

case
study



Mangrove plantation in Viet Nam: measuring impact and cost benefit

Overview

The International Federation of Red Cross and Red Crescent Societies (IFRC) is committed to enhancing the evidence base for community-based disaster risk reduction (DRR) interventions. In an effort to further highlight the impact, efficiency and sustainability of DRR interventions, an external evaluation was conducted on the community-based 'Mangrove Plantation and Disaster Risk Reduction' (MP/DRR) project in the disaster prone coastal provinces of northern Viet Nam. The evaluation assessed the project's performance and progress against set objectives and analysed the extent to which it has contributed to the building of safer, resilient communities. This case study will focus primarily on the evaluation's findings which provide a quantitative analysis of the project's benefits in the coastal provinces. In particular, it will examine how the:

- Project's output over the course of its 17-year implementation, directly or indirectly, increased the resilience of communities.
- Protective, economic and ecological benefits of the interventions outweighed the costs.
- Accrued benefits of the project will be sustained in the long-term, with particular focus on local capacity and ownership (in the absence of donor funding).

General context

Viet Nam, with its 3,260 kilometres (km)¹ of coastline spreads across seven different climatic zones,² is vulnerable to natural disasters including storm surges, flooding and droughts. Extreme climate variability increasingly threatens the country's coastal zones and extensive deltas. Viet Nam has a history of coping with extreme weather-related events, and is ranked amongst the most affected countries, both in terms of fatalities

¹ http://sdwebx.worldbank.org/climateportal/doc/GFDRRCountryProfiles/wb_gfdrri_climate_change_country_profile_for_VNM.pdf

² UNEP and IPONRE. *Viet Nam Assessment Report on Climate Change*. Ha Noi, 2009.

and economic losses.³ It is estimated that the country faces an average of six to eight typhoons annually⁴ – causing fatalities and wreaking havoc on infrastructure and the population's livelihoods. Climate-related vulnerabilities are key factors in undermining the country's sustained efforts in reducing poverty.

It is projected that the sea level in Viet Nam's coastal regions will rise between 65 to 100 centimetres by 2100.⁵ These projections are further supported by a recent report by the Intergovernmental Panel on Climate Change projecting an increase in sea levels along coastal areas due to climate variability.⁶ The impact on the coastal population from a one metre sea-level rise will be quite severe. It is projected that by 2100, 4.4 per cent of Viet Nam's coastal areas will be inundated, directly affecting six million people (7.3 per cent of the country's population).⁷

The coastal provinces in northern Viet Nam face a number of formidable challenges. Exposure to climate-related disasters and rising sea levels poses significant threats to and underlines the existent vulnerabilities of the coastal regions. This vulnerability is compounded by rapid population growth, coastal modifications and extensive land-use changes such as agricultural intensification and expansion, wetland conversion and urbanization, issues which were precipitated by the introduction of the Doi Moi, a series of economic reforms, in 1986. The Doi Moi, heralded substantial economic growth, notably, the period between 1990 to 2004 witnessed a tripling of the country's gross national product and saw the percentage of poor households decrease from 58 per cent in 1994 to 24 per cent in 2004.⁸ However, it should be noted that certain economic liberalization paradigms also propelled a significant decrease in mangrove forests to make way for the establishment of shrimp farms as well as for industrial and urbanization projects. This rapid expansion has had detrimental effects on the environment. The adverse environmental effects continue to be exacerbated by the increasing frequency of natural disasters in Asia, and the projected long-term impact of climate change, including increases in storms and sea-level rise.

Mangrove forests provide essential functions and services to coastal communities. These include acting as carbon sinks thereby mitigating the effects of climate change, providing nutrients for marine life and enhancing protection to coastal communities from associated storm surges and erosion, by capturing soil during periods of heavy precipitation thus stabilizing shoreline sediments. Additionally, "mangroves serve as a nursery and breeding ground for many reef organisms,"⁹ while they have also been sustainably used "for food production, medicines, fuel wood and construction materials."¹⁰ In an attempt to mitigate the impact of disasters, restoration and rehabilitation of mangrove forests have been a central focus of both governmental and non-governmental actors in the region. Afforestation was seen as a means to combat the loss of natural coastal protection by safeguarding sea dykes, reducing the risk of flooding and protecting livelihoods.

