

Assessment of the feasibility of applying payment for forest ecosystem services in Vietnamese mangrove forests

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ABSTRACT

Mangroves can play a major role in efforts to mitigate climate change through two pathways. These are (1) carbon sequestration following reforestation of areas where mangroves previously existed, and (2) protection of existing carbon stores in intact mangrove forests. There is considerable international interest in carbon mitigation by governments and businesses as a way of meeting emissions reduction targets, and this could result in significant investment in mangrove restoration and protection. This is likely to have positive benefits in terms of coastal protection, biodiversity protection and new economic activity. This project examined three aspects of mangroves related to the emerging carbon economy. There has been considerable (0.2 million hectares) mangrove restoration in Vietnam and this activity provides insights into the causes of project success or failure. A review of this restoration concluded that the failure of several past restoration projects in Vietnam could be attributed to poor species and site selection and lack of incentives to engage residents in long-term management. The economic, environmental and social aspects of mangrove-shrimp farming or aquaculture (MAS) systems in Ca Mau Province, Vietnam, were examined, and it was concluded that this approach allows the achievement of these multiple objectives. Whereas, most of the discussion around mangroves and their role in carbon management is at the international and national levels, implementation occurs at the local level. It was found that whereas local stakeholders had a reasonable understanding of climate change, they were less clear about carbon markets and the role that mangroves can play. This points to the need for new educational programmes. The study concluded that monitoring and verification systems for both carbon and biodiversity are essential to allow the resultant multiple benefits of carbon mitigation projects to be realised.

KEYWORDS

Carbon mitigation, forest restoration, co-benefits, Vietnam, mangrove forests



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HIGHLIGHTS

- Mangrove ecosystems are highly prospective for carbon mitigation.
- Carbon mitigation will also result in a range of environmental and societal co-benefits.
- Many landowners have a lack of understanding around mangrove carbon reforestation.
- Gaining payment for co-benefits requires clear metrics.

1. INTRODUCTION

Mangroves are the dominant vegetation in tidal, saline wetlands along tropical and subtropical coasts (Alongi, 2002) and provide several marine-based ecosystem services such as timber and food production, fish nursery maintenance, coastline protection, carbon storage and tourism (Barbier et al., 2011).

More than half of the global mangrove area has been lost (FAO, 2007) due to land conversion to aquaculture and agriculture, overharvesting and sea-level rise (Duke et al., 2007; Giri et al., 2015; Richards & Friess, 2015). The total global mangrove area was estimated in 2012 to be 14.7 million ha (Kauffman & Donato, 2012) compared to 19.8 million ha in 1980 (Valiela, Bowen, & York, 2001). The average annual rate of mangrove loss of 0.21%/year from 1996 to 2016 exceeds that of tropical and subtropical forests (IUCN, 2018).

This loss has important consequences, not only for the reduction in ecosystem services but also for overall carbon storage (Wylie, Sutton-Grier, & Moore, 2016). Mangrove loss has been calculated to contribute a substantial component (c. 3–19%) of the total global emissions from deforestation. However, investment in mangrove carbon projects may provide the capital for extensive restoration and protection efforts and thus reverse mangrove decline.

Mangrove restoration projects and programmes have been implemented in many countries, these

including projects in the 1950s in China and India (Kodikara, Mukherjee, Jayatissa, Dahdouh-Guebas, & Koedam, 2017). More recent examples followed the 2004 Indian Ocean tsunami (Kodikara et al., 2017) and the 2013 Haiyan typhoon (Barnuevo, Asaeda, Sanjaya, Kanesaka, & Fortes, 2017; Wolanski & Elliott, 2015). Vietnamese mangrove restoration projects commenced in 1975 following the end of the Second Indochina War (Hong, 2008), with considerable subsequent activity (around 0.2 million hectares) funded through both state and international programmes.

Payment for ecosystem or environmental services (PES) schemes are a market-based approach to forest conservation with the aim of reducing forest loss by incentivising land managers (Locatelli et al., 2014; Wunder, 2015). As described above, mangroves can provide a wide range of ecosystem services and hence, the potential for mangrove PES has become the focus of current and critical debate (Thompson, Clubbe, Primavera, Curnick, & Koldewey, 2014). Additionally, there has been work to determine how mangrove ecosystems can be included within existing policy frameworks, including mechanisms such as Reducing Emission from Deforestation and Forest Degradation (REDD+) and United Nations Framework Convention for Climate Change (UNFCCC) mechanisms (Herr, Pidgeon, & Laffoley, 2012).

