus providing the further benefit of allowing a project to operate at scale.

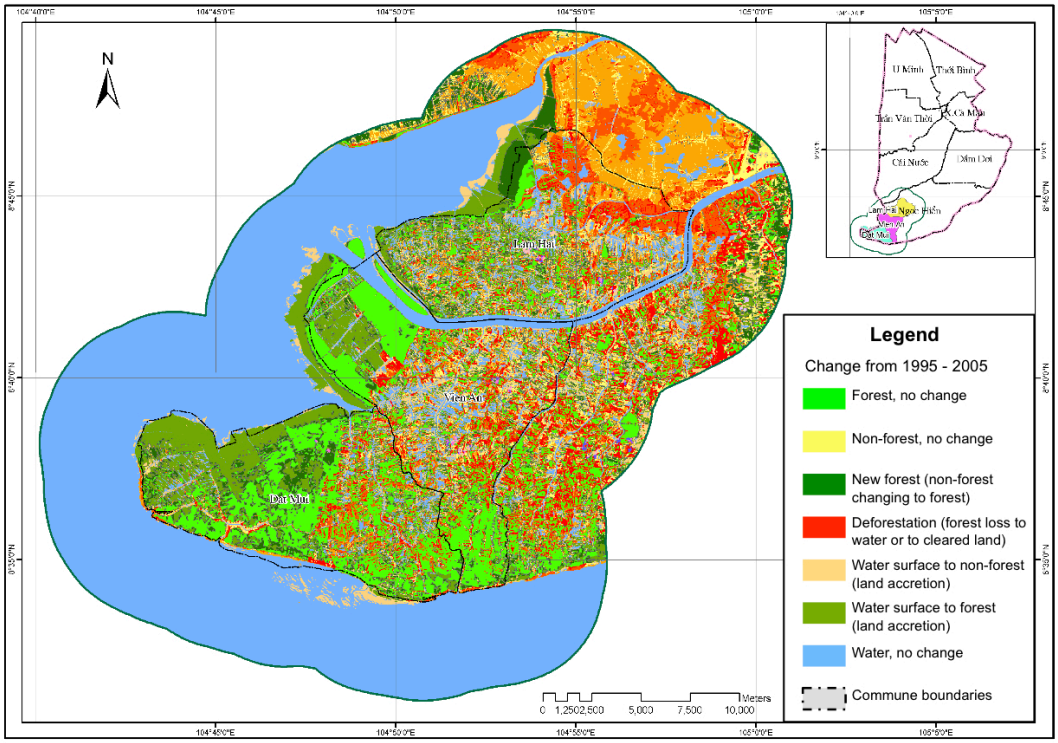
To be eligible for APD, it is necessary to have evidence that deforestation was planned and would have gone ahead in the absence of the project. In Viet Nam, this means that the official land-use planning documents and or official decisions to re-zone or develop an area of eligible mangrove forest must have been issued and then cancelled. Viet Nam develops five-year and ten-year Master Plans for both provincial socio-economic development and also for the different key sectors, including agriculture and aquaculture. These plans include proposed ideas for re-zoning and/ or developing land and may be sufficient to demonstrate that certain mangrove forests are earmarked for removal, though they will need to be accompanied by evidence that the plans will actually be executed.

Given the importance of such plans, convincing local authorities to revise and/ or overturn re-zoning and development decisions will be an obstacle. On the other hand, the benefits of REDD+ mangrove projects are not all financial, are less immediate and are generally shared within the community. With the high level of political support in response to the threat of climate change (in December 2008, the Prime Minister issued *Decision No 158/2008/QD-TTg* to approve the National Target Program (NTP) to Respond to Climate Change), it may be possible to convince authorities to change their plans to convert mangrove areas for agriculture and aquaculture and instead to preserve and protect them.