3 Germanwatch. *Global Climate Risk Index 2011*. Berlin, 2010.

4 http://sdwebx.worldbank.org/climateportal/doc/GFDRRCountryProfiles/wb_gfdr climate_change_country_profile_for_VNM.pdf

5 UNEP and IPONRE. *Viet Nam Assessment Report on Climate Change*. Ha Noi, 2009.

6 www.ipcc.ch/news_and_events/docs/srex/SREX_fact_sheet.pdf

7 International Centre for Environmental Management. *Rapid Assessment of the Extent and Impact of Sea Level Rise in Viet Nam*. Queensland, 2008.

8 *Ibid.*

9 <http://serendip.brynmawr.edu/biology/b103/f00/web3/hayesconroy3.html>

10 *Ibid.*

The Viet Nam Red Cross (VNRC) has been at the forefront of these activities since 1994, when its Thai Binh chapter launched the community-based MP/DRR project with the support of the Danish Red Cross (DRC). By 1997, after a series of successes the project was expanded to include another seven coastal provinces in northern Viet Nam. In support of VNRC's implementation of the project, the DRC expanded its coverage to Nam Dinh province, while the Japanese Red Cross (JRC) initiated funding to six provinces (Ha Tinh, Hai Phong, Nghe An, Ninh Binh, Thanh Hoa and Quang Ninh) through the IFRC. By the early 2000s, the project's focus was broadened to include disaster preparedness training and afforestation with bamboo and casuarina trees in communes along rivers. In 2005, DRC finished its part of the project, and JRC has funded activities in all eight provinces since.

Benefits of mangrove forests

Protective benefits

- Shoreline and river bank protection
- Reduced disaster-induced non-material losses (injuries, deaths)
- Reduced disaster-induced indirect (long-term) losses (reduced productivity due to saltwater intrusion or injuries)
- Shoreline stabilization (reduction of soil erosion)
- Reduced costs in sea-dyke maintenance and repair
- Reduced disaster-induced material losses (public infrastructure, buildings, crops, livestock, aquaculture)

Ecological benefits

- Carbon sequestration
- Nutrient retention
- Sediment retention
- Biodiversity habitat
- Flood attenuation
- Wastewater treatment
- Water supply and recharge

Project timeline

1994-1996	1997-2000	2001-2005	2006-2010
DRC Phase 1	DRC Phase 2	DRC Phase 3	IFRC/JRC Phase 3
Thai Binh	Nam Dinh, Thai Binh IFRC/JRC Phase 1	Nam Dinh, Thai Binh IFRC/JRC Phase 2	Ha Tinh, Hai Phong, Nam Dinh, Nghe An, Ninh Binh, Thai Binh

1994-1996	1997-2000	2001-2005	2006-2010
	Ha Tinh, Hai Phong, Nghe An, Ninh Binh, Thanh Hoa, Quang Ninh	Ha Tinh, Hai Phong, Nghe An, Ninh Binh, Thanh Hoa, Quang Ninh	Thanh Hoa, Quang Ninh

Project overview

Total project expenditure 1994-2010 (at original value)	8,885,000 US dollars
Number of direct beneficiaries of the project	350,000
Number of hectares of mangroves that exist today as a result of the project	8,961
Estimated length of sea dyke protected by mangroves	100
Costs in US dollars at present value to create one hectare of mangrove	843 US dollars
Numbers of communes in which trees were planted through the project	166

Methodology

The evaluation of the community-based MP/DRR project was carried out over the course of 20 days in 2011. A combination of both qualitative (focus group discussions, key informant interviews, site visits) and quantitative (data set analysis, household survey) approaches and tools were utilized. Primary data was gathered through field visits to 26 communes in six (Ha Tinh, Hai Phong, Nam Dinh, Nghe An, Ninh Binh, and Thai Binh) of the eight provinces covered by the project as well as through key informant interviews. Concerted efforts were made to include communes involved throughout the different phases of the project, while also ensuring that the various types of plantation (mangroves, bamboo, casuarina) were included in the sample groups. Furthermore, non-project communes were included as control groups. A total of 360 individuals were surveyed and were represented as follows:

- 50 per cent were planters in the project communes
- 25 per cent were non-planters from project communes
- 25 per cent were from the control group

On average, there were approximately 60 respondents per province.

Analysis

The evaluation assessed the project on three fundamental aspects: impact, efficiency and sustainability. Specific methodologies were designed for each of the three areas of evaluation. The following provides a brief overview of the analytical framework that was used and the challenges posed during the evaluation.



Approximately 100km of dyke lines have been protected by mangrove forests.

