UN HABITAT

3.1 MANGROVE PLANTATIONS FOR IMPROVED COASTAL RESILIENCE

MANGROVE PLANTATIONS FOR IMPROVED COASTAL RESILIENCE

INTRODUCTION

Problem statement

Mangrove ecosystems are rapidly declining in many parts of the world. This has resulted in the loss of important environmental and economic products and services including agricultural products, flood mitigation and nursery grounds for fish.

Deliverables	Delivery of mangrove plantation for coastal resiliency
Beneficiaries	17,754
Budget	$208,704 (USD)
Location	All Communes

Consultations with local communes in Kep Province and Prey Nob District have identified that coastal communities are being impacted by climate change and its effects on the coastal environment, leading to the serious consequences for local people. The identified environmental impacts listed below can be attributed to a combination of declining mangrove ecosystems and/or insufficient coverage by existing mangrove reserves and the impacts of climate change:

- Significant reduction in fish levels for local fishermen and women;
- Coastal erosion leading to loss in coastal agricultural land and damage to coastal infrastructure;
- Storm surges resulting in salt water ingress into the local agricultural land and surface water, resulting in decreasing agricultural productivity and surface water availability;
- Reduced resilience of houses in the coastal area to flooding and high winds, contributing to potential loss of life and property damage.

This investment will plant mangroves along the coast in Prey Thom, Kep Pong Teuk and Angkaol Communes in Kep Province and Prey Nob Commune in Prey Nob District establish mangrove protected areas in these locations.

The case of environmental and socio-economic benefits for this investment are strong: as per the International Federation of Red Cross and Red Crescent Societies (IFRC) study dated 2011 *Mangrove plantation in Viet Nam: measuring impact and cost benefit* the plantation of mangroves over a 30-year period is estimated to provide benefits per hectare of mangrove plantation 28 to 104 times the initial establishment costs.

Location

The selected locations for mangrove plantation in this investment are all in area classified as 'state public land', and thus do not impact private land, but provide protection to land behind the plantations as well as preventing coastal erosion, and supporting marine biodiversity through increased fish and crab spawning areas.

Land maps below are coloured based on the anticipated chance of that proposed plantation will achieve all criteria within the Mangrove Planting Management Plan and be targeted for plantation:

Green – target areas for the project where there will strengthen the existing mangrove plantation

Yellow – Proposed new mangrove plantations, supported by the project

Red – alternative locations for mangrove plantation if the situation of land ownership or suitability for plantation of the yellow areas changes between now and the start of the project implementation

- Green: Areas indicated in green are areas where mangrove plantation is expected to be achieved with a very high probability of success;
- Yellow: Areas indicated in yellow are areas where mangrove plantation s expected to be achieved with a high probability of success;
- Red: Areas nominated in red are areas where mangrove plantation is expected to be achieved with a moderate probability of success.

