



MANGROVE PAYMENT FOR ENVIRONMENTAL SERVICES IN VIETNAM: OPPORTUNITIES & CHALLENGES

TENURE AND GLOBAL CLIMATE CHANGE (TGCC) PROGRAM



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Cover Photo: Community members near Do Son in Haiphong Province prepare mangrove seedlings for planting

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ACRONYMS AND ABBREVIATIONS

CPC	Commune People's Committee
ES	Environmental Service
GVN	Government of Vietnam
MARD	Ministry of Agriculture and Rural Development
PES	Payment for Environmental Service
PFES	Payments for Forest Environmental Services
REDD+	Reduced Emissions from Deforestation and Forest Degradation plus carbon sequestration from forest enhancement
TGCC	Tenure and Global Climate Change
USAID	United States Agency for International Development

I.0 REPORT OVERVIEW

The natural environment provides important environmental services to local, regional, national and international stakeholders, such as erosion control and pollination to neighboring stakeholders, to carbon sequestration benefits to the global community. These services include goods (e.g. physical products), services (erosion control, water purification), and cultural benefits. Yet traditionally, the owners or managers of these habitats have had few ways to benefit economically from the services provided to broader beneficiaries. Payment for environmental service (PES) mechanisms have been proposed as an efficient way to incentivize those with management or ownership rights to manage land for these wider benefits to human welfare.

Vietnam has been a global leader in piloting PES, particularly in upland forests through user fees associated with hydropower and tourism. Yet these experiences have not trickled down to PES in coastal areas and mangrove forests, which provide numerous environmental benefits. This report provides an analysis of some of the barriers to PES in mangrove forests, and key issues to address in the design of a coastal mangrove PES scheme. The assessment recognizes that the Government of Vietnam (GVN) is interested in expanding PES to coastal systems and that there are upcoming investments, for example from the World Bank, KFW, and future U.S. Agency for International Development programs, and policies, for example the revised Forest Law and Coastal Forest Decree, that may promote further piloting of PES.

I.1 METHODS

This assessment is informed by the academic and grey literature on PES in Vietnam and globally, as well as translated Vietnamese policy and legislation. A one week assessment was carried out in Haiphong Province, primarily in Tien Lang District and Cat Ba Island, to consider the local context around PES opportunities. Interviews were carried out with commune, district, and provincial government, as well as with a limited number of private sector and civil society organization actors.

The assessment follows a standard PES framework by examining the characteristics of:

- Mangroves in coastal areas and their relationship to environmental services;
- Potential “buyers” of the services; and,
- Potential “sellers” of the services.

Throughout these descriptions, the assessment considers the transaction challenges and opportunities related to:

- Monitoring of the services for purposes of conditionality;
- Valuation, costs and the willingness of buyers and sellers;
- Collecting revenue; and,
- Distributing payments.

Legal and policy conditions are not addressed in detail, as these considerations are best developed in coordination with an expert on Vietnamese environmental and finance law, which was not available as part of this assessment. Recommendations are provided in bold throughout.

Recommendation: Further interviews and ground truthing with private sector actors across the region are necessary; further discussion with national government representatives to test the findings of this report is also needed.

1.2 BACKGROUND TO PES AND MANGROVE PES

PES was initially defined as a 1) voluntary transactions where 2) a well-defined environmental service (ES) is 3) being “bought” by a minimum of one ES buyer 4) from a minimum of one ES provider, 5) if and only if the ES provider secures ES provision (conditionality) (Wunder, 2007). Other definitions have focused on the concepts of conditionality and the use of positive incentives to promote environmental service delivery, recognizing that PES schemes are rarely voluntary transactions, with well-defined services and clear buyers and sellers (Sommerville, Jones, & Milner-Gulland, 2009; Wunder, 2015). In practice, few PES schemes that meet all of the above criteria are embedded within existing national or local frameworks that assign partial rights to land holders, and require government to create new institutions and markets (Vatn, 2010). Implied in the concept behind a functioning PES is that the positive incentives from engagement should outweigh the costs of lost opportunities for the service providers. PES was initially proposed as a simple, efficient approach because it stressed a direct transaction between buyers and sellers with clear monitoring provisions. However, as new institutions are created to receive and distribute payments, the transaction costs increase and the direct relationships between buyer and seller are easily lost.

Despite this theory and early excitement around the concept, PES schemes are relatively rare globally, though Vietnam has been a leader in piloting Payments for Forest Environmental Services (PFES). In 2010, Vietnam adopted a countrywide PES decree to scale up activities from early models in the Lam Dong and Son La, both upland forest areas, around service provision and also building on the Vietnam Forestry Development Strategy 2006-2020 and previous approaches to incentivize forest restoration. To date, Vietnam’s PFES has been primarily focused on contract approaches in upland areas and purchasing models have focused on direct government support and watershed protection associated with hydropower and tourism to a lesser extent. Vietnamese PES models have applied an approach where land is contracted to individual households or groups of households, but with restrictions on use, and payments have been provided based on both forest protection and forest establishment/planting (with planting receiving a higher value).

2.0 MANGROVE FORESTS AND ENVIRONMENTAL SERVICE

The assessment mentions a range of coastal activities and resulting services, but primarily focuses on the role of mangrove establishment and protection. Vietnam has a globally significant coverage of mangroves; however, the mangrove ecosystems and the services they provide differ dramatically between the south and north. This assessment focuses exclusively on mangroves in the north of Vietnam and the recommendations here must be re-evaluated for relevance to the south, where the majority of mangroves can be found and where the largest decline has been experienced. Mangroves represent only approximately one percent of Vietnam's total forest cover (141,941 hectares in 2010). Between 1995 and 2010, total forest cover increased by over 15 percent across the country, yet at least a quarter of the country's mangroves were lost (MARD, 2015). In the north, mangroves can primarily be found outside of the seawall and in estuaries, particularly around the Red River Delta. Many of these mangroves have been planted since the 1990s as coastal protection, though there are pockets of older, more established mangroves in some areas. In particular, the mangroves around Tien Lang, Kien Thuy Districts and Haiphong City are almost entirely recent plantations of one to three species and represent a 50 – 500 meter wide coastal belt between the seawall and ocean.

2.1 MANGROVE SERVICES

Not all mangrove forests provide the same services, as these depend significantly on their location and the broader habitat they surround. Ewel, Twilley, and Ong (1998) divide mangrove systems into fringe, riverine, and basin forests, where fringe forests act as coastal protection on a shoreline, riverine forests occur at the mouths of estuaries, and basin forests cover large areas not heavily impacted by moving water. While the Mekong has a large amount of basin forest (in addition to riverine and fringe forests), the forests of the Red River Delta are primarily riverine and fringe. Basin forests tend to be important for carbon stocks and for community timber and wood use, while the relatively small bands of riverine and fringe forests are more important for coastal shoreline protection, sediment trapping, and food and habitat for marine life both within the forest and in the nearshore area.

As shown in Table 1, Fries et al. (2016) highlighted a range of environmental services provided by mangrove systems and whether the services can be assessed and monitored, valued financially, and easily traded, which are key to the viability of PES models.

TABLE I: CHARACTERISTICS OF MANGROVE ECOSYSTEM SERVICES OF IMPORTANCE TO PES SCHEMES

<i>Ecosystem service category</i>	<i>Selected ecosystem service^a</i>	<i>Quantifiable</i>	<i>Valorable</i>	<i>Fungible^b</i>
Provisioning	fisheries	yes: fish yield, catch survey, and underwater census	yes: market price and production function method	depends on quality and species composition of the catch and size of individual; relative quality of a given ton of fish may vary (e.g., differences in texture and taste) and may affect price; given that catch may have different proportions of species
	food	yes: yield and consumer census	yes: market price	
	fuel wood and charcoal	yes: yield	yes: market price	depends on quality of product (e.g., type of wood species [calorific value] and kilning process used)
	fiber (e.g., nipa fronds) tannins (e.g., batik dye) fodder for domestic livestock	yes: yield yes: yield yes: weight	yes: market price yes: market price yes: market price	depends on quality depends on quality depends on quality
Regulating and supporting	climate regulation (carbon storage and sequestration)	yes: carbon storage via above- and below-ground carbon stock assessment, carbon sequestration via net primary productivity	yes: price determined by various carbon trading platforms (typically the voluntary carbon market)	yes: traded on international markets through a common unit (1 CO ₂ e)
	coastal protection	yes: percent wave attenuation, avoided damage costs, and rate of erosion or accretion	indirectly, avoided damage costs	no: spatially and temporally dependent (relative coastal protection values afforded to mangroves differ as a function of location)
	water-quality maintenance	yes: various water-quality indicators (e.g., turbidity and pollutant concentrations) and water-quality protocols exist	yes: qualitative willingness to pay or stated preference determined through surveys	possibly, site dependent, which restricts potential for trading in water-quality indices
Cultural	nutrient cycling	possibly: measurements of aspects of the nutrient cycle	possibly: difficult to valorize nutrient cycling (e.g., N and P) as a commodity for PES schemes	possibly, but potentially site-dependent
	recreation and tourism	yes: census and distance traveled	yes: choice modeling and willingness to pay	no
	heritage and culture, religious value	possibly: qualitatively through questionnaires and quantitatively through social media analysis	possibly: contingent valuation (e.g., willingness to pay or stated-preference assessments)	no
	aesthetic value	possibly: qualitatively through questionnaires and quantitatively through social media analysis	possibly: contingent valuation (e.g., willingness to pay or stated-preference assessments)	no
	spiritual enrichment	possibly: qualitatively through questionnaires	possibly: contingent valuation (e.g., willingness to pay or stated-preference assessments)	no
	education and scientific research value	number of students, researchers, or publications produced	Possibly	no

^aUNEP 2014.