Analysing impact

In terms of impact evaluation, studies often juxtapose two scenarios: “a comparison between what happened and what would have happened in the absence of an intervention.”¹¹ However, due to constraints in availability of data and limited time, a longitudinal comparison was used to assess impact for this study. In analysing what happened, the evaluation first looked at the intended objectives of the project and the expected linkages between outputs and inputs within the economic, social and environmental contexts in which the project was being implemented. This understanding enabled the evaluators to assess the different levels and forms of actual impact of the project. Finally, to the extent possible, and given limited time and data availability, before and after comparisons of changes attributable to project intervention were conducted. This includes a comparative analysis on the protective impact of the mangrove forests in the Dai Hop commune. A longitudinal analysis was conducted of two level 9 typhoons which hit Dai Hop before and after 835 hectares (ha) of mangroves were planted. In 1987, the storm caused serious damage to a three km-stretch of the sea-dyke that needed to be repaired at a cost of 270,000 Swiss francs (CHF) (300,000 US dollars (USD)/218,000 euro (EUR)). Conversely, during the 2005 storm, the same dyke did not sustain any damage due to protective capacity of the mangrove forests.

Equally, the substantial protective impact of 1,010ha of mangroves planted in the province of Thai Binh was assessed through a longitudinal comparison of two level 11 typhoons that hit the commune in 1996 and 2006. In 1996, when the mudflats were mostly bare and only partially covered with newly planted mangroves, the typhoon caused severe damage to the sea-dyke, and four km of it needed to be repaired at a cost of CHF 360,000 (USD 400,000/ EUR

¹¹ IFRC. *Breaking the waves: Impact analysis of coastal afforestation for disaster risk reduction in Viet Nam*. Geneva, 2011.

291,000). In 2006, the dyke damage was much less severe; a mere 1.6km stretch needed to be repaired at a cost of CHF 162,000 (USD 180,000/EUR 131,000). The difference in damage of CHF 198,000 (USD 220,000/EUR 160,000) can be attributed to the project. Damage to private property was even more significantly reduced: whereas 90 per cent of shrimp farm value was destroyed in 1996, (total damage of CHF 5.1 million ((USD 5.7 million/EUR 4.1 million)) only 25 per cent were swept away ten years later (total damage of CHF 714,885 (USD 793,260/EUR 577,000).

Analysing efficiency

In order to measure efficiency of the MP/DRR project, a cost-benefit analysis (CBA) was conducted. The basic premise of a CBA is to “identify and quantify all expected or witnessed benefits B as well all related costs C and then divide B/C to calculate the benefit/costs ratio (BCR). Generally, where the benefits are greater than costs ($B > C$ and thus $BCR > 1.0$), there is a positive benefit-cost ratio and thus a case for suggested or implemented intervention.”¹² The evaluators took into account the general limitations of conducting a CBA. These include the difficulty in assessment of non-market impacts (i.e., health, environment, environmental externalities, etc.) as well as ethical questions surrounding value of a human life saved. Moreover, limitations regarding time and scale were also taken into account.

This particular CBA focused on assessing efficiency related to protective, direct economic and ecological benefits as well as dis-benefits (i.e., a decrease or loss in income due to stoppage in economic activities in order to allow for mangrove plantation).

This CBA conducted an analysis on quantifiable impacts. Based on data gathered, fixed and variable costs identified for this project included overall administrative overhead, awareness-raising campaigns in targeted communes, training as well as costs associated with planting and protection of mangroves. Costs and benefits were then modeled over the lifetime of the project. For the purposes of this study, the timeframe for costs and benefits were extended until 2025, as this is the projected lifetime that the project is expected to accrue to the communities. A discount rate of 7.23 per cent (reflecting average inflation rate between 1994 and 2010) was used in the calculations of protective benefits. Annual probabilities for the occurrence of typhoons and floods were also taken into account.

Analysing sustainability

Primarily, qualitative methods – focus group discussions and key informant interviews – were used to assess the sustainability of the project, that is, the capacity to continue the benefits of the project once it has been phased-out. However, findings from the quantitative household surveys were also used to assess sustainability. The purpose of this analysis was to gauge the sense of local ownership as well as other factors that influence the continuity of accrued benefits (i.e., financial, organizational, formal, behavioural and managerial aspects).

¹² *Ibid.*

Global findings

The evaluation's findings note that globally the project has had a significant impact both towards a reduction of disaster risk and an enhancement of communities' livelihoods. The overall costs for the project spanning 17 years stands at CHF 7.99 million (USD 8.88 million/EUR 6.46 million). This investment has translated into the creation of 9,462ha of forest (8,961 of them mangroves) in 166 communes and the protection of approximately 100km of dyke lines. It is estimated that approximately 350,000 beneficiaries were reached directly by the project's intervention, while another two million were indirectly protected through the afforestation efforts. Comparing the damage caused by similar typhoons before and after the intervention, the evaluation has found that damages to dykes have been reduced by CHF 73,000 (USD 80,000/EUR 59,000) to CHF 270,000 (USD 295,000/EUR 218,000) – savings which represent less than the costs for mangrove planting. However, total savings due to avoided risks in the communities at large were found to be quite substantial, standing at approximately CHF 13.7 million (USD 15 million/EUR 11 million).