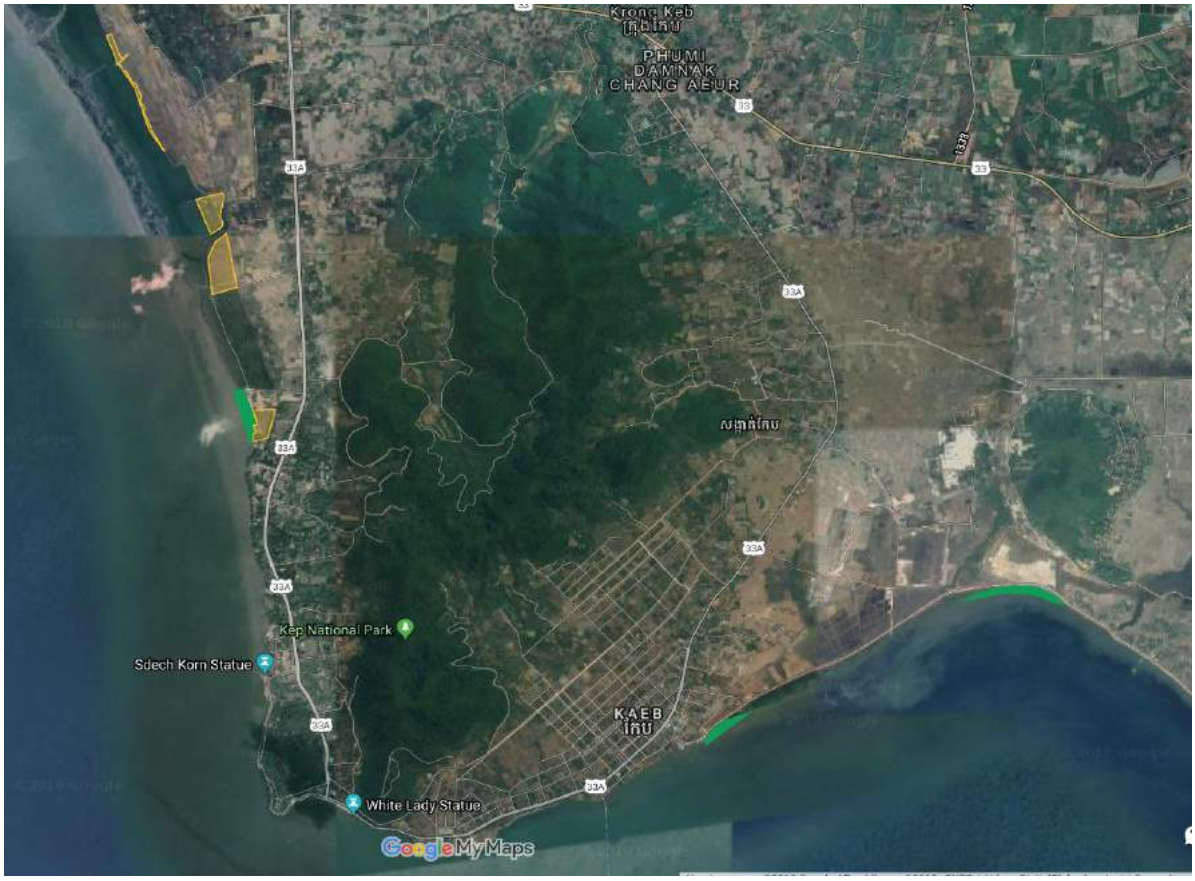

Figure 1 *"Proposed location for the mangroves in Kep Province"*

Figure 2 "Proposed location of mangroves in Angkaol District"

Figure 3 "Proposed location of mangroves in Prey Nob District"

Beneficiaries

Key beneficiaries include:

BENEFICIARIES	REASON	QUANTITY	COST/ BENEFICIARY
Local Fishermen	Improved fishing yields resulting from the improved marine ecosystem. As per the International Federation of Red Cross and Red Crescent Societies (IFRC) study dated 2011 *Mangrove plantation in Viet Nam: Measuring impact and cost benefit* 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 shellfish and oyster by 209-789 per cent.	1000	$11.52
Protection of Local Infrastructure, Property and Residents	Mangrove plantations provide protection against coastal erosion, salt water ingress to rice fields and protection of residents, infrastructure property against storm surges and other environmental impacts. As per the International Federation of Red Cross and Red Crescent Societies (IFRC) study dated 2011 *Mangrove plantation in Viet Nam: Measuring impact and cost benefit* mangroves can provide direct protective benefits between $800 and $3287 per Ha subject to site specific constraints.	16, 754	$11.61

BUDGET

Mangrove Plantation

LOCATION	ZONE	LAND SIZE (Ha)	ALLOCATED BUDGET ($USD)(3)
Kep Province	Confirmed Mangrove Plantation Zones	12.84 Ha	$13,803
	High probability of success mangrove plantation zones (1)	24.5 Ha	$18,436
	Moderate probability of success mangrove plantation zone (2)	119.40 Ha	$51,342
Prey Nob District	Confirmed Mangrove Plantation Zones	0 Ha	$0.00
	High probability of success mangrove plantation zones (1)	129 Ha	$97,072
Nursery Establishment Costs	Mangrove Nursery ($25,000)	NA	$28050
	TOTAL	**285.74**	**$208,704**

Notes:

1. Assumed that only 70% of the mangroves zones that have a high probability of being suitable are confirmed during the implementation phase.
2. Assumed that only 40% of the mangroves zones that have a moderate probability of being suitable are confirmed during the implementation phase.
3. Assumed plantation cost is $1075 per hectare ($850 with a 26% augmentation due to inflation) in accordance with IFRC (International Federation of Red Cross and Red Crescent Societies) paper 'Mangrove plantation in Viet Nam: Measuring impact and cost benefit' (2011)
4. Mangrove Nursery Costs based on paper entitled Sinohin, V., & Baconguis, S. (2000). Establishing a mangrove nursery. SEAFDEC Asian Aquaculture, 22(1), 7-8, 28-30 and with 1998 costs inflated at 3% per year.