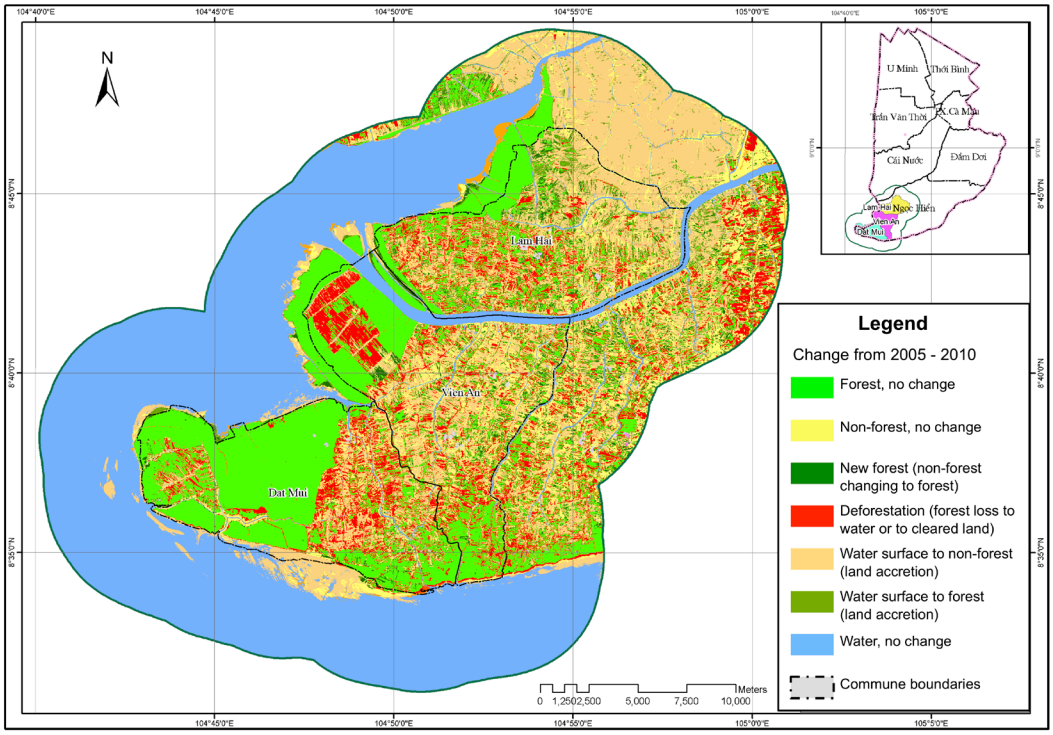
(ii) Avoiding unplanned frontier deforestation and degradation (AUFDD)

AUFDD is the least relevant of the three REDD+ practices. Large, remote tracts of natural mangrove forests can only be found in Ca Mau Province. Northern and central mangrove forests occur in smaller areas along narrow coastal stretches that have always been accessible to communities. Even in the Mekong Delta, much of the mangrove occurs in a thin strip along the coast. Also in the most remote areas, such as the southern tip of Ca Mau, there have been and continue to be human interventions. Much of the remaining mangrove forest area now falls under Mui Ca Mau National Park [Maps 2a and 2b illustrate deforestation of mangroves from 1995 to 2005 and 2005 to 2010]. Given the high population densities in and around the mangrove areas, it would be possible to conclude that AUFDD is not relevant for Viet Nam.

Map 2a: Mangrove forest change in Ca Mau, 1995 to 2005. Mapping carried out for SNV by the Space Technology Institute of Vietnam.



Map 2b: Mangrove forest change in Ca Mau, 2005 to 2010. Mapping carried out for SNV by the Space Technology Institute of Vietnam



(iii) Avoiding unplanned mosaic deforestation and degradation (AUMDD)

AUMDD is applicable to many mangrove forests in Viet Nam. Mosaic degradation and deforestation is occurring in many areas due to population pressures and lack of adequate enforcement by Forest Management Boards and other managers. Small areas are progressively cut down for timber and fuel and small areas are cleared for clam and shrimp farms, despite regulations that prohibit this. More than half (32,719 hectares) of the total area of land that is officially recognised as mangrove forest in Viet Nam is classified as protection forest and is owned by a Management Board (MB). In many of these areas, illegal logging and clearing of mangroves is occurring, so these forests would be eligible for AUMDD.