^bIndividual units or goods that can be mutually substituted.

Source: Fries et al., 2016.

2.2 CHALLENGES AND THREATS TO MANGROVE ESTABLISHMENT AND PROTECTION

PES should generally deliver some form of measurable benefit either through reducing threats or increasing service provision (additionality). In the case of mangroves this may represent implementing

management activities to reduce threats or planting new mangrove forests. In some cases, PES have been established not to change the service provider's behavior directly, but rather to influence their attitude toward environmental regulations and subsequently improve their compliance with law. This is the case where the law clearly prohibits service providers from converting the land, and as a result a payment is given to providers to follow the law (Sommerville et al., 2009). In such cases, service providers may be given partial rights (for example collection/use rights) to the service as part of their payment.

Recommendation: PES should reduce threats to a service or increase service provision. They may be used to directly influence behaviors, as well as improve attitudes towards law and thus improve compliance.

The threats outlined in section 2.2.2 represent key challenges to mangrove environmental service delivery that a PES system would address.

2.2.1 Establishing New Mangrove Areas

The establishment of mangrove areas is more costly and technically challenging than terrestrial forests. Kairo, Dagdough-Guebas, Bosire, & Koedam (2001) argue that the methods for mangrove plantation have been largely unchanged since the 1920s, but that practitioners continue to relearn the same lessons through trial and error.

APPROPRIATE PLANTING SITES: The establishment of mangroves requires particular care in terms of site selection to make sure that the depth of water and tidal range are appropriate for planting as well as long-term management (Bosire et al., 2008). It is important to also recognize that planting mangroves may not be an unambiguously beneficial activity. Concern has been expressed by some that planting mangroves in intertidal mudflats acts as conversion from one important ecosystem, seagrass beds and mudflats, to another. Just because mangroves can be established in an area does not mean that they should be established (Erftemeijer & Lewis, 1999). Vietnam has undertaken mapping exercises to identify appropriate sites for planting (MFF, 2011), however, the status of these maps and the relationships between these analyses and actual planting sites and the broader ecological impact of planting is not always clear.

APPROPRIATE PLANTING TECHNIQUES: As much as the appropriate site selection, planting technique is particularly important, as well as any structures and barriers to prevent mortality from waves. Appropriate spacing is important to ensure survival and that the forest can grow into an ecosystem that provides the most relevant services. Yet there are clear incentives to space trees too densely, given that nursery suppliers are paid based on number of seedlings sold, and laborers are often paid by the hour or number of trees planted rather than on area planted or quality of planting. The choice of species and diversity of species is of particular concern as well. While the selection of a single species may simplify the planting process, single species systems are also much more vulnerable to catastrophic events, as has occurred in the Philippines with a single moth larva decimating an entire mangrove restoration effort (Walton, Le Vay, Lebata, Binas, & Primavera, 2006).

EARLY CARE: Initial planting and early care, whether thinning seedlings or clearing barnacles from seedlings, have long-term impacts on survivorship of newly planted mangrove forests and on the long-term ecosystem services that they can provide. These elements of early care and plantation techniques become particularly important in the long-term expansion of mangrove areas, as the forests cannot be



Mangrove seedlings to be planted at an older age and need more protection than terrestrial plantations.

PHOTO: MATT SOMMERVILLE/TETRA TECH

planted into the ocean indefinitely (though there has been a large amount of coastal reclamation that has occurred particularly in the Red River Delta, for example around Ha Long City). As planting viability becomes more tenuous, the costs for establishing a successful hectare of forest increases dramatically.

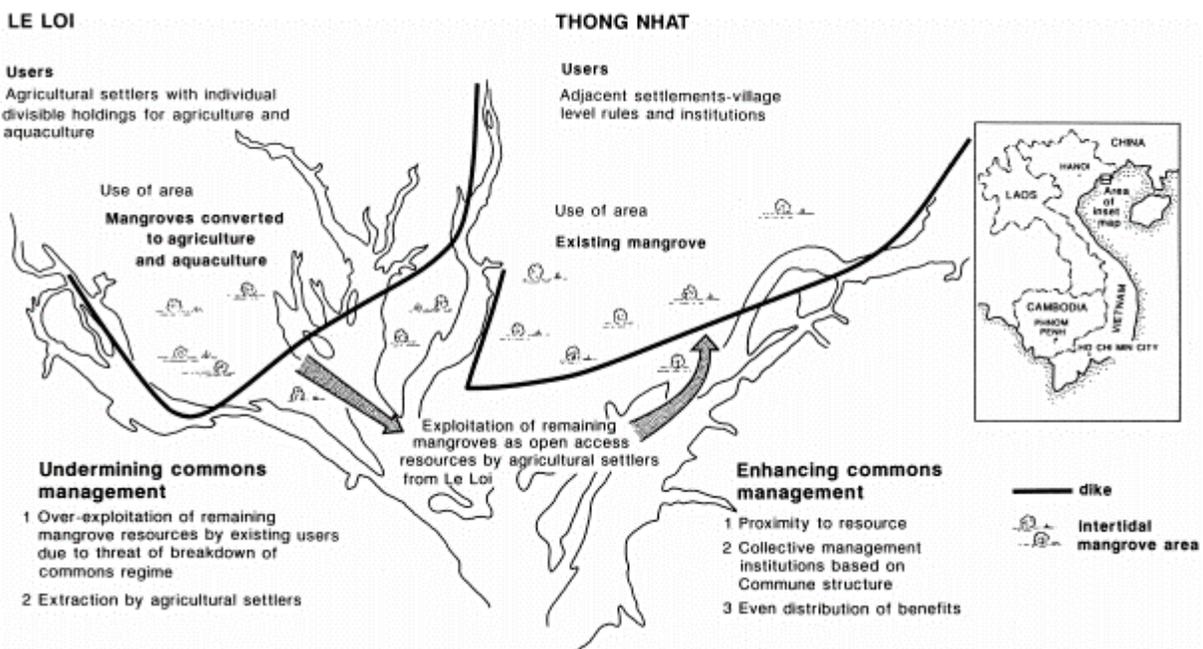
These characteristics mean that though mangroves are high in ecosystem service delivery, their establishment can be much more costly than terrestrial forests, and this is one of the main reasons that community-based replanting efforts globally have not been more successful (Bosire et al, 2008).

Recommendation: Structuring planting and early management incentives to reward quality of planting, appropriateness of siting and survivorship over three to five years will be more effective than paying for inputs and labor alone and will encourage a transition from planting to management.

2.2.2 Management Threats

LACK OF CLARIFICATION OF USE RIGHTS LEADING TO OVERUSE: Particularly in the Red River Delta, mangroves are being established in areas where they have not existed for over a generation, and the lack of community management rules or government clarification of rights can lead to a tragedy of the commons situation, or a case of privatization of rights in the hands of a few. Both of these trajectories were observed in Tien Lang District. As noted above, mangroves are used for multiple activities that may or may not impact the underlying habitat. Collection of shellfish and using nets for fishing may result in overfishing; harvesting of timber for charcoal or firewood can degrade, though in some cases it improves, habitat; and conversion of mangroves to aquaculture, agriculture, or coastal clam farming will result in the loss of environmental services. Ensuring that these overlapping use rights are defined and clear among all government and community stakeholders can reduce the threat of negative impacts. The open access nature of mangroves and changing economic incentives for coastal area use has been identified as a major threat and driver to mangrove conversion globally (Walters et al., 2008), as well as specifically in the Red River Delta (Adger & Luttrell, 2000).

FIGURE 1: PROPERTY RIGHTS REGIMES AND CONFLICTS IN MANGROVE CONVERSION IN QUANG NINH, NORTHERN VIETNAM



Source: Adger and Luttrell, 2000).

POLLUTION: Aquaculture occurs between the seawall and mangroves, and often relies on heavy organic inputs. Across Southeast Asia this has caused negative impacts on coastal water quality, harming agriculture, as well as leading to red tide algae blooms that threaten mollusk cultivation (Alongi, 2002; Eng, Paw, and Guarin, 1998). Additionally, pollution impacts on mangroves can occur where coastal industries are established. Ports and the steel and paper industries are some of the primary polluting industries in the Haiphong City area. While these impacts can threaten habitat, mangroves can also provide environmental regulating services by processing this pollution and increasing the quality of water around aquaculture farms, agriculture and coastal industries (Primavera, 2006; Valiela & Cole, 2002). These threats and benefits differ depending on species, currents and severity of the threat.