The majority of PES forestry projects, however, concern terrestrial ecosystems, with little known

about how the PES approach can be applied to mangrove-dependent communities (Corbera, Brown, & Adger, 2007). Only 87 km² of mangrove forests worldwide are currently included in operational PES (Thompson, Primavera, & Friess, 2017), with this involving projects that focus on payment for carbon services (projects in Kenya and Madagascar and India (Wylie et al., 2016). Another mangrove PES in Thailand is related to tourism services (Jarungrattanapong, Mahasuweerachai, & Nabangchang, 2016). Twenty-nine countries, including Vietnam, formally pledged mangrove restoration activities as part of their response to the Paris Agreement of the UNFCCC (Herr & Landis, 2016).

Given the interest in incorporating mangroves into a PES framework and the considerable interest around carbon mitigation options using these ecosystems, this project centred on Vietnam, where there has been considerable activity related to mangrove restoration and the development of a PES framework. We considered that this work could provide insights into the implementation of mangrove carbon projects in the broader region. We thus examined the following:

1. The major insights gained from mangrove restoration projects in Vietnam, where over 0.2 million ha has been established through various funding mechanisms since 1975, and consideration of how the findings from this activity might relate to future carbon reforestation programmes;
2. The interplay between environmental, economic and social objectives for residents who participate in the protection of restored mangroves and engage in aquaculture (shrimp) production, and
3. The understanding of local communities around the carbon mitigation options from mangroves in the emerging carbon economy. This involved surveys in Ca Mau Province, Vietnam. Whereas much discussion is around international and national level treatment of carbon markets, mangrove carbon projects will be implemented locally, and this component directly examined the views from three stakeholder groups at the local level.

2. METHODOLOGY

The following are the main questions which were addressed. Each of these questions, and the methodology used, has been addressed in a formal publication.

1. How successful are mangrove restoration projects and programmes in Vietnam, and what are the main reasons for their success or failure (Hai, Dell, Phuong, & Harper, 2020)? This involved the examination of formal published outputs (50 papers), and also grey literature reports and project plans in English and Vietnamese.
2. To achieve sustainable management of mangroves in the long term, how can environmental, economic and social objectives be balanced for residents who participate in the protection of restored mangroves (Nguyen, Chu, Harper, Dell, & Hoang, 2022)? This involved a survey of 98 households in Ca Mau Province, with 3 contrasting systems involving shrimp farming and mangrove protection. The systems were (1) extensive shrimp farming without vegetation, (2) mangrove and shrimp (MAS) where the activities are integrated and (3) intensive shrimp farming.
3. Can payment for mangrove carbon service schemes be implemented as an incentive for local communities for mangrove protection (Nguyen, Dell, & Harper, 2023)? In this component, 73 interviews were undertaken across three stakeholder groups (potential sellers, potential buyers and intermediaries). The sellers included 40 households, five forest management boards, the buyers nine processing companies, eight intensive shrimp producers. and eight charcoal producers. The intermediaries comprised

three local authorities. Whereas much of the discussion is around international and national level treatment of carbon markets, mangrove carbon projects will be implemented locally, and this study directly examined the views from three stakeholder groups at the local level.

3. RESULTS AND DISCUSSION

Over the last three decades, there has been considerable investment in mangrove restoration programmes in Vietnam, resulting in 0.2 million hectares of mangroves being restored. For the first Project question, [Hai et al. \(2020\)](#) examined the effectiveness of mangrove restoration efforts and concluded that failure in some mangrove restoration programmes can be attributed to poor site and species selection and lack of incentives to engage local residents in the long-term management of restored areas. This review also suggests approaches to enhance mangrove restoration success, including improved matching of species with site types, having well-defined monitoring/reporting procedures, and instigating a co-management approach with local communities.

