

CASE STUDY:

DISASTER MITIGATION AND PREVENTION THROUGH RESTORATION OF LITTORAL VEGETATION, AMPARA DISTRICT, SRI LANKA

Prepared by the Mangrove Action Project, for the report *“The Role of Environmental Management and Eco-Engineering in Disaster Risk Reduction and Climate Change Adaptation”* (ProAct Network 2008), available at www.proactnetwork.org

1. BACKGROUND INFORMATION

This is a post tsunami mangrove rehabilitation project which also involves community capacity building and livelihood improvements. Sewalanka Foundation is in the final stage of implementing this 21 month project taking place at two lagoons in Ampara District on the Southeast coast of Sri Lanka.

32% of Sri Lanka’s estimated 20 million population live within the coastal zone. Over the past 25 years, a lack of alternative livelihood sources or opportunities coupled with the overexploitation of resources has led to a rapid and significant environmental degradation. Traditional coastal management has focused on engineering solutions to curb immediate coastal erosion problems through the construction of protective structures. However, the lack of understanding of the dynamic nature and complex interrelationship among ecosystems and human activities in the coastal zone resulted in an escalation of coastal problems. A study in 1992 revealed that nearly 44% of the mangroves on the eastern shore were lost during the period 1981 to 1992 whilst 734 ha of salt marsh, which are a natural flood defence, were also destroyed.

In addition, the 2004 Asian Tsunami affected heavy losses on coastal vegetation and its biodiversity. Many areas of natural sea defences have been left incapacitated and the displacement of the natural coastline has left the area far more vulnerable to sea level rise and storm inundation. Within the Panama lagoon system approximately 40% of mangroves have suffered heavy damage with total damage occurring within the first 200-300m from the lagoon mouth with partial damage of those 300-500m from the mouth. Within the Turkkovil lagoon system, the cover of mangroves and mangrove associates were lost from lagoon shorelines leading to increased erosion that has been exacerbated by the community. Where before people would use specific entry points and store their boats in communal locations, with no natural forest cover on the waters edge people and cattle use every meter and are quickly eroding the sandy bank. Livestock grazing on mangroves further restricts the natural regeneration.

Figure 1. Boat launch entry points and livestock grazing are two obstacles to establishing thick continuous greenbelt buffers along the lagoon shoreline.



Post-tsunami stories from Sri Lanka, India, Indonesia and Thailand reported less infrastructure damage and loss of human life led to an interest from governments, NGOs, development organizations and CBOs to rehabilitate coastal mangroves^{1,2,3,4}. In view of the above, the Government of Sri Lanka including the Central Environment Authority started promoting the idea of establishing a Green Belt and mangrove vegetation along the coast as it could bring about numerous benefits to the local community and to the coastal environment at large. Sewalanka Foundation has been piloting this initiative aiming at effective restoration and establishment of thick green vegetation (shelter belt) and mangrove vegetation along the lagoon shores and beach plants along the coast.

In Ampara District the local Fisheries Societies and Sewalanka Foundation who had previously worked together gained financial assistance from Diakonie Katastrophenhilfe of Germany to rehabilitate mangroves in three lagoons in 2006.

HAZARDS

Vulnerability due to Tsunami Impacts on natural vegetation – The tsunami of 26 December 2004 struck a relatively thin but long coastal area stretching over 1,000 km, or two thirds of the Sri Lanka's coastline. The damage stretched from Jaffna in the north down the entire eastern and southern coast, and covered the west coast as far north of Colombo as Chilaw. About 88,500 houses were damaged; of which more than 50,000 were completely destroyed. The tsunami also damaged 24,000 boats (about 70% of the fishing fleet), and 11,000 businesses. Coastal infrastructure (roads, railway, power, telecommunication, water supply, fishing ports) was also significantly affected. The Southeast coast of Sri Lanka was hit extremely hard by the tsunami with 10,436 deaths recorded in Ampara District alone, over a third of the entire country's casualties of 30,229.



Figure 2.. Tsunami damage to mangroves at Panama Lagoon, Ampara District, May 2006

The Tsunami uprooted large areas of mangrove, and killed many more, which were later removed by fishermen for firewood. In areas, this has led to excessive bank erosion, which is now starting to eat away peoples land. In Thirukkivil the area of exposed bank is roughly 1 km in length and is of sandy soil so is at risk of further erosion during future flooding events. These exposed areas of banks leave the land and houses of local fishermen and their families in a very dangerous position, heavy rains and rough seas can both work to cause erosion of their lands and flood activity could be potentially disastrous.

Cyclones which had previously hit the east coast were another reason for planting mangroves to act as a buffer from tropical storms. Because the natural re-growth of vegetation in the area has been hindered by human, animal and environmental issues the restoration of littoral vegetation through this project is of vital importance.