DATA COLLECTION

Inputs

The following inputs were used for the development of this proposed investment.:

- Consultations (refer to Part II, Section H – The Consultative Process)
- Site Photographs (Refer to section XXX)
- Historical mangrove studies (See IFRC, 2011)

Consultations

Consultations with the communes were undertaken to understand the impact of strong winds and flooding on the specific communes. The dates for relevant consultation sessions wherein vulnerability to strong winds and flooding hazards were identified are as follows:

- 16 October 2018 - Meeting with Dr. Vann Monyneath
- 17 October 2018 - Meeting with the Fisheries Administration, Kep Province
- 17 October 2018 - Meeting with Department of Environment, Kep Province
- 18 October 2018 - Meeting with the representatives of the target communes, Kep Province
- 22 October 2018 - Consultation with the Eight Communes of Prey Nob District

Key messages received from these consultation sessions are as follows:

- Consensus that the cutting down of mangrove has resulted in greater instances of salt water ingress into agricultural land and surface water;
- There is a clear understanding that mangroves provide substantial ecological and economic benefits (e.g. more robust fisheries and better protected agricultural land);
- Limited budget in local communes to support mangrove preservation education campaigns;
- In some areas, mangroves have been cut to enable the expansion of agricultural land. The Department of Environment has indicated that providing clear delineation between agricultural land and mangrove preservation zones (e.g. by construction of a road) has been very successful;
- In areas where mangroves have been removed there has been increased coastal erosion;
- On 18th October 2018 commune leaders in Kep Province indicated that 350-375m of mangrove is sought after to mitigate significant erosion of local beaches and prevent salt water ingress;
- On 16th October 2018 Kep Municipality requested an 8km mangrove plantation along the west-facing Prey Thom coast;

- Support for mangrove plantations and preservation of existing mangrove is consistent at all levels of government.

Site Records

- Site visits and review of areas selected for potential mangrove sites have confirmed the following:
- Proposed sites for mangrove plantation are typically located at historical mangrove plantation locations and/or are located adjacent to existing mangrove plantations (refer to photo 1 as an example);
- Where reduced mangrove depths relative to agricultural plots were identified, salinisation issues are noted by local residents and commune leaders as more prevalent;
- Fishing community evident across all communes (refer to photos)

Studies

Sinohin, V., & Baconguis, S. (2000). Establishing a mangrove nursery. SEAFDEC Asian Aquaculture

Technical Guidance Document for Mangrove Planting Permitting and Management Plan. EAD-TMBS-TG-01. The Environment Agency–Abu Dhabi (EAD).

Hanneke Van Lavieren, Mark Spalding. Securing the Future of Mangroves. United Nations University Institute for Water, Environment and Health

JICA Expert Team (2014). Technical Document 3 Mangrove Plantation Guideline. The Qurm Environmental Information Center Project

Spalding M, McIvor A, Tonneijck FH, Tol S and van Eijk P (2014) Mangroves for coastal defence. Guidelines for coastal managers & policy makers. Published by Wetlands International and The Nature Conservancy. 42 p

Clarke, A. and Johns, L. (2002) Mangrove Nurseries: Construction, Propagation and Planting: Fisheries Guidelines, Department of Primary Industries, Queensland, Fish Habitat Guideline FHG 004, 32 pp.

Kathiresan, K. (2003a). How do mangrove forests induce sedimentation? Revista de Biologia Tropical, 51(2) : 355-360.

Brian Kastl, Kong Kimsreng (2012). Study of Coastal Mangrove Forest Devastation and Channel Sedimentation: Community-based Solutions Koh Kong Province, Cambodia. International Union for Convervation of Nature (IUCN) - Building Coastal Resilience.