Although there are no methodologies currently approved for REDD+, there are proposed methodologies which are subject to final approval and which should become available soon. For REDD+ projects, the burden of proof regarding the baseline is burdensome, particularly for AUMDD projects. Here a baseline projection of deforestation and degradation must be developed for the region where the project area is located. This must take into account historical deforestation/degradation rates as well as factors in likely future scenarios. Modeling and designing such baselines requires a high level of technical skill and can be expensive.

In order for a REDD+ Project to create revenue, there degradation and/or deforestation must be present. Therefore, more detailed analysis of the extent of these processes will be needed. SNV is currently carrying out a study in the area around Mui Ca Mau. Given the high soil carbon content in mangroves, this carbon pool should also be considered. However, there are currently no studies which have examined the impact of degradation and deforestation on mangrove soil carbon levels. If it is considered to be significant, such an assessment could be carried out.

In Kien Giang, the mangroves grow in thin belts along the coasts. Such areas are under pressure, with an estimated fifty percent subject to cutting, mainly for firewood and building materials[49]. Such activities degrade mangroves and prevent them from naturally regenerating to their maximum possible biomass. A typical mangrove tree increases in biomass by more than five times with every doubling of its trunk diameter. It is estimated that protection of the mangrove forest has the potential to increase biomass by as much as 3.5 times current levels[50]. It has hence been concluded that REDD+ could offer a financially viable incentive for protection[51].

Such thin belts of mangrove forest can be found in a number of other provinces in Viet Nam and are subject to the same pressures and degradation. A difficulty of introducing REDD+ across these areas is that the mangroves tend to span many different jurisdictions and management units, making it increasingly difficult to establish, manage and enforce project activities.

If possible, REDD+ projects should have a manageable and defined project boundary that is under the control of the project proponent. When ownership of forests is fragmented, or when existing efforts to manage forests and enforce regulations prohibiting deforestation and degradation are ineffective, REDD+ projects become harder to manage. As such, existing protected forests and national parks with clear boundaries and management

49 *GTZ (2010). Assessing Mangrove Forests, Shoreline Condition and Feasibility of REDD+ for Kien Giang Province, Viet Nam (A Technical Report).*