Climate Change and Sea Level Rise

Sri Lanka has a coastline of 1585 km mainly areas of which are low lying and under threat from erosion. Accelerated erosion, salt-water inundation, floods and salt-water intrusion through the estuaries are expected to be aggravated in near future because of changing weather conditions and sea level rise. In the past changing weather patterns have caused unpredictable disasters in many parts of Sri Lanka. Droughts, floods, and associated land slides and cyclones are now becoming a common feature in the country.

Conflict

The project areas are located in the conflict-affected area of east Sri Lanka. These communities have less interaction with other parts of the country and poverty is widespread. For example, Panama village has only one access road from the outside, which is often inaccessible, due to annual floods and the conflict situation. Largely confined to this location the community relies on local resources to supply their requirements for food, water, housing material, fuel and various other needs. Therefore, the natural resource base is of prime importance to the people for their livelihood and food security making them more vulnerable in the circumstances of natural disasters.

PROJECT SCALE

3,955 individuals (the population of the project areas Panama North 1328, Sastrawela 837, Thirukkivil Palakuda 860, Tandiyadi 930) are expected to benefit from the project with 10km of Ampara District having coastal vegetation belts.

PLANNING INSTITUTION, EXECUTING INSTITUTION, SUPPORTING AGENCY

- ★ Sewalanka Foundation – Executing Agency
- ★ IUCN Sri Lanka –Supporting Research
- ★ Mangrove Action Project – Training and Technical Support
- ★ Diakonie Katastrophenhilfe, Germany - Funder (Disaster Prevention in the Context of Climate Change Programme)

2. PROJECT DESCRIPTION

Running for two years (Sept 2006 -May 2008) the primary aim of the project is to protect the selected coastal communities in Ampara District from potential negative impacts of global warming and future natural disasters through a program of restoring mangrove and coastal vegetation. Working with the active participation of communities in Panama and the Tirukkivil Lagoon system, the project will enhance the adaptive capacity of local communities to extreme climate events and sea level rise through interventions such as land use zonation and community management and restoration of degraded littoral vegetation. With assisted regeneration, mangroves and beach vegetation should have re-grown enough to offer significant coastal protection within 10 years and the accretion of sand and sediment should make a significant difference within 15 years. Nurseries have been set up in both project locations and nursery managers trained and employed. Seeds and propagules are collected from the surrounding area or from other communities if there is a lack of local seeds. Restoration has taken the 6-step Ecological Mangrove Restoration (EMR) technique into consideration whereby planting only occurs in the correct hydrological zone where there is a lack of propagules which would limit natural regeneration. Planting is also intended to speed up the recover process to provide dense mangroves sooner.

LOCATION AND CONDITIONS

The target areas in Ampara district are:

- ★ Panama area (consisting of Panama North lagoon and Sastrawela lagoon)
- ★ Tirukkivil Lagoon system (made up of Palakuda, Paravai, Thandiyadi and Umithi lagoons).

Situated in the dry zone of Sri Lanka, the mean annual temperatures range from 25°C to 27°C. Mean annual rainfall is between 1500mm and 2000mm with most falling during the northeast monsoon (November to February).

ECOLOGY

Panama

Habitats include mangroves, salt marshes, flood plains, paddy fields, sand dunes, beaches, tropical thorn forest, tropical dry mixed evergreen forest, home gardens and chena cultivations. In total 163 plant species, including 19 mangrove species, belonging to 67 families were recorded in the area. As the major habitat around the lagoon there are about 70 ha of mangroves surrounding the village. *Avicennia marina* is the dominant species with the other true mangrove species found being *Rhizophora mucronata*, *Lumnitzera racemosa* and *Bruguiera gymnorrhiza* as well as 15 associated mangrove species. The mangrove extends back between 10 and 25m before the incline of slope results in terrestrial communities taking over. Average tree density near the waters edge was roughly one tree every 2.5m² while at the rear of the mangrove the plant density is much higher at roughly one tree every 1.2m².

From the major habitat and vegetation types within the Panama lagoon area, a total of 216 species of vertebrates belonging to 132 families were recorded. The vertebrate fauna of Panama represents about 18 % of the total vertebrate fauna recorded in Sri Lanka of which 10 species were found to be endemic while 19 are listed as nationally threatened.

Tirukkivil

Tirukkivil lagoon is made up of four small sub-lagoons that vary in salinity with the high saline areas being Palakuda and Paravia lagoon to the less saline back lagoons. Mangroves are generally thin fringing belts along the shoreline between 5 and 15m thick depending on location. A total of 149 vertebrate species were recorded from 75 families, 7 of which were endemic and 15 nationally threatened.