IFRC (2011). Mangrove plantation in Viet Nam: measuring impact and cost benefit. International Federation of Red Cross and Red Crescent Societies (IFRC)

IMPLEMENTATION

Key Risks & Safeguarding Issues

The Mangrove Planting Management Plan is required to ensure planting of mangroves is ecologically the most appropriate species for the site-specific location.

Mangrove plantations to be clearly identified as mangrove protected reserves to prevent any deforestation risks, this will also be included in the Mangrove Planting Management Plan

Refer to Part II, Section K and Annex 3 for more information on safeguarding management.

Community Engagement

Community to be directly engaged in plantation of mangroves.

Community and governing body to be educated in the benefits associated in the protection and propagation of mangroves. This linked to Output 1.3 of the project proposal

Construction

Construction is anticipated to use largely unskilled labour, sourced from local communities.

An ecologist trained in mangrove ecology is to be involved in the development of the Mangrove Planting Management Plan, and may be required to supervise the planting to ensure optimum success. and during the implementation phases.

Design

Stage 1 – Site Re-confirmation

The project formulation selected sites based on physical features, land ownership and use, suitability, and absence of other barriers to plantation

Sites selected as part of this proposal (see maps, above) were selected as they passed initial screening processes and are deemed to have a high likelihood of success based on the criteria listed below:

- Land use & Ownership: Identified sites for mangrove plantation are classified as state public land land. Some sites are noted as abandoned historic agricultural sites (likely abandoned due to inhospitability for agricultural crops due to proximity to coast – high winds and salt water ingress).
- Accessibility: Sites are physically accessible for plantation and maintenance.
- Topography: The site should be slightly sloping, draining tidal water back to the sea, unlike flat ground where the water stagnates. Suitable ground height level, usually at

around mid-point of the tidal range is ideal for a mangrove plantation. The site should also be sheltered from strong winds and tidal currents that may seriously affect the survival and growth rate of mangrove saplings;

- Soil: Soil testing to bed should be undertaken to confirm that soil is well drained, aerated and either silty clay or sandy clay in nature. Some sites proposed around Angkaol are noted as having been historical salt farms, now abandoned. Soil salt concentrations are to be verified for all sites and confirmed as hospitable for mangrove plantations.
- Pressure: The site should be inaccessible to high numbers of grazing animals in its initial phases, and should be pollution-free in terms of household wastes, effluents, oil and other petroleum products and construction materials and rubble.
- Beneficiaries & Safeguards: All safeguarding principles should be adhered to and extent of potential beneficiaries maintained.

It is noted that during the implementation phase that sites will be surveyed, ground material suitability tested and land ownership re-confirmed for each individual plantation. Should a potential plantation area be confirmed as unviable for technical reasons and/or in breach of the safeguarding principles then an alternate plantation site will be identified. This is highly unlikely however, based on the formulation work undertaken in the development of this proposal. By applying a probability of success for potential plantation sites during initial screening stages UN-Habitat are ensuring that in the event of a site being declared un-fit that an alternative location with comparable benefits can be secured.

Stage 2 - Develop Mangrove Planting Management Plan:

The Mangrove Planting Management Plan should outline:

- Site baseline features;
- Plantation site map;
- Plantation methods approach including, but not exclusive to:
- Assessment of optimum mangrove seedling spacing;
- Assessment of optimum seedling protection methods;
- Assessment of direct sowing method vs seedling transplantation method;
- Assessment of preferred mangrove seedling species based on site location;

Note: Species Ipomoea pes-caprae (for planting adjacent to ocean front) & Rizophora mueronata (for planting in brackish water on the landward side) have been noted in other studies as suitable candidates for the Cambodian coastline.

Note: Coconut trees (Nypa fruticans) to be also considered where applicable to provide additional wind-breaks where adjacent to local housing and to buffer shorelines.

- Justification for site selection and design

- Management plans for ensuring the community and government involvement in ongoing protection of mangrove zones;
- Establishing quantitative and measurable success criteria;
- Monitoring and reporting plan articulating project success vis-a-vis the success criteria. Plan to including reporting on lessons learned from both successes and failures:
- Detailed outline of project safeguards.
- Recommendations for replication and upscaling in other areas.