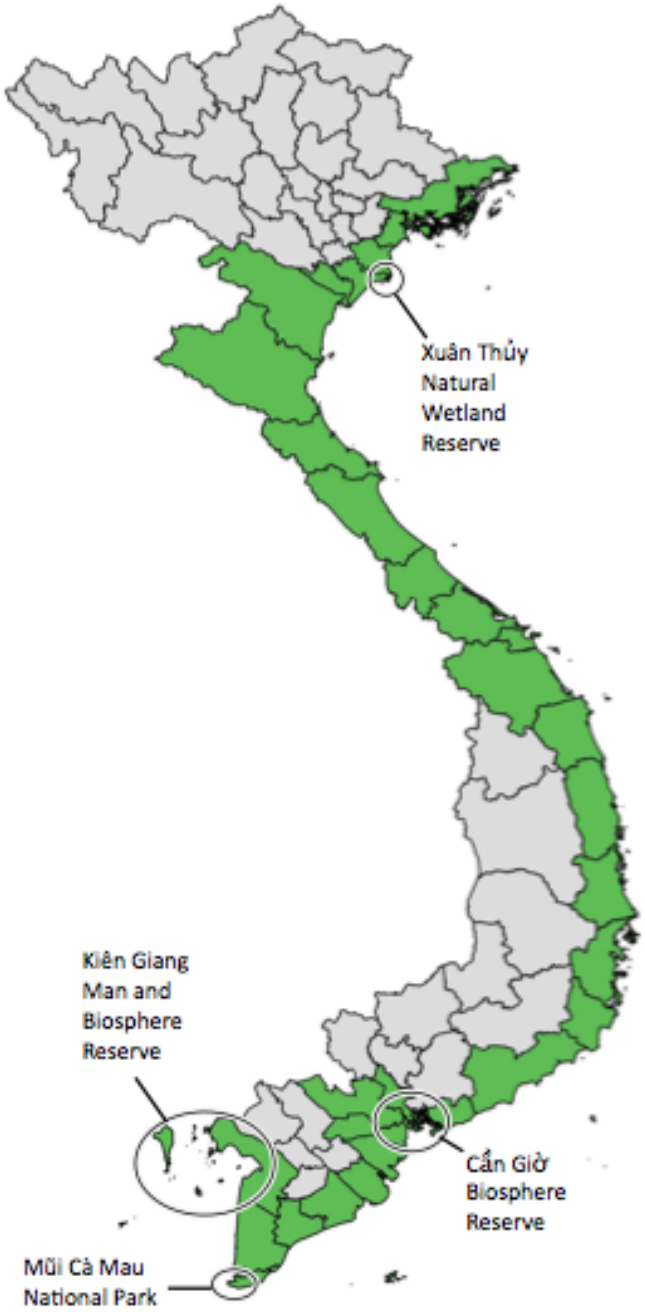
50 *ibid*

51 *ibid*

structures may be some of the most suitable sites. The ownership and the management of the forest by one entity and as a unified area will make implementation and management of the REDD+ component easier. In Viet Nam, there are several protected areas and national parks that contain mangroves. REDD+ revenue could be used as sustainable financing for the Forest Management Boards. These areas include [See Map 4]:

- Can Gio Biosphere Reserve, Ho Chi Minh City
- Xuan Thuy Reserve, Nam Dinh Province (note: Ramsar-designated)
- Mui Ca Mau National Park, Ca Mau Province
- Man and the Biosphere Reserve, Kien Giang Province

Map 3: Protected mangrove areas in Viet Nam



Population pressures along the coastal areas are increasing. The demand for wood to be used as fuel, and for timber, as well as the demand for land for alternative uses, will only intensify. In order to be successful, a REDD+ project must address the root causes of deforestation and degradation of the mangrove forests. Part of any strategy must be to look at supplying alternatives, as well as strengthening enforcement.

Effective REDD+ projects will need to overcome the current drivers for deforestation and degradation of mangroves in Viet Nam, largely related to increasing population pressures. However, compared to pressures on other types of forest, mangroves have some advantages in this regard:

- Relatively low timber value, resulting in less deforestation and forest degradation being driven by non-local people, which implies that leakage for a mangrove REDD+ project will be less;
- A relatively high value of non-timber forest products, largely due to aquatic products such as crabs, shellfish, etc.;
- Significant additional tangible benefits, such as storm-protection;
- As a valuable nursery and habitat, mangroves provide fishery benefits (given that coastal communities are generally predominantly comprised of fishing households);
- Mangroves also protect aquaculture areas and support the long-term sustainability of aquaculture through provision of environmental services;
- Much of the mangrove land has limited agricultural value, though this is offset by aquacultural value. However, aquaculture often requires a greater investment than agriculture and so is less likely to occur on a large scale without secure land tenure;
- Mangroves are relatively fire resistant;
- Mangroves in Viet Nam are mostly classified as protection forests;
- A relatively high level of community support for protecting mangrove forests in recognition of their storm-protection and benefit to fisheries and due to experiences related to the failure of other projects to convert the areas;
- Relatively high GHG removal capacity, in particular due to high soil carbon accumulation.

Care should be taken in choosing appropriate sites but given these advantages, there could be a strong case for the introduction of a REDD+ mangrove project, particularly if it is possible to develop a large project and thus gain the benefits of scale. The Vietnamese government's prioritization of mangrove restoration and replanting, although highlighted earlier in this report as a potential hurdle for additionality, may in fact offer an opportunity for REDD+. Strong government support for improving mangrove cover generally may open the possibility for a sectoral approach where carbon financing is used to cover gaps in government programs.