Mangroves have also had a positive impact on the provision of additional income for coastal communities through an increase in per hectare yield of aqua culture products such as shells and oyster by 209-789 per cent. Direct economic benefits from aqua product collection, honeybee farming, etc., are found to be between CHF 310,000 (USD 344,000/EUR 250,000) to CHF six million (USD 6.7 million/EUR 4.8 million) in the selected communes.

The significant ecological benefits of the project should be noted – the present value of estimated minimum CO₂ emissions absorbed by the planted mangroves stands at CHF 196 million (USD 218 million/EUR 159 million), assuming a price of USD 20/t CO₂e.¹³

The BCR calculations indicate that mangrove afforestation has been extremely efficient. A BCR greater than one is considered economically “worth it.” The evaluation conducted two types of BCRs:

- BCR1: excluding ecological benefits amounts to three in the 68 in communes studied.
- BCR 2: including ecological benefits – which have yet to be materialized – comes to values between 28 and 104 in communes studied.

¹³ The price point around which real price fluctuated at the time of study is taken from European Union Emission Trading Scheme for the period 2007-2010. As such it reflects the higher price band of carbon now. No safeguards have been discounted in using total carbon capture estimates.

Estimated benefits and costs in selected communes 1994-2025

Commune	Dai Hop	Thai Do	Nam Thinh	Giao An	DienBich
District	KienThuy	Thai Thuy	TienHai	GiaoThuy	DienChau
Province	HaiPhong	Thai Binh	Thai Binh	Nam Dinh	Nghe An
Population	10,955	6,087	7,240	10,496	10,521
Sea coastline (km)	3.9	5.5	5.9	3.2	3.5
Dyke line (km)	4.0	7.5	5.9	3.2	3.5
Timeframe of planting	1998-2005	1994-2005	1997-2005	1997-2005	1998-2005
Planting input (ha)	835	1,010	1,287	2,403	145
Planting output (ha)	450	900	380	678	100
Planting-related costs, USD	425,866	858,373	362,424	646,641	95,374
Protective benefits, USD	676,868 ^C	15,330,243	n.a. ^D	37,818,545	n.a. ^E
Direct economic benefits, USD	628,094	672,436	4,799,476	6,748,533	344,931
Ecological benefits, USD	10,989,000	32,730,828	12,307,055	23,308,814	3,437,879
Total identified benefits, USD	12,293,962	48,733,507	17,106,531	68,375,892	3,782,810
Benefit/cost ratio 1 ^A	3.06	18.64	13.24	68.92	3.61
Benefit/cost ratio 2 ^B	28.86	56.77	47.20	104.96	39.66

Note: A: Excludes ecological benefits. B: includes ecological benefits. C: Protective benefit concern only the reduced damages to the sea-dyke. D: Protective benefits were identified but could not be validity attributed to the project. E: Protective benefits were identified but could not be quantified.

With regard to sustainability, the evaluation notes that there is strong local ownership towards plantation and maintenance of mangrove forests. Equally, there is strong support and commitment on the part of the government to sustain these efforts. However, specific challenges to long-term sustainability include the need for greater coordination for long-term planning between the VNRC, the Ministry of Agriculture and Rural Development and the Ministry of National Resources and Environment. Moreover, there is a need for the VNRC to improve the capabilities of staff and volunteers.

Conclusion

Overall, mangroves have proved to protect dykes and coastal communes well – the added protection for private assets, in particular those located between mangroves and dykes, is found to be extremely valuable. The project is seen as highly efficient in that it has generated benefits in great excess of its costs. Mangrove afforestation is seen as a comparably more efficient way to protect coastal communes than other tools – not only because it is cheaper per se, but also because it offers benefits other tools fail to offer (direct economic and ecological benefits, protective benefits for assets located outside the sea-dyke).

The community-based MP/DRR project has led to remarkable achievements that improved the protection of dykes and left coastal communities better prepared to cope with disasters. The fact that more than a quarter of all existing mangroves in the eight northern provinces are due to the VNRC project speaks for itself. Mangrove afforestation can be an efficient and effective tool for disaster mitigation and enhanced livelihood as well as for the mitigation of climate change.



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