LACK OF SILVICULTURAL MANAGEMENT: As noted above, many mangrove areas are planted too densely for some ecosystem services, and the use of one to three species does not allow for natural succession to occur in mangrove forests, potentially leading to the loss of forests over time. There is mixed experience around the world on how well these densely planted monocultures provide long-term ecosystem services including for fisheries, coastal protection, new tree species establishing themselves, and pollution control. The monoculture forests have also been criticized because after 30 years of soil accretion, the mangroves may no longer be able to survive inland, and they will have no other mangrove species to fill the new ecological niche. The long-term establishment of mangrove forests may thus require additional planting of new species through time.

CREATION OF “NEW” LAND AND COMPETING LAND USES: Land reclamation is an active process in Vietnam, particularly around tourism development. Community members in Tien Lang District noted that, “We do not have any more land inside the seawall, we can only look to the sea for our future.” With this in mind, communities do not see mangrove forests as a stable long-term area of forests for the future, but rather as a dynamic system that is creating new land that can be used in the future. Mangroves have been used in Bangladesh to establish new land (Iftekhar & Islam, 2004), and it may be viable in parts of Vietnam. Therefore, competing land uses becomes both an incentive for planting mangroves (to create new land) and a threat to their long-term survival (by creating land). Spatial plans and clear regulations regarding how these rights can be administered and allocated must be developed.

Recommendation: Mangrove forests are dynamic systems and long-term visions should be developed to consider how mangroves will be managed after they are established, and whether they may ultimately be converted to other uses.

2.3 VALUATION OF MANGROVE SERVICES

2.3.1 Benefits

There are many ways to evaluate the benefits to human welfare of mangrove environmental services, and because the benefits are often localized there are important spatial variations on mangrove services. For example mangroves that provide coastal protection to an urban area will likely provide a much greater benefit than mangroves in a rural area. The challenge of valuation becomes how a change in the status of mangroves impacts a beneficiary’s well-being, and how much the beneficiary is willing to pay to avoid negative impacts or receive positive benefits.

As a result, two key challenges to understand are:

- the production function of how much service each hectare of mangrove provides; and,
- how much the service user/buyer/beneficiary is willing to pay for that service.

TABLE 2: ECOSYSTEM SERVICES, PROCESSES AND FUNCTIONS, IMPORTANT CONTROLLING COMPONENTS, EXAMPLES OF VALUES, AND HUMAN DRIVERS OF ECOSYSTEM CHANGE FOR MANGROVES

Ecosystem services	Ecosystem processes and functions	Important controlling components	Ecosystem service value examples	Human drivers of ecosystem change
Raw materials and food	generates biological productivity and diversity	vegetation type and density, habitat quality	US\$484–585·ha ⁻¹ ·yr ⁻¹ capitalized value of collected products, Thailand (Barbier 2007)	mangrove disturbance, degradation, conversion; coastline disturbance; pollution; upstream soil loss; overharvesting of resources
Coastal protection	attenuates and/or dissipates waves and wind energy	tidal height, wave height and length, wind velocity, beach slope, tide height, vegetation type and density, distance from sea edge	US\$8966–10 821/ha capitalized value for storm protection, Thailand (Barbier 2007)	
Erosion control	provides sediment stabilization and soil retention in vegetation root structure	sea level rise, tidal stage, fluvial sediment deposition, subsidence, coastal geomorphology, vegetation type and density, distance from sea edge	US\$3679·ha ⁻¹ ·yr ⁻¹ annualized replacement cost, Thailand (Sathirathai and Barbier 2001)	
Water purification	provides nutrient and pollution uptake, as well as particle retention and deposition	mangrove root length and density, mangrove quality and area	estimates unavailable	
Maintenance of fisheries	provides suitable reproductive habitat and nursery grounds, sheltered living space	mangrove species and density, habitat quality and area, primary productivity	US\$708–\$987/ha capitalized value of increased offshore fishery production, Thailand (Barbier 2007)	
Carbon sequestration	generates biological productivity, biogeochemical activity, sedimentation	vegetation type and density, fluvial sediment deposition, subsidence, coastal geomorphology	US\$30.50·ha ⁻¹ ·yr ⁻¹ †	
Tourism, recreation, education, and research	provides unique and aesthetic landscape, suitable habitat for diverse fauna and flora	mangrove species and density, habitat quality and area, prey species availability, healthy predator populations	estimates unavailable	

† Based on Chumra et al. (2003) estimate of permanent carbon sequestration by global salt marshes of 2.1 Mg C·ha⁻¹·yr⁻¹ and 23 September 2009 Carbon Emission Reduction (CER) price of the European Emission Trading System (ETS) of €12.38/Mg, which was converted to US\$2000.

Source: Barbier 2011.

One recent review study by Barbier et al. (2011) suggests that mangrove services could be worth in the order of \$14,000 - 16,000 per hectare per year, with the majority of benefits coming from erosion control. This analysis focuses on the uses by coastal communities; the majority of the valuation studies from this work are focused on Southeast Asia and may therefore be comparable with Vietnam, though this value is substantially higher than the valuation study below.

2.3.2 Costs

While it important to quantify the value of a service, the costs of establishing the service are also crucial. The costs of mangrove establishment and management, as well as the opportunity costs associated with their protection, are higher than in upland forest areas due to the issues identified above around

mortality, the age of seedling at planting, and the general difficulty of planting and protecting trees in water.

ESTABLISHMENT AND MANAGEMENT COST: Mangrove forests exact a cost on local communities and government, both in their establishment and their long-term management. At present, much of the cost of establishing new forests appears to be from the central government or the international donor community, and community members are paid for their labor in planting new forest



Mangrove plantations require significant investments to reduce wave action in newly planted areas.

PHOTO: MATT SOMMERVILLE/TETRA TECH

area. Globally there have been reports of paid labor taking little care in the planting of new mangrove areas, as they tend to be paid by the day or number of seedlings planted, not based on the success of the plantings, the new (additional) area coverage, or the diversity of habitat that it creates. As a result, and as observed in Haiphong, mangrove forests may be planted in extremely dense patterns, which provides fewer opportunities for the use of forests for livelihoods (mollusk collection). This pattern of overplanting is also encouraged by the seedling providers as a more densely planted forest results in greater profits.

Short-term management costs are also important to consider when planting mangroves. Direct planting of

seedlings in areas where there is high wave action risks high mortality; there are many protection measures that can be taken to create barriers out of bamboo poles or even concrete that help increase sedimentation and reduce exposure. These protective structures can be more expensive than individual trees.

The longer-term management costs for mangroves are poorly understood in the context of the Red River Delta. There are limited direct pressures on mangrove habitats at present. For example only minor use of mangroves for fuelwood or construction was reported in Tien Lang (though as the forest matures, construction pressures may increase). Overexploitation of mangroves for mollusks or other products is a distinct possibility, though more research is needed on the capacity of planted mangroves to provide products and appropriate management regimes for collection and fishing on the fringes. Competition for mangrove expansion areas as well as conversion to new uses are threats that must be addressed through broader spatial planning, regulations and management plans.

Management needs are likely to take the form of monitoring, decision-making, and adaptive management by a community or government organization. The costs associated with this relate to collecting information, developing operational management plans, organizing monitoring and enforcement, and encouraging transparent decision making. A PES scheme needs to address more than just the management costs to encourage a long-term sustainable PES with a motivated service provider.

OPPORTUNITY COST: While the benefits of mangrove services are shared across a wide number of stakeholders, the foregone benefits of converting mangroves to aquaculture, clam farming, or other economic uses is borne by a much smaller group of stakeholders, including:

- Families and companies with plans to develop aquaculture or clam farms. Aquaculture outside of the seawall is commonly limited to a small subset of families who may perceive a long-term interest in neighboring mangrove forests for future aquaculture expansion. Because they do not have existing rights to the forests, they are not explicitly bearing the cost of using land for mangrove forests. However, they may have the perception that their future access and ability to acquire contractual rights is infringed upon by mangrove protection activities.

- Government, which has the ability to receive tax revenue from conversion of mangrove areas to aquaculture and therefore could see mangrove management as a net loss.

These opportunity costs must be considered for long-term coastal forest management, as they are a major source of pressure on land use. As mangroves are established and ecosystem services are provided, the marginal benefit of each additional hectare of mangrove forest decreases and therefore the pressure to convert forest to alternative uses increases. This is particularly relevant in mangrove areas, as mangroves reportedly can become so successful in increasing sedimentation that over 30 years, as they march seawards, inland mangroves may no longer be viable.



Women are important resource users and potential managers in mangrove systems.

PHOTO: MATT SOMMERVILLE/TETRA TECH

2.3.3 Cost/Benefit Analysis

Nguyen, Adger, and Kelly (1998) identified the costs and benefits of coastal protection in Nam Dinh Province, suggesting an overall benefit of about \$420-520 per year per hectare (in 1998 dollars). While this positive benefit is encouraging, it must be compared to profitability of alternative land uses, e.g. the aquaculture sector. Additionally, Nguyen’s analysis focused on coastal protection in Nam Dinh Province, a largely rural/agricultural province along the coast, and it only includes seawall protection and not protection of the infrastructure inside the seawall as in Barbier’s analysis. The inclusion of coastal protection of infrastructure inside of the seawall would undoubtedly increase Nguyen’s analysis dramatically, and would be much higher in Haiphong than Nam Dinh.