Stage 3 - Approvals

Submit Mangrove Planting Management Plan and attain formal approval from the Fisheries Administration of Kep and Preah Sihanouk Provinces for proposed plantations.

Stage 4 - Planting & Monitoring

Following approval of Mangrove Planting Management Plan planting and monitoring of seedlings to occur in accordance with the plan.

PHOTOS

Figure 1 - Typical mangrove plantation location. Sample site at Kep commune for proposed mangrove plantation (Coordinates 10°30'37.2"N 104°17'15.8"E).

Figure 2 - Example of thriving mangrove plantation within Kep Province (Coordinates 10°29'43.9"N 104°20'31.8"E)

Figure 3 - Example of thriving mangrove plantation within Prey Nob province (Coordinates 10°35'49.2"N 103°50'54.9"E)

Figure 4 - Prey Nob Fishing community (Coordinates 10°36'00.6"N 103°50'41.1"E)

Figure 5 – Kep Fishing Community, Angkaol Beach (Coordinates 0°27'29.2"N 104°22'59.3"E)

SAFEGUARDS

ENVIRONMENTAL AND SOCIAL SAFEGUARD PRINCIPLE	RISK MITIGATION ACTIONS INCORPORATED IN THE DESIGN
Compliance with the law Projects/programmes supported by the Fund shall be in compliance with all applicable domestic and international law.	There are no anticipated legal issues. The mangrove plantations are all on state public land, and the activity is within the provisions of national laws, presented in Part II, Section E of the proposal
Access and Equity Projects/programmes supported by the Fund shall provide fair and equitable access to benefits in a manner that is inclusive and does not impede access to basic health services, clean water and sanitation, energy, education, housing, safe and decent working conditions, and land rights. Projects/programmes should not exacerbate existing inequities, particularly with respect to marginalized or vulnerable groups.	The investment will deliver: improved resilience against salt water ingress for local agricultural plantations Improved protection against coastal erosion and associated land loss Improved safety for local houses against storm surges and other climate-related extremes Improved ecosystem conditions to support local marine environment and improve fish stock levels / sustainability This project will not exacerbate existing inequalities. All proposed plantation locations are on state public that is not occupied by settlements or agricultural land. While access and equity issues are not anticipated, alternative locations are possible if safeguarding issues emerge in this area, as shown in the maps, above
Marginalised and Vulnerable Groups Projects/programmes supported by the Fund shall avoid imposing any disproportionate adverse impacts on marginalized and vulnerable groups including children, women and girls, the elderly, indigenous people, tribal groups, displaced people, refugees, people living with disabilities, and people living with HIV/AIDS. In screening any proposed project/programme, the implementing entities shall assess and consider particular	There are no anticipated issues regarding marginalised groups as there is no potential for discrimination or favour in the protections offered by the mangrove plantations.

impacts on marginalized and vulnerable groups.	
Human Rights Projects/programmes supported by the Fund shall respect and where applicable promote international human rights.	There are no anticipated issues regarding human rights as the mangroves are all proposed on land owned by the state. The mangroves will not jeordise the provision of any basic services, such as water.
Gender Equity and Women's Empowerment Projects/programmes supported by the Fund shall be designed and implemented in such a way that both women and men 1) have equal opportunities to participate as per the Fund gender policy; 2) receive comparable social and economic benefits; and 3) do not suffer disproportionate adverse effects during the development process.	In the poor communities affected by the proposal it was observed that women tend to take more of a household and community management role and therefore they are likely to accrue greater long-term benefits from the community's improved fishing and crop yield, as they will be likely to take on the role of selling surplus outputs as well as the protections offered by mangrove. Men and women will be given equal opportunity to provide their labour to the planting process, under the People's Process approach. Whenever women provide their labour, the project will ensure that they have access to separate bathrooms and hygienic products. All labourers (male and female) employed under the project will be given a mandatory briefing on the prevention of sexual harassment and exploitation prior to commencing their work.
Core Labour Rights Projects/programmes supported by the Fund shall meet the core labour standards as identified by the International Labour Organization.	There are no anticipated issues regarding core labour rights. Planting the mangrove will draw upon labour from the community. All workers in the project will be informed of their rights to organise, including joining formal labour unions, in accordance with the law. Unskilled labourers will be paid $300 per month (assuming an 8-hour working day, 5 days per week, this is 50% higher than the national minimum wage).