Examination of mangrove restoration project documents and discussions with local authorities revealed that there has been an acute lack of financial support for the management of restored areas after the initial establishment phase of 1 to 4 years. This is likely to have led to a decline in mangrove health and the failure of some mangrove restoration projects in Vietnam. One way to address this vexing problem is to empower local communities to be more engaged in long-term mangrove management. Therefore, for the second Project outcome, [Nguyen et al. \(2022\)](#) explored the development of the mangrove–shrimp farming system (MAS) in the Mekong Delta to protect mangroves by balancing economic, environmental and social objectives for local farmers who participate in mangrove protection. Ecosystem payment systems using shrimp rice systems had previously been explored in the Mekong Delta by [Loc, Diep, Can, Irvine, and Shimizu \(2017\)](#). Using household

survey data in Ca Mau Province, it is concluded by [Nguyen et al. \(2022\)](#) that integrating mangroves with shrimp farming can support multiple objectives. This is because the mangrove–shrimp farming system provides the higher rate of economic return of all shrimp farming systems in south Vietnam; is inexpensive to implement and run; provides less risk for producers as shrimp production is less exposed to risks from natural disasters and shrimp diseases; helps to conserve mangrove cover and habitat; and women are more involved in the mangrove shrimp farming system than other shrimp production systems. Thus, due to these economic, environmental and social outcomes, [Nguyen et al. \(2022\)](#) described this as a “triple-win approach towards sustainable development”.

A further strategy for the sustainable management of restored mangroves is to offer incentives for local communities ([Nguyen, 2021](#)). Payment for forest environmental services (PFES) is one way to support rural communities in managing forest reserves, and this scheme is well-known in Vietnam. However, payment for carbon forest services (C-PFES) is less known and, so far, has not been applied to mangroves in Vietnam. However, much of the discussion around mangroves and carbon is at the international and national levels. Simply put, the views of local communities where mangrove restoration projects are likely to occur have not been canvassed. Using interview data from potential sellers, potential buyers and intermediaries, [Nguyen et al. \(2023\)](#) investigated the feasibility of applying C-PFES for mangroves in Ca Mau province, Vietnam. Results for the third Project showed that farmers are generally aware of the impacts of climate change on their production and of how mangroves could help with environmental management. However, farmers had limited understanding of C-PFES or the carbon sequestration capacity of mangroves, and this presents a challenge in the future if C-PFES schemes are to be introduced. Only 29–56% of potential buyers were willing to participate in such a payment scheme. As carbon sequestration capacity of mangroves is an international ecosystem

service, C-PFES for mangroves in Ca Mau and elsewhere should involve the participation of private companies, government agencies and international investors. We recommend policy revisions to allow stakeholders at national and international scales to participate in C-PFES investment.

Prior to implementing C-PFES projects, it is essential that the carbon budget for mangroves be accurately determined. However, the carbon budget of mangrove ecosystems is complicated by attributing carbon accumulation to mangrove primary production, oceans and terrestrial sources. Nguyen (2021) notes that there is often a misperception between carbon storage and carbon sequestration, leading to an exaggeration of the role of mangroves in climate change mitigation. Therefore, instead of focusing on the single role of mangroves in sequestering carbon, co-benefits generated from mangrove ecosystems should also be integrated into restoration projects and programmes. Hai et al. (2020) demonstrated the clear deficiencies in the long-term monitoring of mangrove projects and the need to develop inventory systems to verify rates of carbon sequestration. This will be crucial in the running of any future carbon market. Similarly, measuring, reporting and verification is required for other environmental markets (e.g. biodiversity and marine habitats).

4. CONCLUSIONS

Overall, mangrove restoration is important in Vietnam and across the Asia-Pacific region, where deforestation is a critical issue. Although there are some successful mangrove restoration projects, many programmes in Vietnam have failed with a low survival rate. Besides developing a provincial and national monitoring system, providing incentives to local residents may provide a solution for the long-term management of mangroves. One approach is to promote mangrove-shrimp farming, which can generate a triple-win solution in environmental, economic and social aspects. Promoting payment for mangrove carbon services (C-PFES) with the participation of multiple buyers, including the private sector, government and international

investors, will increase livelihoods for local communities and protect mangroves. A key requirement, however, is for the different environmental services to be valued so that the benefits can be obtained by local landholders. Although carbon management is crucial in tackling climate change, mangrove preservation and restoration should be promoted in terms of carbon management and the delivery of co-benefits such as protection of biodiversity and marine habitats.

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