Nguyen et al. (1998) highlight that an important part of seawall protection is a 25 to 30 percent reduction in seawall maintenance costs from the presence of a mature mangrove stand. Importantly, this analysis considers not only the economic benefits of the service (as Barbier’s analysis is limited to) but also the costs associated with providing the service.

TABLE 3: BENEFITS AND COSTS OF MANGROVE REHABILITATION IN VIETNAM

Impact or asset valued	Method and assumptions for valuation	Timing of costs and benefits
<i>Benefits</i>		
Timber benefits	Market data: Thinning (VND 180 per tree); extraction mature trees (VND 5 000)	Thinning and extraction from year 6 with 3 year rotation
Fish	Market data: Mean price of VND 12 500 per kg; yield 50 kg per ha.	Fishing benefits from year 2 after planting
Honey	Market data: Potential yield estimated at 0.21 kg per ha.	Honey collected from year 5 after planting
Sea dike maintenance costs avoided	Morphological model; costs avoided = f (stand width, age, mean wavelength).	Benefits rising from year 1.
<i>Costs</i>		
Planting, capital and recurrent costs	Market and labour allocation data: Costs of seedlings and capital (VND 440 000 per ha); Workdays valued at local wage in rice equivalent (VND 5 500 per day).	Planting costs at year 1; thinning from year 6 on 3 year rotation

Note: US\$1 = VND 11 000.

Source: Nguyen et al., 1998.

TABLE 4: COSTS AND BENEFITS OF DIRECT AND INDIRECT USE VALUES OF MANGROVE RESTORATION

Mangrove restoration in Vietnam: N.H. Tri et al

Discount rate	Direct benefits (PV million VND per ha)	Indirect benefits (PV million VND per ha)	Costs (PV million VND per ha)	Overall B̂C ratio
3	18.26	1.40	3.45	5.69
6	12.08	1.04	2.51	5.22
10	7.72	0.75	1.82	4.65

Notes: US\$1 = VND 11 000. B̂C ratio = NPV total benefits / NPV costs.

Source: Nguyen et al. 1998.

As will be discussed below, a particular challenge is in understanding the different service users/buyers who may contribute to this positive valuation, as well as the individuals/communities that provide the service. Barbier et al. (2001) note important management actions relevant to this valuation study, including:

- The need to consider mangrove valuation (and PES) within the context of coastal planning, and other coastal ecosystem, particularly sea-grass beds, dunes, and marshes;
- The need to allow local coastal communities legal rights to establish and enforce control over mangrove ecosystems and be involved in decision making; and,
- The encouragement of ecological restoration, including the financing restoration of mangroves in other areas by current coastal land users (industrial, ports, tourism, and aquaculture).

Recommendation: The net economic benefits of mangrove protection are positive, but aquaculture has a much higher profitability, particularly for government and existing aquaculture interests, if mangroves are considered alone. As a result, any mangrove PES scheme has to be based in part on regulations that limit the conversion of mangroves and influence attitudes to follow these restrictions. PES should be targeted toward those whose access/benefit streams are restricted, and those who are undertaking management actions on the ground.

3.0 SERVICE PROVIDER AND CONTROL OVER SERVICE PROVISION

Rights to resources are central elements of structuring effective PES systems, particularly as it relates to sellers/service providers. Service providers in a PES should, in theory, be focused narrowly on the people whose right (de facto or statutory) to use or convert a resource is being affected, or who are undertaking the effort to protect the resource; any other payments may be used to influence attitudes but are not resulting directly in service provision. In the design of a PES system, there is rarely a single service provider with full rights to make decisions on management, exclusion, and transfer. Instead there may be a complex relationship between:

- users of the resource;
- local government and/or community members who nominally manage the resource on a daily basis; and,
- national or provincial government that establish rules around the use of resources (which may or may not be followed, monitored, or enforced).

Where a service provider has clear and enforceable rights, a positive incentive through a PES system may be an appropriate intervention. However, where providers do not have recognized rights (either statutory or de facto), PES is not likely to be an appropriate option on its own, as paying a provider for not breaking the law is a morally questionable approach. Rather in these cases it may make sense to initially recognize the rights of stakeholders (as highlighted by Barbier et al., 2011).

In the upland areas of Vietnam, these rights are defined through the interaction between forest legislation implementation and land law implementation. Rights and responsibilities are more ambiguous in mangrove forests because:

- Forest legislation is generally designed for upland forest management and not coastal forest management, and thus may not consider mangrove-specific pressures. As a result mangroves are almost entirely protected forests.
- Mangroves are mostly found outside of the coastal seawalls (at least in Haiphong Province) and are therefore often outside of the area that is subject to land use certificates, “red books.” Land law is somewhat ambiguous in the areas outside of the coastal seawall, in terms of the most appropriate ways to document rights of households and communities. This has led to the use of contractual arrangements between communes and districts. These contracts are not as structured or as formalized as the terrestrial land use certificates.



Commune-level government has an important role in supporting co-management arrangements.

PHOTO: MATT SOMMERVILLE/TETRA TECH

ROLE OF LAND TENURE IN VIETNAM MANGROVE PES

In Vietnam, given the interest of government in developing a functioning PES system, the concept of incentives has to be embedded in the existing legal and regulatory framework. Indeed, insecure land tenure has posed a significant challenge to functioning PES schemes alongside high transaction costs, high opportunity costs and local elite capture of benefits (Phuc, Dressler, Mahanty, Pham, & Zingeri, 2012). As a result, a functioning mangrove PES (or even long-term management strategy) must rely on supportive legal framework that clarifies rights, responsibilities and enforcement for natural resource management.

With respect to the role of tenure and property rights, Vietnam's transition to a market economy in the late 1980s and 1990s was accompanied by an opening of the forest sector and the establishment of the 1993 Land Law. The Land Law allowed farmers to access land use certificates to lease, inherit, and transact land. Households were also able to acquire title. However in many cases, particularly in the uplands, there were issues with individuals privatizing areas that had previously been used under a more communal access and led to an overlap of statutory and customary rights (Sikor & Tran, 2007).

As a result, if Vietnam chooses to recognize rights in the coastal areas through a more formal structure, it is important to ensure that lessons are learned from the experiences of land certification in upland areas. The establishment of community (perhaps at the district level) co-management bodies with legal authorities could be a useful approach that balances the individualization of mangrove forests, but also avoids a community open access policy.

Participation of community members in a coastal PES presents a challenge of defining community resource rights-holders. Various stakeholder groups use mangroves, from those who collect bivalves within the mangroves and mudflats to those with existing and potential future interests in aquaculture. Additionally, if mangroves are managed at the commune level then the rights of management and associated benefits may accrue at the commune level. However, these rights need to be discussed and negotiated.

There is a particular risk in PES of rewarding those with pre-existing power and rights to resources, as well as reinforcing historical inequities. Indeed, there are examples in Vietnam in upland forests where PES is incentivizing wealthier families to privatize individual rights to forests, which may exclude others (Phuc, Dressler, Mahanty, Pham, & Zingeri, 2012). On the one hand, this incentive approach creates clear responsibilities for a small group of people to manage an area, which also may help allow limited incentives to be adequate to influence monitoring and enforcement behaviors. However it also raises question of exclusion of the remaining members of the community and whether historical customary rights have negatively been impacted. The use of documented rights as the basis for PES schemes poses this risk, as often it is wealthier individuals in a community who have formal documentation.

In cases where there are overlapping rights, those with documented and spatially defined rights (like forest or mudflat boundaries), are likely be to given enforcement authorities over people who may have

Based on the assessment, many of the uses of mangroves were identified (e.g. fishing, mollusk collection, minimal use of timber and firewood), but the proportion of the population and their relative roles in terms of wealth and power in the community were not fully understood. The lack of land use certificates or protection contracts based on historical use rights in coastal areas makes it difficult to identify specific service providers from among the variety of users. Additionally, though management of a mangrove area may be devolved to the commune level by the Commune People's Committee (CPC), it is rarely the full commune (~10,000 people) that is engaged in mangrove use or protection, or management of neighboring aquaculture lands.

In these areas, the calculation of an appropriate incentive for ecosystem management is further complicated by differences in de facto and statutory rights. For example, though the law may prohibit or require permits to commercially harvest wood or clear forest, the customary norms may allow these practices. As a result, service providers may perceive their de facto rights to be strong, but still require a positive incentive to counterbalance lost opportunities.

general use rights to collect products. It is important that as PES rights are established, the overlapping rights framework and the relative impact of each activity on the resource should be considered.