3.2.3 VCS - Improved Forest Management

Activities related to IFM are those implemented on forest lands managed for wood products such as saw-timber, wood pulp and fuel-wood and are included in the IPCC category "forests remaining as forests" (as per the IPCC AFOLU 2006 Guidelines)[52]. Only areas that have been designated, sanctioned or approved for such activities (e.g. logging concessions or plantations) by the national or local regulatory bodies are eligible for crediting under the VCS-IFM category. Under VCS-IFM, various sanctioned forest management

52 *From http://www.v-c-s.org/docs/Guidance%20for%20AFOLU%20Projects.pdf*

activities are changed to increase carbon stocks and/or reduce GHG emissions, with the aim of making a measurable difference to the long-term increase in GHG benefits compared to status quo practices[53].

Under the VCS guidelines there are four sub-categories of IFM: (i) conversion from conventional logging to reduced impact logging (RIL); (ii) conversion of logged forests to protected forests (LtPF); (iii) extension of the rotation age of evenly aged managed forests (ERA); and (iv) conversion of low-productivity forests to high-productivity forests (LtHP).

There is currently one approved specific VCS-IFM methodology: V*M0003 Methodology for Improved Forest Management through Extension of Rotation Age*. This methodology is only applicable under relatively strict conditions, for example that the project must be Forest Stewardship Council (FSC) certified within a year of project start date, that the project have no impact on wetlands, and that only clear-cut or patch-cut practices are used in both the before project and with project scenarios[54].

In Viet Nam, State-Owned Enterprises (SOEs) own only 9,610 hectares of the land that is officially recognised as mangrove forest in Viet Nam. The use of mangrove forests for production of timber on a commercial scale is not that common as mangrove wood is generally of low timber value. Mangroves can be used for charcoal production, particularly in Ca Mau Province. It is not clear how much of this is extracted illegally and how much is sanctioned. If illegal, then it would be more relevant to REDD+; if legal and there is the possibility of influencing this practice to increase carbon sequestration, then it could fall under IFM. If mangrove areas which are planned to be converted can be protected, then this could offer possibilities.

In some areas in the southern provinces of Viet Nam, mangrove forestry combined with aquaculture is being employed. This may be one type of project that has some potential for VCS-IFM. However, from an initial assessment it would seem that there are limited opportunities from IFM.

3.3 VCS Conclusions

- In Viet Nam, there is potential for VCS-ARR mangrove projects. There are areas of intertidal mudflats that could be used for mangrove plantations. While there are some competing uses for these mudflats, mangrove forests are likely to provide greater socio-economic benefits in the long term, and can complement these competing uses. There is an outstanding issue in regards to the impact on biodiversity large-scale mangrove plantations in these important habitats will have.
- There is much overlap between the VCS-ARR and A/R CDM schemes; however, in relation to forest carbon there are many benefits to choosing the voluntary market over the compliance market. This includes more flexibility in the technical aspects and eligibility of A/R projects, in particular around land qualification and the inclusion of more carbon pools for all methodologies, as well as the ability to deal with permanence. Moreover, the voluntary market fetches a higher price than tCERs, making any project more financially viable. For these reasons, the VCS-ARR approach would be preferable. However, there is currently no VCS-approved methodology. Until a methodology is developed, those from the CDM, which are accepted under the VCS, may be used.
- The potential also exists for VCS REDD+ mangrove projects in Viet Nam. Given that there are limited mangrove forest

53 *From http://www.v-c-s.org/docs/Guidance%20for%20AFOLU%20Projects.pdf*

54 *From http://www.v-c-s.org/VM0003.html*

areas in Viet Nam, there are only a small number of areas where a REDD+ project would make sense. However, there must be further assessment of the extent of degradation and deforestation in and around these sites.