	All workers employed by the project (including under agreement of cooperation) will be aged 18 or over) See above provisions for women's labour.
Indigenous People The Fund shall not support projects/programmes that are inconsistent with the rights and responsibilities set forth in the UN Declaration on the Rights of Indigenous Peoples and other applicable international instruments relating to indigenous peoples.	There are no indigenous people in the target area
Involuntary Resettlement Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids or minimizes the need for involuntary resettlement. When limited involuntary resettlement is unavoidable, due process should be observed so that displaced persons shall be informed of their rights, consulted on their options, and offered technically, economically, and socially feasible resettlement alternatives or fair and adequate compensation.	There is no resettlement required as a result of this investment, and there is no evidence to suggest risk of unintended resettlement as there is no one living on the sites earmarked for mangrove planting or restoration. All mangroves are accessible by public roads or tracks, and all are situated on public land Numerous locations for proposed plantations have been nominated. Allowance has been made for alternative locations to be nominated should any land be occupied between the time of proposal formulation and the last site visit (October 2018) and the commencement of this investment.
Protection of Natural Habitat The Fund shall not support projects/programmes that would involve unjustified conversion or degradation of critical natural habitats, including those that are (a) legally protected; (b) officially proposed for protection; (c) recognized by authoritative sources for their high conservation value, including as critical habitat; or (d) recognized as protected by traditional or indigenous local communities.	This investment will have a direct benefit with regard to protecting the natural habitat. Mangrove plantations will facilitate the creation of mangrove reserve and protection areas. The Mangrove Planting Management Plan will ensure that selected mangroves for plantation are suitable for the environment and will support the local ecosystem.
Conservation of Biological Diversity Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids any significant or unjustified	Mangrove Planting Management Plan will ensure that selected mangroves for plantation

reduction or loss of biological diversity or the introduction of known invasive species.	are suitable for the environment and will support the local ecosystem. Material and seedlings imported to site will be environmentally screened to ensure that there are no invasive species brought to site. Biological diversity is expected to improve as a direct benefit of this investment. Mangroves are essential to the survival and development of numerous species of coastal plant and aquatic life. In particular, the coast near Kep is home to an extensive crap population, which depends on mangroves for feeding and spawning. Crab fishing is an essential livelihood source for the people of Kep.
Climate Change Projects/programmes supported by the Fund shall not result in any significant or unjustified increase in greenhouse gas emissions or other drivers of climate change.	The investment will help to offset the effects of climate change for the poor local communities. CO_2 emissions are expected to be mitigated due to this investment.
Pollution Prevention and Resource Efficiency Projects/programmes supported by the Fund shall be designed and implemented in a way that meets applicable international standards for maximizing energy efficiency and minimizing material resource use, the production of wastes, and the release of pollutants.	This investment does not anticipate generating any waste of polluting materials.
Public Health Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids potentially significant negative impacts on public health.	The investment will benefit public health by improving crop production. Some mangrove species have nutritional or health-giving properties and their fruits can be harvested. There are no anticipated negative effects.
Physical and Cultural Heritage Projects/programmes supported by the Fund shall be designed and implemented in a way that avoids the alteration, damage, or removal of any physical cultural resources, cultural sites, and sites with unique natural values recognized as such at the community, national or international level. Projects/programmes	There are no anticipated issues regarding physical and cultural heritage. For example, there are no sites of spiritual, religious or recreational importance in the proposed plantation zone.

should also not permanently interfere with existing access and use of such physical and cultural resources.	
Land and Soil Conservation Projects/programmes supported by the Fund shall be designed and implemented in a way that promotes soil conservation and avoids degradation or conversion of productive lands or land that provides valuable ecosystem services.	This investment should reduce the instances of salinisation due to storm surges to agricultural fields and soil erosion. There are no known contaminants arising from the project, and chemical fertilizers will not be used.