TABLE 5: POTENTIAL SERVICE PROVIDERS

Service Provider & Justification	Impact on Service Provision	Challenges
Subsistence Users: Long-term de facto use rights	Their use may be regulated to avoid overharvesting, but they would not have been expected to negatively impact forest. They may be among the most effective at monitoring status.	Identification of individual users is difficult, and changes over time. Not a well-organized grouping and power to enforce is likely limited. Difficult to target payments.
Individual Households: Possible to provide household forest protection contracts that clearly define rights and responsibilities	Monitoring responsibilities can be clearly defined and targeted. Likely to be the most cost effective because targeting payments to few individuals.	Enforcement would have to rely on government. Concerns of elite capture in how protection rights are allocated.
Coastal Villages: Lack explicit rights, but proximity means they can influence management, likely overlap with subsistence users	Best suited to enforce and make rules over resource use, if supported through co-management arrangement.	Not necessarily organized legally as a management unit with explicit rights to mangrove forests. Payment distribution likely to result in elite capture.
Commune/ District Govt: Has management rights over coastal area	Decides on allocation of management rights and responsibilities. Allocates contracts CPC. Has some monitoring ability.	Payment to government is less of a PES and more of a tax and regulate system. More likely to take an administrative fee for PES transactions.
Full Commune: Has rights over the area through the commune government	Limited impact beyond the coastal villages.	Too many people (10,000 per commune) with too little direct impact on the service.
Aquaculture Farmers: Directly adjacent to mangrove areas and may have some land use certificates over mangrove areas	If aquaculture farmers have rights over neighboring forests, they could be paid to forego those rights, as in a conservation easement. They may be paid to forego their rights to restore mangroves.	Aquaculture rights were purchased over recent decades and it may not be socially appropriate or legal to pay them to change their land use to forest.
Central Government: Established rules around mangrove protection and finances enforcement	Legal framework, but daily management is devolved.	Same as with Commune/District Government.

A tension exists between:

- approaches that individualize forest tenure into households that can clearly monitor and enforce rights (to the exclusion of others in the community);
- approaches that are more community-based, but will also reduce the amount of payments that incentivize any given household; and,
- approaches that place all management authority in the hands of government.

In general, a household approach can be used where populations are low, or where communities are not particularly cohesive. A community approach may be more viable where there is a history of communal management of an area, or where there are complex and overlapping groups involved in resource use (often resulting in local level conflict). A government-centric approach may be more viable in urban areas such as Haiphong City, though this would most likely not be organized as a PES.



Collection of clams is one of the many important livelihoods activities that can be improved through mangrove management.

PHOTO: MATT SOMMERVILLE/TETRA TECH

density in Tien Lang and Haiphong, a more community-focused approach is likely more appropriate.

Based on Table 1 and the analysis above, co-management approaches through coastal villages are likely to be the most appropriate structure for a PES system around mangroves in Tien Lang. Coastal villages would have to apply for rights to forests, perhaps through protection contracts or community forest agreements. It is not clear whether the communities would have to register as an entity or management association prior to applying for this management right.

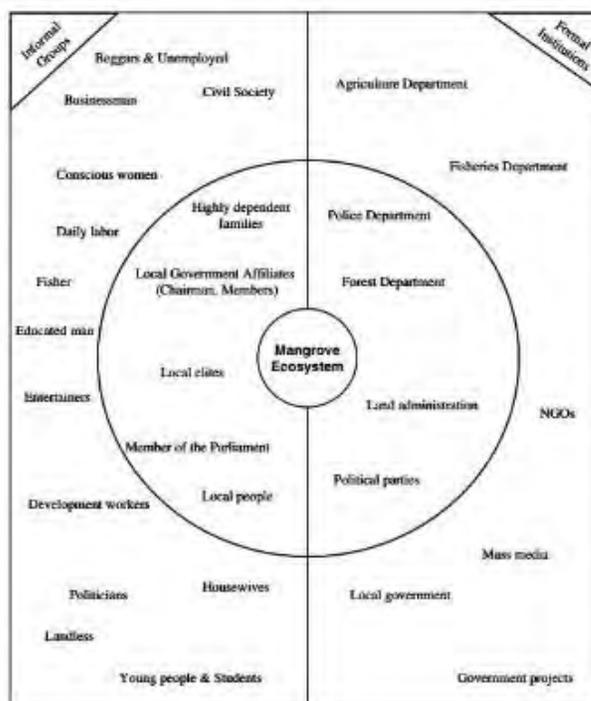
Role of Subsistence Users: While there would be a role for subsistence users in such a scheme, they are simply too difficult to target with payments and their power to monitor for compliance and subsequently enforce is limited. These users could be employed through the co-management structure for their monitoring capacities, but would have to rely on a more formal structure to support enforcement. In cases where historical individual/household rights have existed or where all households surrounding an area can be included contracting with individual households may be a more viable and successful structure (Tran, van Dijk, & Visser, 2014). However, given the population

Recommendation: A mangrove PES system should be able to adapt to a community-based or a household-based approach; however, the decision should be taken at a district level, rather than mixing the two approaches within a single jurisdiction. A mangrove PES scheme could be divided into plantation incentives, primarily through government and subsequent management payments.

Additionally, before carrying out a PES scheme it will be important to examine the impacts of each stakeholder group on the state of the forest resource (Iftekhar & Takama, 2007). Figure 2 is a diagram that highlights a process used in Bangladesh to map the importance of various stakeholder groups to the environmental service outcomes of mangrove forests; it underscores the range of impacts that any given stakeholder has on the environmental outcomes of a PES management system.

FIGURE 2: MAJOR STAKEHOLDER GROUPS FOR MANGROVE ECOSYSTEM MANAGEMENT IN NIJHUM DWIP ISLAND, BANGLADESH

Fig. 12 A schematic diagram on the major stakeholder groups for management of the mangrove ecosystem in Nijhum Dwip Island. *Source:* Structured interview of 110 households and seven group meetings in the Nijhum Dwip Island executed during June–July 2006. The respondents were asked to identify five most important stakeholders who are or might be involved in forest management. Here, the names inside the circle indicate the groups/institutions with direct strong influence on the forest. Others outside the circle indicate those having indirect influence on the forest.



Source: Itfekhar & Takama 2008.

3.1 TRANSACTION CONSIDERATIONS FOR SELLERS

3.1.1 Production Function

A strong PES system will provide a service where the actions of the service provider have a direct and measurable link to the quality and quantity of the service, or where the quality of the service can be measured with a high degree of accuracy. The strength of this relationship differs depending on the service. For example, forest carbon values between a standing forest and cleared land can be measured (though the counter-factual of how much deforestation would there be in the absence of an intervention is more controversial). While the production function is important in the design of a PES, a logical and easily understood environmental service may be viable even if the science is not conclusive. For example, the science on the relationship between water quality and forest cover remains contested though countries, including Vietnam have been successful at developing PES systems (Kinzig et al., 2011).

TABLE 6: EVIDENCE BASE OF THE PRODUCTION FUNCTION DEVELOPED BASED ON GLOBAL REVIEWS

Environmental Service	Evidence base
Coastal protection from waves	Strong and measurable, dependent on location
Treatment of shrimp farm effluent	Medium and measurable, but based on location
Creation of new land	Strong and measurable, extremely dependent on location
Reduction of erosion	Strong and measurable, extremely dependent on location
Habitat and fish nursery for stocking	Dependent on the structural complexity of the mangrove forests

Carbon	Strong and measurable, counterfactual is the main challenge
Habitat for mollusks and other species for collection	Strong and measurable, depends on initial populations
Timber and fuel wood	Strong but not extremely important in Vietnam context
Tourism	Strong, but mangroves may contribute to or detract from tourism

Sources: Primavera, 2006; Boseire et al., 2008; Mazda et al, 2008.

Based on Tables 1 and 6, there is strong scientific evidence on the relationship between mangrove forest cover and the overall environmental service provision. It is up to government and local stakeholders (buyers and sellers) to decide which of these services are worth bundling together to develop an incentive.

3.1.2 Existing Forest Management Incentives

There are existing incentives that influence the establishment and protection of mangroves and which must be considered within a PES system. Mangrove establishment is already a government priority and with international donors there are ongoing efforts to expand mangrove forest coverage with an estimated \$120 million worth of funding in 2011 (MFF, 2011). If a PES scheme is used to incentivize the planting of mangroves, it should be integrated into this broader government promotion. Care must be taken to avoid “double-counting” and paying stakeholders twice for the establishment of a single area of mangroves.

Forest conservation incentives are also currently administered by government through the Ministry of Agriculture and Rural Development (MARD), where households are paid 200,000 – 400,000 Dong per hectare per year through management contracts. Mangrove forests are currently paid at 200,000 per year, while upland forests receive 400,000. While undoubtedly welcomed by the households with monitoring contracts, these amounts cannot compete with the value of alternative use of mangrove areas. It is also unclear whether these costs are fully consistent with the costs that would be needed to monitor and enforce sustainable mangrove management.



Monitoring is one of a number of activities that conditional payments can be based upon.

PHOTO: MATT SOMMERVILLE/TETRA TECH

Recommendation: Opportunities to bundle PES payments with these existing forest management contracts should be explored in order to raise the potential incentive for mangrove management. However in the course of bundling it is critical that the service provider and buyer are clear and that the relevant responsibilities are aligned.