- Given that REDD+ entails protecting existing stocks of mature mangrove forest, in a situation where mangrove clearance is a significant threat, then the potential carbon revenue per hectare will be higher and therefore financially more attractive. In addition significant carbon revenues are generated sooner, thus reducing the time between project inception and potential revenue. The amount of revenue will depend on the current rate of deforestation and degradation of the forest, among other things. Studies in Viet Nam have shown that there is still good potential for carbon emissions reductions and revenues if deforestation and forest degradation can be averted. They may be sufficient to provide adequate incentives to local communities to protect and manage the forests. REDD+ projects could be introduced to stop either planned deforestation and/or forest degradation
- There is potential for avoidance of planned deforestation (APD). Most of the recorded destruction of mangrove forests in Viet Nam is due to conversion of mangrove forest land to other uses. APD projects will need to overcome ongoing plans to re-zone and develop mangrove forests. This will require working closely with local authorities to demonstrate the long-term and sustainable benefits of REDD+ projects. Recent failures of large-scale shrimp aquaculture on land converted from mangroves adds weight to the argument in favor of protecting mangrove forests. There is also high-level political impetus behind protecting mangrove forests for their storm-protection values due to increased attention on climate change adaptation.
- There is also potential for AUMDD (mosaic) given the gradual degradation of many of the mangrove areas in Viet Nam. This potential is highlighted by studies carried out in Kien Giang, though will likely be harder to manage and implement. Given the high population density and migration to the delta and coastal areas there is less relevance of AUFDD within Viet Nam.
- Although there is currently no approved methodology for REDD+, there are a number of appropriate examples which are close to approval. Under VCS, project proponents may combine a variety of activities spanning three AFOLU categories into a single VCS project, such as ARR and REDD+. This could be applicable, though there is currently no clear methodology.

SECTION 4:

MANGROVE CARBON IN VIET NAM: CONCLUSIONS AND RECOMMENDATIONS

It can be concluded that there is, in fact, potential for mangrove carbon projects in Viet Nam. The case for reforestation and protection of mangrove forests is aided by the growing recognition by government authorities and local communities of the long-term environmental, fishery and storm-protection benefits of mangrove forests.

For mangrove projects to be successful, the benefits to individual households and communities of protecting mangrove forests must be sufficient to outweigh the opportunity costs. Mangrove forests have an advantage over other forest types in this regard, in that they have a low timber value and a relatively large value from non-timber forest products and other environmental services. Revenue per household will depend on the carbon revenue earned per hectare and the hectares of mangrove forest allocated per household. This will be higher for REDD+ than A/R. Mangroves also have a relatively high GHG removal capacity, which will further enhance carbon revenues. However, at some sites, there may not be enough mangrove forest to enable allocation of sufficient areas to all households in the community.

There is an existing specific A/R CDM methodology for wetland forests, and a mangrove project is currently seeking registration with the CDM. However, given the current price of tCERs and the availability of eligible land, it is not recommended to undertake an A/R CDM mangrove project at this time. Some of the differences between VCS and CDM make the VCS A/R more attractive. This is mainly due to the less onerous methodological and technical requirements, land eligibility, higher prices, ability to deal with impermanence and inclusion of more carbon pools. There is currently no methodology designed for VCS-ARR, but the CDM methodology can be used.

VCS-AFOLU provides a broader framework for potential mangrove forest carbon projects. VCS-AR and VCS-REDD+ have potential to be applied to mangrove forests in Viet Nam, while conversely VCS-IFM has limited potential due to limited commercial forestry of mangroves.

VCS-REDD+ also offers the potential for mangrove forest carbon projects in Viet Nam. The avoidance of planned deforestation (APD) due to land re-zoning or development, such as conversion of mangrove forests for shrimp aquaculture, offers potential, as does the reduction of mosaic deforestation and degradation through improved community-based management systems and increased monies for protection of forests in the long term from carbon revenues.

However, there are several barriers that need to be overcome. The main issues to be resolved in order to facilitate the development of A/R CDM and/or voluntary AFOLU projects in Viet Nam include:

- Lack of data on the areas and status of mangrove forests and intertidal flats.
- Limited data on the GHG removal capacity of mangroves and the parameters required in the methodologies and guidance. This will need to be improved to better demonstrate potential benefits (carbon revenues) from CDM and VCS projects.
- Difficulty of achieving scale of project that is sufficient to be financially viable, given frequently small individual areas of project-appropriate land.
- Management of projects with regards to land tenure, community collaboration and sharing of benefits. There have been several projects in Viet Nam focusing on community-based management of mangroves and benefit sharing from which valuable lessons have been learnt and could be built upon.

