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# Keys to successful blue carbon projects: Lessons learned from global case studies



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## ABSTRACT

Ecosystem services such as protection from storms and erosion, tourism benefits, and climate adaptation and mitigation have been increasingly recognized as important considerations for environmental policymaking. Recent research has shown that coastal ecosystems such as seagrasses, salt marshes, and mangroves provide climate mitigation services because they are particularly effective at sequestering and storing carbon dioxide, referred to as “coastal blue carbon”. Unfortunately, degradation of blue carbon ecosystems due to anthropogenic impacts contributes to anthropogenic carbon emissions from land use impacts and prevents these ecosystems from continuing to sequester and store carbon. Given the impressive carbon sequestration and storage in coastal ecosystems, many countries with blue carbon resources are beginning to implement blue carbon restoration projects using carbon financing mechanisms. This study analyzed four case studies of projects in Kenya, India, Vietnam, and Madagascar, evaluating the individual carbon financing mechanisms, the project outcomes, and the policy implications of each. Strengths and challenges of implementing blue carbon projects are discussed and considerations that all projects should address are examined in order to develop long-term sustainable climate mitigation or adaptation policies. This analysis can help to inform future project design considerations as well as policy opportunities.

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## 1. Introduction

As anthropogenic climate change presents an ever-growing problem to the international community, policymakers have increasingly sought creative ways to reduce the human carbon footprint, including addressing land-use changes. Changes in land use, including deforestation and farming activities, comprise up to 20% of total global carbon emissions, and more so for many countries with uniquely high rates of deforestation [1]. In order to respond to this significant contributing factor of anthropogenic climate change, the United Nations Framework Convention on Climate Change (UNFCCC) has adopted policies to allow countries to account for gained and lost carbon emissions through land use change, both by including these emissions in national assessments and by providing mechanisms to fund and incentivize conservation projects [2].

Several recent studies have focused on the importance that coastal

ecosystems such as salt marshes, seagrasses, and mangroves have in mitigating climate change by acting as carbon sinks [3–8]. While these ecosystems only make up two percent of global area, studies have shown that these coastal ecosystems are both ten times more effective at sequestering carbon dioxide on a per area basis per year than boreal, temperate, or tropical forests [9] and about twice as effective at storing carbon in their soil and biomass [10]. The “blue carbon” service is only one of the important benefits these ecosystems provide along with shoreline protection, water quality improvements, building materials, and seafood [11].

Unfortunately, coastal blue carbon ecosystems have been lost at an alarming rate—an estimated one third of the global total lost over the past several decades [12]. This degradation is primarily caused by direct and indirect anthropogenic factors such as deforestation, increasing coastal population size and coastal development, agriculture and aquaculture, sedimentation and siltation, and effects of climate change such as sea level rise and extreme weather events [9]. When these ecosystems are degraded, they not only fail to act as carbon sinks, but also contribute to carbon emissions by releasing stored carbon into the atmosphere. With a global annual loss of blue carbon ecosystems between 0.7 and 7%

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annually, it is projected that these ecosystems are releasing between 0.15 and 1.02 billion tons of carbon into the atmosphere each year [12], contributing significantly to anthropogenic climate change.

In response to the significant negative effects of blue carbon ecosystem degradation, there is an opportunity to develop coastal wetland projects with the goal of mitigating climate change [13] and many groups are in the process of planning or implementing blue carbon conservation projects. In addition, the international community has begun to evaluate how these ecosystems can be more effectively included within existing policy frameworks, including carbon financing mechanisms such as Reducing Emissions from Deforestation and Forest Degradation (REDD+) and other UNFCCC mechanisms [2]. The goal of this study was to develop a database of many of the blue carbon projects around the world and examine in more depth which financing mechanisms appear to be working to support these coastal conservation and climate mitigation projects. Four case study projects were selected in Kenya, India, Vietnam, and Madagascar, exploring financing methods, outcomes, and policy implications of each project. Conclusions based on these case studies address the current best opportunities to facilitate future coastal conservation and climate mitigation projects to inform the broader international climate policy discussions and negotiations in order to make it simpler for countries with rich blue carbon resources to conserve and restore coastal wetlands while reducing carbon emissions.

## 2. Methods

The first step was to develop a larger list of projects that had a focus on blue carbon ecosystems and conservation (see Table S1, Supplemental online information). These four case studies were chosen based on availability of information as well as the type of financing mechanism the project is using or has attempted to use (in order to include a diversity of funding mechanisms) (see Table 1). Projects that were included are using or attempted to use carbon markets, and more specifically are using UNFCCC mechanisms such as REDD+ and the Clean Development Mechanism (CDM) or voluntary carbon markets, all of which are based on carbon offsets and credits. In developing each case study, a number of resources were used including personal interviews, project status reports and evaluations, and peer-reviewed studies.

Carbon markets for natural carbon sinks are based on the idea that carbon stored in these ecosystems can be quantified using scientific methods and can be sold as credits, which the buyer will then use to offset emissions. This method is also known as emissions trading. Carbon credits are verified by a certain “standard”, which includes accounting, monitoring, verification, and certification standards, and registration and enforcement systems. The credits are then sold either on the compliance market, in which parties such as national governments or industry members are required to reduce their emissions under a treaty (such as the Kyoto Protocol or the European Union Emissions Trading Scheme), or on the voluntary market, in which buyers voluntarily buy credits in an effort to be more sustainable [14]. It is important to note that credits verified under the compliance market can be sold on the voluntary market, but not vice versa [14].

UNFCCC mechanisms that utilize the carbon market, such as REDD+ or CDM, fall under the compliance market. CDM is a mechanism in which Annex I, or developed, countries under the Kyoto Protocol can implement development projects in non-Annex I, or developing, countries, and receive carbon offset credits for those projects. REDD+ is a mechanism that works similarly to CDM, but expands upon the land use sector in an effort to more effectively implement projects focused on reducing emissions from land use change. Alternatively, a blue carbon project could be financed by

**Table 1**  
Descriptions of the four blue carbon mangrove case studies.

Project	Location	Lead organizations	Funding organizations	Size	Is project including Soil Carbon?	Financing mechanism	Stage
Mikoko Pamoja	Gazi Bay, Kenya	Association for Coastal Ecosystem Services (ACES), Kenya Marine Fisheries Institute, Earthwatch Institute, Napier Edinburgh University, Plan Vivo	Kenya Marine Fisheries Institute, Earthwatch Institute, Napier Edinburgh University, Plan Vivo	117+ ha	No	Voluntary Carbon Credits – Plan Vivo	Implemented
Markets and Mangroves	Mekong Delta, Vietnam	SNV Netherlands, International Union for Conservation of Nature (IUCN)	International Climate Initiative, German Federal Ministry for the Environment, Building and Nuclear Safety (BMU), Minh Phu Livelihoods, Danone Fund for Nature	1715 ha	No	Natural Organic Shrimp Certification	Implemented
India Sundarbans Mangrove Restoration Project	Sundarbans, India/Bangladesh	Livelihoods, NEWS, Institute of Environmental Studies and Wetland Management		6000 ha	Yes	Voluntary Carbon Credits – VCS	Implemented
Blue Forests Madagascar	Ambanja Bay and Ambaro Bays, Madagascar	Blue Ventures	Blue Ventures	26,000 ha	Yes	REDD+ or Plan Vivo	Planning

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