4.0 SERVICE BUYERS

Mangroves provide a broad range of services, and as a result there are a variety of users (potential buyers), not all of whom can afford to pay. Because of this diversity of beneficiaries of mangroves environmental benefits, the transactions to which a service fee could be added are diverse and difficult to consolidate in a single government managed or voluntary scheme. Mangroves also differ from upland forest PES schemes where buyers are often tens, hundreds, or thousands of kilometers away from the buyer and the watershed or carbon service that is being provided. Instead, in mangrove PES, the buyers and sellers are more often operating in direct proximity to one another. For example, with coastal protection, mangroves are protecting industry or aquaculture directly adjacent to the forest, and providing fisheries and water quality benefits in the nearshore coastal environment. This proximity means that developing a PES where revenues move through central, or even provincial, government is likely to reduce the efficacy of the system, as it will increase transaction costs and reduce the direct relationship between the buyer and seller, and thus the conditionality.

4.1 LOCAL COLLECTORS OF FOREST PRODUCTS

Local community members who use mangroves for livelihood and subsistence activities are an important interest group that act both as the beneficiaries of mangrove services and the service providers themselves. In such cases, the establishment of a PES does not make sense. However, given that they are a crucial interest group for successful management, their interests should be integrated into a PES co-management system through small user fees/licenses. Such fees would be nominal and not intended to generate income, but rather clarify rights for these community members. Use fees could be based on the level of use of the mangrove forests. However, it is likely that this group would overlap substantially as the subset of the community that is involved in direct day-to-day management of controlling forest access and use.

4.2 FISHERIES AND AQUACULTURE INDUSTRY

The importance of mangroves to coastal fisheries is strong, but the impacts of any given mangrove area on the productivity and sustainability of a region's nearshore fishery is difficult to assess. As a result, the fisheries industry should be divided between those fishing for subsistence and local sale and those fishing for an external market, though these two groups may overlap. Local communities are beneficiaries of mangrove fisheries through their netting practices within and surrounding mangroves and their collection of mollusks within the mangroves. In this case there is no need to establish a PES, as there is no need, nor simple mechanism, to collect and distribute payments from this group, though as above with local collectors of forest products a licensing approach would be preferable.

Nearshore fishers may be charged environmental service fees associated with the benefits they receive from mangroves, in terms of protection of the vessels during storms (when they are docked within the mangroves), as well as for the fisheries benefits. These fees are likely to be relatively small, but could be collected associated with the permits provided by the CPC or District People's Committee for registering their boats locally. Some effort would have to be made to define the fishing grounds for the district and provide a method for excluding outsiders who have not paid a mangrove management fee.

Fishers and aquaculture actors may also be considered service providers as well as beneficiaries, if they are taking action to reduce impacts on mangrove forests and choose to manage their fishing based on sustainable catch models. As used in other parts of the world, a price premium model would act as a PES, where fishers (or collectors) are offered a slightly higher than market premium for managing



Nearshore fisheries benefit from mangrove protection and may pay license fees to support mangrove management.

PHOTO: MATT SOMMERVILLE/TETRA TECH

organize and can be expensive to manage, particularly if an existing certification label is used. More research is required to understand who local fish processors are selling to and the interest/willingness of these markets to pay for mangrove-friendly products. Importantly, however, this type of PES system would be almost entirely outside of government engagement, except to the extent that whole districts or even a province are certified under a particular production regime.

Despite the importance of mangrove environmental services to fisheries and aquaculture, if a government-managed PES is attempted, it is likely more viable to establish payments based on the area of production (for aquaculture) or per vessel size (for fishing) rather than production overall. This is simply due to the challenge of monitoring productivity and sales for either industry.

4.3 PORT AND ECONOMIC ZONE

Ports have significant impacts on the environment. They are often based in estuaries and areas protected from direct wave impact. These areas are often historically associated with mangrove and other sensitive saltwater habitats. The development and maintenance of ports cause long-term changes to the landscape including contamination, frequent dredging, reclamation of land, significant waste and water quality issues that have impacts on humans and the environment surrounding them (Portopia, 2016). Community conflict with ports are common around the world, in part due to environmental impacts. Illegal dumping of hazardous materials is a particular threat that can have additional negative impacts to fisheries productivity and quality (e.g. UNEP, 2016a), as well as impacts on air pollution and local quality of life (e.g. UNEP, 2016b). Ports around the world have implemented fees associated with environmental protection and the application of such a fee could be a viable mechanism in Vietnam. However, discussions would need to be held with other port operators, as only applying such a charge

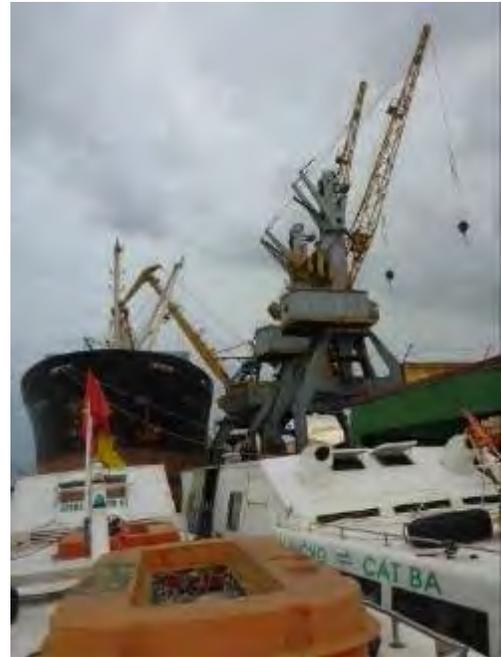
mangroves and fishing in sustainable manner. These price premiums have been offered by socially conscious food processors/buyers in other parts of the world. Products are then sold as “mangrove friendly” fish or prawns. In most cases these certification and price premium schemes are organized and carried out at the community level, but by a buyer that has an existing market, either domestic or global (Dinerstein et al., 2012). Such operations are extremely costly to

in a single port would create a competitive disadvantage. A particular advantage of working in part through ports is that they have a system that can be monitored and they have existing mechanisms to collect and distribute revenues. Additionally, vessels are already committed to paying docking fees, which makes collecting fees less challenging.

In addition to the impacts from ports, mangrove can also provide services to the port through protection of estuary areas. Fees related to environmental services can be attached to:

- Size of vessel;
- Efficiency and other characteristics of the vessel;
- Time vessel is docked at port; and,
- Amount of water or other resources used while at port.

While none of these represent a direct link to mangroves, they do represent impacts on the coastal environment and each benefits from the coastal protection provided by mangroves. Vessels are able to pay more substantial but fewer fees than in other models, and more on a use basis since their comings and goings are easily monitored.



Haiphong port has significant impacts on the health of the coastline and generates significant economic activity for the region.

PHOTO: MATT SOMMERVILLE/TETRA TECH

4.4 INDUSTRY AND COMMERCIAL LAND USE

There are emerging options for commercial land users to pay an environmental service fee, based on the proximity of their business to coastal zones and the vulnerability of their infrastructure. Commercial coastal land users may be required to support annual mangrove establishment or management activities, as a financing mechanism for the coastal protection offered by mangroves. These commercial fees on top of existing land use fees though would likely contribute both to mangrove protection and other hard forms of coastal adaptation and flood control. As noted above, the challenge in this cases is to understand the production function of the ecosystem service (is the commercial land use actually protected) and to ensure the payment is contributing directly to the industry's protection. This issue of location of infrastructure and the role of mangrove establishment and conservation is crucial, as urban areas like Haiphong are often pressured to develop in existing vulnerable locations. Regulations and the risk of disasters are often not adequate deterrents to development in these areas that are often suitable for mangrove establishment. These fees could easily be collected through existing rates associated with land use certificates.

4.5 TOURISM OPERATORS

Tourism operators can benefit from mangrove ecosystems and in some cases compete with mangroves based on their preferred building sites. While mangroves are not often a draw for ecotourism activities, the presence of mangroves is preferable to aquaculture from an aesthetic perspective. Tourism operators may charge a bed levy or transport levy (for example to Cat Ba Island) focused on environmental service protection and management. Haiphong Province is an extremely important tourism destination in Vietnam both for the resorts in Do Son, as well as the karst islands around Cat Ba and access to Ha Long Bay.



Industrial aquaculture on Cat Ba Island (left) detracts from the potential economic value of ecotourism found on the island and in the bay (right).

PHOTOS: MATT SOMMERVILLE/TETRA TECH

The production function between the number of tourists and the impacts on the environment and coastal ecosystem is direct and there are emerging alliances to reduce environmental impacts around Cat Ba and Ha Long Bay. At

present, tourists are not charged in relation to their impacts on this environment. Yet Cat Ba Island receives between 1.2 and 1.6 million tourists per year. There are three options that would be feasible, in terms of willingness to pay and mechanisms to collect payments and generate millions of dollars per year:

- A fee associated with boat ferries to Cat Ba Island, which are only applicable to non-residents of Haiphong Province, could generate significant amounts of income and would be easily collected at the two main ports of entry to Cat Ba Island. A similar fee could be applied with a lower premium to access the Do Son Peninsula.
- A fee associated with visiting the National Park. At present the fee of less than \$2 per visitor is not adequate to fund basic park management. By increasing the fee for non-residents to a reasonable \$15-20 per person, the park would become self-sufficient and would generate additional revenue to support coastal protection outside of the park. This fee would have to be applied to both the terrestrial park entrance (which receives only 40,000 visitors per year), and to boats accessing the bay from Cat Ba Harbor, where the majority of tourists arrive.
- A tourism bed levy fee, which could be placed across the province, or restricted to resorts or locations with tourism zonation, would generate a significant amount of income. However, the administration of collecting such incentives from across all hotels would represent large transaction costs.