The decision for mangrove protection and/or restoration needs to be made in the context of other non-carbon benefits of mangrove forests, in particular storm protection and as a nursery for fisheries. In order to bypass the restrictively narrow limitation of project-level eligibility criteria and accounting for carbon projects a sector-wide approach with government-led programmatic activities to conserve and restore mangroves is suggested. A follow up to this report exploring the introduction of a sector-wide (or Mekong Basin-wide) mangrove and carbon programme is strongly recommended.

Further research is required with regards to:

- Mangrove areas in Viet Nam by location, ownership, species and status (including age).
- Data on intertidal mudflats suitable for mangrove plantations and their classification and management framework.
- Evidence of historical and current deforestation and degradation of mangroves by location.
- A review of the lessons learned from the last decade of mangrove reforestation projects in Viet Nam, both technical lessons as well as institutional and management lessons.
- A review of the current and proposed legal framework governing mangrove forests and design of appropriate legal arrangements for community-based systems and the payment of carbon revenue proceeds to local participating communities and households, building on the success of new models being introduced.
- The biology of mangrove forests in Viet Nam, particularly the GHG removal capacity of mangrove species common in Viet Nam.
- Financial feasibility studies of carbon mangrove projects including a review of all potential sources of revenue and the costs of implementing and managing projects.

REFERENCES

Ashton E. C., P. J. Hogarth and D. J. Macintosh (2003) “A Comparison of Brachyuran Crab Community Structure at Four Mangrove Locations under Different Management Systems along the Melaka Straits – Andaman Sea Coast of Malaysia and Thailand.” Estuaries Vol. 26.6, 1461-1471.

Basyuni, M., C. Kusmana and J. Siregar (2002). *Composition and species diversity of vegetation in mangrove production forest, Riau*(Master thesis) Ryukyus University, 28.

Bouillon, S., et al. (2008). “Mangrove production and carbon sinks: A revision of global budget estimates.” Global Biogeochem. Cycle 22, GB2013, doi: 10.1029/2007GB003052.

Clough, B.F. (1992). “Primary production and growth of mangrove forests.” Tropical Mangrove Ecosystems, Robertson and Alongi, eds. American Geophysical Union, 225-249.

Dang Trung Tan (2001). *Mangrove forest of Ca Mau* (Scientific report). Forest Science Institute of Viet Nam.

De Jong Wil, Do Dinh Sam and Trieu Van Hung (2006). *Forest Rehabiliation in Viet Nam: Histories, realities and future*. Centre for International Forestry Research.

Food and Agriculture Organisation (2007). *Mangroves of Asia 1980-2005*. (Country Reports). Forest Resource Assessment Programme, Working Paper 137.

Food and Agriculture Organisation (2010). *Global Forest Resources Assessment 2010* (Country Report, Viet Nam). FRA2010/229.

Field, C.D. (1998) “Rehabilitation of Mangrove Ecosystems: An Overview.” *Marine Pollution Bulletin* Vol. 37, No. 8-12, 383-392.

Field, C. D. (2000). “Mangroves.” Reprinted from *Seas at the Millenium: An Environmental Evaluation*. Sheppard C. R. C., ed. Vol. 3, Global Issues and Processes, Pergamon.

Giesen, W., et al. (2006). *Mangrove Guidebook for Southeast Asia*. FAO and Wetlands International.

GTZ (2010). *Assessing Mangrove Forests, Shoreline Condition and Feasibility of REDD+ for Kien Giang Province, Vietnam* (Technical Report).

Hawkins, et al. (2010). *Legal Frameworks for Payments for Mangrove Ecosystem Services in Viet Nam*. Washington, DC: Forest Trends.