The relationship of linking boat ferries or visits to the National Park to environmental service payments presents a stronger case than a tourism bed levy, as the users/buyers (tourists) will be able to directly appreciate the relevance of mangroves to their experience.

4.6 GLOBAL COMMUNITY

The global community's interest in mangroves and coastal adaptation/mitigation will be most closely related to the carbon services and avoided impacts of storms and erosion. Financing for mangroves as a climate change adaptation intervention is not likely to be driven by a PES model but rather a development assistance model or through the Green Climate Fund. Mangroves as coastal mitigation, on the other hand, are potentially valuable for forest carbon mitigation funding, either through integration into Vietnam's REDD+ program or through project level REDD+ activities. Mangroves potentially store three times as much carbon as terrestrial forests (Fries, Richards, & Phang, 2015), and while the relatively small fringe forests of Haiphong will not be significant globally, they may be viable for small-scale forest carbon financing. Mangroves are a side note at present in Vietnam's Emission Reduction Program Document, due primarily to the location of the program in the North Central Coast of

Vietnam, which has very little mangrove coverage. However, this means that to date mangroves have not been prioritized within the framing of REDD+ in Vietnam.

4.7 SUMMARY OF BUYERS

The potential buyers of environmental service from mangrove systems are diverse and represent multiple revenue collection schemes. There would be a significant transaction cost to bill and collect revenues from each of these groups and structure a system to receive funds from across these groups. Only tourism has a fee and an existing revenue collection system that could easily be seen as an environmental service fee, because the benefits of mangroves are clear and visible during each transaction. Because most of the other transactions are likely to be bundled with existing annual payments or on top of a range of other fees (licenses, environmental service fees) the relationship between the buyer and the service of interest can easily be lost, thus reducing the motivational aspects of PES for the buyer. They are likely to perceive the payments as a simple tax.

TABLE 7: POTENTIAL BUYERS OF ENVIRONMENTAL SERVICES IN MANGROVE SYSTEM IN VIETNAM

Potential Buyer	Benefit	Ability to pay	Fee structure
Local Collectors	Fisheries, fiber, wood	Low	Use license, collected at commune
Nearshore Fishers	Fisheries, coastal protection	Low	Vessel license, collected at commune
Aquaculture	Coastal protection, water quality, nutrient cycling, seed	Medium	Price premium for sustainable product, collected through supply chain; or based on area cultivated, collected at commune or district
Ports and Economic Zone	Coastal protection, water quality, nutrient cycling	High	Environmental service fee, collected by port authority
Industry and Coastal Development	Coastal protection	High	Environmental service fee, collected through land use certificate rates at district level/province
Tourism	Recreation, aesthetic (in comparison to alternate use), habitat	High	Entry permit, collected at port or on boat or at park gate, or bed levy, collected through tax
Global Community	Carbon	Medium	Vietnam REDD+ Strategy or Jurisdictional project, collected at national level

Recommendation: Focus incentive payments at the province level on tourism based on entrance fees; port based on vessel docking; and, coastal industries through environmental service fees associated with land-use taxes. Ensure that local community co-management or commune has user fees for boats, collectors, and aquaculture, managed locally.

5.0 OPTIONS FOR STRUCTURING A MANGROVE PFES IN VIETNAM

Mangrove PFES face specific challenges to launching, based on the environmental service, potential service buyers, and potential service providers. There are policy and cultural barriers within the Vietnam context that will have to be considered for a mangrove PFES to be viable. This report did not address these barriers as these are best suited to national legal experts to consider.

5.1 WELL-DEFINED SERVICE

Mangroves offer a clear service of value to millions of people and thousands of businesses and communities along Vietnam's coast. This is part of the reason that their establishment has been incentivized over the past two decades. While coastal protection is a clear responsibility of government, some of these responsibilities have been devolved to communities to carry out and as a result it should be included explicitly as eligible for PFES.

5.2 CLEAR SERVICE PROVIDER

While the government establishes land use regulations and has funded much of the mangrove establishment through partnerships with the Red Cross and Women's Union, coastal communes, villages, and user groups are the day-to-day providers of mangrove-related services. Whole communes or districts are too large and diffuse to act as service providers and therefore a subgroup of a commune must take responsibility for mangrove management and service provision. These roles can be established through a co-management agreement, though additional clarity is needed on structures for developing and registering such a group for coastal forest management.

The model of parceling management contracts to individual households may be viable in some areas where population densities and community cohesiveness are low and mangrove areas are large. However, in the Red River Delta these types of household management contracts are likely to cause discontent, lead to a lack of landscape level management, place power in the hands of a few households, and limit access to legitimate users. The community management groups should strike a balance of being representative (inclusive of multiple user groups), accountable to the commune, and small enough to make management decisions and receive benefits. These groups will also be more likely than individual households to actively focus on the expansion of mangrove areas.

5.3 CLEAR SERVICE BUYER

Vietnam has too many beneficiaries of mangrove services through too many discrete pathways to develop a single payment mechanism as was applied in the upland PFES with water providers. A government regulated PES is not an efficient mechanism when service providers and buyers are in close proximity to the resource (as is the case with fishermen and aquaculture). As a result, at this level,

licensing of mangrove users and fishermen for their use of the forest may build a better understanding of local resource governance rules and management structures. Tourism, port, and commercial industries within coastal districts have been identified as three potential beneficiaries who will have to be coerced into paying environmental service fees through government regulation. Pathways exist to collect funds from these sectors, though the transaction costs will be high with each.

5.4 REVENUE MANAGEMENT

Revenues collected from mangrove PES should not move up to the national level as most of the services and providers/buyers are exclusively in the coastal areas. This will reduce transaction costs. The consolidation and accounting of these funds may present some challenges because they will come from multiple sectors. Planning at the provincial level should split the funding into tranches designed for expansion of mangrove forest and for management of mangrove forests. District-level forest management committees, along with MARD, would be responsible for proposing areas for mangrove expansion, and revenue could be transferred from the provincial level to the district co-management committees through the same contractual structure that MARD uses for its current forest protection payments.

5.5 PAYMENTS AS A MOTIVATION

There has been considerable concern globally that direct market valuation and pricing will lead to the commodification of environmental services. This suggests a direct competition between willingness to pay for environmental service provision and alternative uses. In the case of mangroves, it is dangerous to suggest that ES payments must offset the alternative uses, for example, aquaculture. Even with multiple benefit streams (carbon, coastal protection, non-timber forest products), it is unlikely that mangroves will be able to compete with aquaculture conversion or clam farming. A PES system in Vietnam's mangroves should be based around incentivizing behaviors associated with planting and managing mangrove forests, rather than offsetting opportunity costs.

5.6 CONDITIONALITY OF PAYMENTS

PES is based on conditional payments; if the services of coastal protection or carbon sequestration are not provided, the payments should not be made. However, in the case of mangrove forests in most cases the payments to the service provider will not be based on whether the forest meets its coastal protection function or whether fishery productivity increases, but rather on payment for measurable efforts. These efforts can include planting, early care, and longer-term indicators around management. This focus on effort poses a challenge to PES as a motivational tool. If a storm surge arrives that is larger than what the mangrove forest can attenuate and large-scale damage occurs, will the coastal industries be willing to continue to pay an environmental service fee? Does the government or any institution that facilitates the PES bear liability for lack of service delivery? Thus while the services provided by mangroves are very clear, under certain stresses they may not deliver the full service that is required. The risks associated with non-performance of mangroves must be accepted.

It is important to recognize that PES is not the only model for financing mangrove and coastal protection. Grouped risk insurance may also represent a viable incentive mechanism. A coastal flood risk insurance mechanism could offer premium discounts to districts with well-developed coastal mangrove and flood protection practices. These incentives can be used to lure industry to particular areas.

6.0 NEXT STEPS

These above results must be tested more deeply and may highlight areas of deeper discussions between potential service providers and buyers. In order to proceed, the Government of Vietnam may wish to:

- Consider changes to existing PES and forest laws that would allow for payments for coastal protection, and for PES revenue to stay within the province and for community co-management structures to receive revenue.
- Consider options to document rights to manage mangrove forests, including potentially establishing support mechanisms for user groups to organize as co-management units.
- Develop consistent mangrove planting contracts and mangrove management contracts that could form the basis for PES. These would identify metrics for mangrove management that payments could be based on and would define incentive mechanisms for planting through early survivorship and incentive mechanisms for long-term management.
- Begin dialogue with industry groups, particularly Haiphong port, around willingness to pay and structure mangrove payments; decide internally within government whether there is a willingness/interest to tax these industries with an environmental service fee.
- Consider with the Ministry of Natural Resources and Environment whether land rates can be increased for vulnerable industries in coastal areas.
- Consolidate evidence on production function for each hectare of mangrove.
- Consider pilots related to tourism PES in Cat Ba Island, and co-management and internal revenue management with user licenses in Tien Lang District.

REFERENCES

- Adger, W. N., & Luttrell, C. (2000). Property rights and the utilization of wetlands. *Ecological Economics*, 35, 75-89.
- Alongi, D. M. (2002). Present state and future of the world's mangrove forests. *Environmental Conservation*, 29(3), 331-339.
- Barbier, E. B., Hacker, S. D., Kennedy, C., Koch, E. W., Stier, A. C., & Sillman, B. R. (2011). The value of estuarine and coastal ecosystem services. *Ecological Monographs*, 81(2), 169-193.
- Bosire, J. O., Dahdouh-Guebas, F., Walton, M., Crona, B. I., Lewis, R. R., Field, C., Kairo, J. G., & Koedam, N. (2008). Functionality of restored mangroves: A review. *Aquatic Botany*, 89, 251-259.
- Bui, D. T., & Hong, B. N. (2008). Payments for environmental services in Vietnam: An empirical experiment in sustainable forest management. *ASEAN Economic Bulletin*, 25(1), 48-59.
- Dinerstein, E., Varma, K., Wikramanayake, E., Powell, G., Lumpkin, S., Naidoo, R., Korchinsky, M., del Valle, C., Lohani, S., Seidensticker, J., Joldersma, D., Lovejoy, T., & Kushlin, A. (2012). Enhancing conservation, ecosystem services and local livelihoods through a wildlife premium mechanism. *Conservation Biology*, 27(1), 14-23.
- Eng, C. T., Paw, J. N., & Guarin, F. Y. (1998). The environmental impact of aquaculture and the effects of pollution on coastal aquaculture development in Southeast Asia. *Marine Pollution Bulletin*, 20(7), 335-343.
- Ertfemeijer, P. L., & Lewis, R. (1999, May). *Planting mangroves on intertidal mudflats: Habitat restoration or habitat conversion*. Paper presented at ECOTON-VIII Seminar Enhancing Coastal Ecosystem Restoration for the 21st Century, Phuket, Thailand.
- Ewel, K. C., Twilley, R. R., * Ong, J. E. (1998). Different kinds of mangrove forests provide different goods and services. *Global Ecology and Biogeography Letters*, 7, 83-94.
- Fries, D. A., Richards, D. R., & Phang, V. X. H. (2015). Mangrove forests store high densities of carbon across the tropical urban landscape of Singapore. *Urban Ecosystems*, 19(2), 795-810.
- Fries, D. A., Thompson, B. S., Brown, B., Amir, A. A., Cameron, C., Koldewey, H. J., Sasmito, S. D., & Sidik, F. (2016). Policy challenges and approaches for the conservation of mangrove forests in Southeast Asia. *Conservation Biology*, 00(0), 1-17
- Iftekhar, M. S., & Islam, M. R. (2004). Managing mangrove in Bangladesh: A strategy analysis. *Journal of Coastal Conservation*, 10, 139-146.
- Iftekhar, M. S., & Takama, T. (2008). Perceptions of biodiversity, environmental services and conservation of planted mangroves: a case study on Nijhum Dwip Island, Bangladesh. *Wetlands Ecology and Management*, 16(2), 119-137.
- Kairo, J. G., Dahdouh-Guebas, F., Bosire, J., & Koedam, N. (2001). Restoration and management of mangrove systems – a lesson for and from the East African region. *South African Journal of Botany*, 67, 383-389.
- Kinzig, A. P., Perrings, C., Chapin, F. S., Polasky, S., Smith, V. K., Tilman, D., & Turner, B. L. (2011). Paying for ecosystem services – promise and peril. *Science*, 334, 603-604

- [MFF] Mangroves for the Future. (2011). Vietnam National Strategy and Action Plan 2011-2013. Retrieved from: <https://www.mangrovesforthefuture.org/assets/Repository/Documents/MFF-Viet-Nam-NSAP.pdf>
- [MARD] Ministry of Agriculture and Rural Development. (2015). Historical process of forest cover map generation and the description of the latest map review and activity data generation process. Vietnam National Forest Reference Level Development. Retrieved from [http://vietnam-redd.org/Upload/Download/File/Report_AD_En_13102015_\(ai\)_P_4911.pdf](http://vietnam-redd.org/Upload/Download/File/Report_AD_En_13102015_(ai)_P_4911.pdf)
- Mazda, Y., Magi, M., Kogo, M., & Phan, N. H. (1996). Mangroves and coastal protection from waves in the Tong King delta, Vietnam. *Mangroves and Salt Marshes*, 2, 127-135.
- Nagelkerken, I., Blaber, S. J. M., Bouillon, S., Green, P., Haywood, M., Kirton, L. G., Meynecke, J. O., Pwawlik, J., Penrose, H. M., Sasekumar, A., & Somerfield, P.J. (2008). The habitat function of mangroves for terrestrial and marine fauna: A review. *Aquatic Botany*, 89, 155-185.
- Nguyen, H. T., Adger, W. N., & Kelly, P. M. (1998). Natural resource management in mitigating climate impacts: the example of mangrove restoration in Vietnam. *Global Environmental Change*, 8(1), 49-61.
- Nguyen, Q. T. (2011). *Payment for environmental services in Vietnam: An analysis of the pilot project in Lam Dong Province*. Kangawa, Japan: Institute for Global Environmental Strategies.
- Pham, T. T., Bennett, K., Vu, T. P., Brunner, J., Le, N. D., & Nguyen, D. T. (2013). *Payments for forest environmental services in Vietnam: From policy to practice*. Bogor, Indonesia: CIFOR.
- Phuc, X. T., Dressler, W. H., Mahanty, S., Pham, T. T., & Zingeri, C. (2012). The prospects for payment for ecosystem services (PES) in Vietnam: A look at three payment schemes. *Human Ecology*, 40(2), 237-249.
- Portopia. (2016). European Port Industry Sustainability Report: Governance Fact Finding Study. Retrieved from: <http://www.espo.be/media/news/EuropeanPortIndustrySustRep2016-dimished.pdf>
- Primavera, J. H. (2006). Overcoming the impacts of aquaculture on the coastal zone. *Ocean and Coastal Management*, 49, 531-545.
- Sikor, T., & Tran, N. T. (2007). Exclusive versus inclusive devolution in forest management: Insights from forest land allocation in Vietnam's Central Highland. *Land Use Policy*, 24(4), 644-653.
- Sommerville, M., Jones, J., & Milner-Gulland, E. J. (2009). A revised conceptual framework for payments for environmental services. *Ecology and Society*, 14(2), 34
- Tran, T. P. H., van Dijk, H., & Visser, L. (2014). Impacts of changes in mangrove forest management practices on forest accessibility and livelihood: A case study in mangrove-shrimp farming system in Ca Mau Province, Mekong Delta, Vietnam. *Land Use Policy*, 36, 89-101.
- [UNEP] United Nations Environment Programme. 2016a. *Port assessment report: Cote D'Ivoire*. Retrieved from: <http://www.unep.org/conflictsanddisasters/UNEPintheRegions/CurrentActivities/C%C3%B4ted'Ivoire/tabid/289/Default.aspx>
- [UNEP] United Nations Environment Programme. 2016b. *Global clean ports initiative*. <http://www.unep.org/Transport/ports/>
- Valiela, I., & Cole, M. L. (2002). Comparative evidence that salt marshes and mangroves may protect seagrass meadows from land-derived nitrogen loads. *Ecosystems*, 5(1), 92-102.

Vatn, A. (2010). An institutional analysis of payments for environmental services. *Ecological Economics*, 69(6), 1245-1252.

Vietnam MAB National Committee. (2000). *Valuation of the mangrove ecosystem in Can Gio Mangrove Biosphere Reserve, Vietnam: Final report*. Hanoi, Vietnam: Vietnam MAB National Committee.

Walters, B., Ronnback, P, Kovacs, J. Crona, B., Hussain, S .A., Baodla, R., Primavera, J, Barbier, E., & Dahdouh-Guebas, F. (2008). Ethnobiology, socio-economics and management of mangrove forests: A review. *Aquatic Botany*, 89, 220-236.

Walton, M. E. M., Le Vay, L., Lebata, J. H., Binas, J., and Primavera, J. H. (2006). Seasonal abundance, distribution and recruitment of mud crabs (*Scylla spp*) in replanted mangroves. *Est. Coast. Shelf Sci.*, 66, 493–500.

Wunder, S. (2007). The efficiency of payments for environmental services in tropical conservation. *Conservation Biology*, 2(1), 48-58.

Wunder, S. (2015). Revisiting the concept of payments for environmental services. *Ecological Economics*, 117, 234-243.

Suhardiman, D., Wichelns, D., Lestrelin, G., & Chu, T. H. (2013). Payment for ecosystem services in Vietnam: Market-based incentives or state control of resources? *Ecosystem Services*, 6, 64-71.

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