Hong, Phan Nguyen and Quan Thi Quynh Dao (2003). “Mangrove Reforestation in Viet Nam: Achievements and Challenges.” *Evaluation of the effects of mangrove reafforestation on the environment and coastal local life in JRC funded project areas* (Workshop Proceedings). January 2003.

Laffoley, DA. and G. Grimsditch, eds. (2009). *The management of natural coastal carbon sinks*. Gland, Switzerland: IUCN, 53.

Macintosh, D. J. and E.C. Ashton (2002) *A Review of Mangrove Biodiversity and Management* Aaarhus University: Centre for Tropical Ecosystem Research.

Mazda Y., et al. (1997). "Mangroves as a coastal protection from waves in the Tong King Delta, Viet Nam." *Mangroves and Sub Marshes 1:* 127-135.

Ministry of Agricultural and Rural Development (MARD) (2006). T*he national forest strategy for the period 2006 – 2020* (Draft).Ministry of Agricultural and Rural Development (MARD) (2001). *Regulation on natural forest management for protection, production and special use forest.*

Ministry of Natural Resources and the Environment (MoNRE) (2009). *Gap Analysis of Terrestrial Protected Area System in Viet Nam* (Draft Report). Viet Nam Environment Administration, Biodiversity Conservation Department, October 2009.

Ong, J.E. (1993). "Mangroves - a carbon source and sink." *Chemosphere* 27:1097 -1107.

Ong, J. E., W.K. Gong and B. Clough (1995). "Structure and productivity of a 20 year -old stand of Rhizophora apiculata mangrove forest." *Biogeography* 22: 417-424.

Phan Minh Thu and J. Populus (2006). "Status and changes of mangrove forest in Mekong Delta: Case study in Tra Vinh, Viet Nam." *Estuarine, Coastal and Shelf Science 71* (2007) 98-109.

Phuong Vu Tan (2004). *National Report on Mangroves in South China Sea.* UNEP Global Environment Facility, South China Sea Project. Research Centre for Forest Ecology and Environment (RCFEE).

Spalding, M. D., F. Blasco and C. Field (1997). *World Mangrove Atlas*. Okinawa, Japan: The International Society for Mangrove Ecosystems, 178.

Spalding, M., M. Kainuma, and L. Collins (2010). *World Atlas of Mangroves*. Earthscan.

Tri N. H., W. N. Adger and P.M. Kelly (1998). "Natural Resource Management in mitigating climate impacts: the example of mangrove restoration in Viet Nam." *Global Environmental Change* Vol. 8, No. 1: 49-61.

United Nations Environment Programme (UNEP) (2003). *Viet Nam Report on Review of National Data and Information on Mangrove Forest*. Hanoi: UNEP Global Environment Facility, South China Sea Project.

United Nations Environment Programme (UNEP) (unpublished). *National Strategic Action Plan for Conservation and Sustainable Development of Viet Nam Coastal Wetlands in Period 2004-2010* (Draft). Hanoi: UNEP Global Environment Facility, South China Sea Project, 2004.

United Nations Environment Programme (UNEP) (2004b). *Mangroves in the South China Sea: Reversing Environmental Degradation Trends in the South China Sea and Gulf of Thailand*. UNEP Global Environment Facility, Regional Working Group on Mangroves.

United Nations Environment Programme (UNEP) (2010). CDM JI Pipeline Analysis and Database, www.cdmpipeline.org.

United Nations Framework Convention on Climate Change (UNFCCC) (2005). *Report of the conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol on its first session*. Montreal: 28 November - 10 December 2005, http://cdm.unfccc.int/Reference/COPMOP/08a01.pdf

Voluntary Carbon Standard. VCS documentation and guidance material, www.v-c-s.org, accessed 2010.

Vu Tan Phuong, et al. (2007). *Reducing greenhouse gases through reforestation: Use of CDM in the forestry sector – the Viet Nam experience*. Hanoi: International Symposium on Biodiversity and Climate Change – Links with Poverty and Sustainable Development, 22-23 May 2007.

SNV Netherlands Development Organisation

www.snvworld.org

Design by **T.E.A.M DP**