SOCIO-CULTURAL CONDITIONS

Panama

Panama village belongs to Lahugala Pradeshiya Sabha situated in Ampara district of eastern Sri Lanka, adjacent to the Kumana National Park. Altogether 1395 families and 5900 inhabitants live in the village, which is situated on the banks of the mouth of the Wila Oya River. The eastern side borders the coast and the inland side borders the Kumana National Park. Three communities are present in this area (Sinhala, Tamil and Muslims) with the majority being Sinhala.

Agriculture, fishing and tending livestock are the major livelihood activities in the village. The majority of the Panama population depends on agriculture for their livelihood and more than 90 % of the families' main income is from it. Paddy cultivation contributes to 70% of the village's total income and nearly 2000 acres are under cultivation. About 450 people are directly engaged in fishing (prawn, lagoon and sea fish) and about 100 families depend on lagoon fishing. In addition, hired labour and livestock provide considerable employment opportunities to the community. Women are engaged in minor income generating activities such as weaving coconut leaves for thatching and helping in fishing related activities. Very few people are employed in the government or the corporate sector. Of the entire population, most of them can be categorized as living below the poverty line as they receive less than Rs. 2,000 (12 Euro) per month. Thereby 90% receive government assistance (Samurdhi recipients). Almost all households derive mangrove products such as firewood, wooden poles, and vegetables for their subsistence use.

Tirukkivil

The primary livelihoods of Tirukkivil are subsistence lagoon fishing and agriculture. (waiting for additional information from a recent IUCN socio-economic study)

ECOSYSTEM MEASURES APPLIED

Rubble, dead wood and rubbish were removed from the planting sites. Where necessary the restoration of natural channels and waterways was undertaken to restore the natural hydrology of the area; for example, rubble cleared and sediment removed manually using mamoties. Badly eroded surfaces and banks were stabilised. By the end of Feb 2008 a total of 20 000 mangrove seedlings were planted in Panama and 24 000 in Tirukkivil each covering an area of 4km by 30 m (0.12 km²).

A few Pandanus seedlings have already been planted in beach locations in an attempt to create beach forest vegetation as seen in Calido Beach and a further 2500 seedlings are being raised in nurseries for future planting.

STARTING POINT OF THE PROJECT; MILESTONES

Sept 06- Nov 06

- * Stakeholder Identification and obtaining permissions from the relevant authorities
- * Community Awareness Sessions in Panama and Tirukkivil

Dec 06 – Feb 07

- * Village Social Profile and SWOT analysis completed and community capacity building needs identified. Training in resource management and environmental awareness was identified as priority areas in both communities.
- * Technical Training Course by the Mangrove Action Project and Robin Lewis. Two workshops were run to introduce the concepts of Ecological Mangrove Restoration and community management. The first was aimed at national level government staff, local NGOs and university academics. The second at community representatives, local government officials and field level NGO staff and was translated into Sinhalese and Tamil.
- * Agreements signed with the Fisheries Cooperative Societies in each project area detailing agreement to work together to achieve this project
- * Two nurseries were constructed and seed collection began

March 07 – May 07

- * Socioeconomic and biodiversity surveys of Panama completed by IUCN and reports given to Sewalanka Foundation.
- * Mapping of planting area in Panama complete – Area to be planted 20-30m from lagoon inland along a 4km stretch
- * Site clearance and land preparation for planting at Panama North
- * 3 500 Seedlings planted in Panama North, the seedlings are monitored, dead ones removed and vacancies filled.
- * Social Mobilisation and Training Need Assessment completed. 200 members from the Fisheries Association attended, 50% of attendees were women.

June 07- Aug 07

- * Evaluation visit from Dikaonie
- * Training on Mangrove Restoration run by Small Fishers Foundation held at Chilaw. 12 members of the Panama and Tirukkivil communities including community leaders and managers attended the training during which they were shown mangrove nurseries and how to plant mangrove seedlings.
- * Exposure visit to Calido beach in Kalutara. Beach vegetation was established in this area 15 years ago by the Forestry Dept. Seeds were collected to be raised in the nurseries and planted along the beaches in the project area.

- * 1 500 seedlings planted at Panama North; the seedlings are monitored, dead ones removed and vacancies filled.

Sept 07 – Nov 07

- * 15 000 seedlings planted in Panama North and 3000 in Tirukkivil
- * Sewalanka Study Tour to Thailand. Attended by 10 members of Sewalanka staff, visits were made to the Krabi Ramsar site, Regional Mangrove Office in Phang Nga and Ranong Mangrove Research Centre. Attendees learnt about the ecology and current problems facing Thai mangroves as well as attending a number of technical sessions on mangrove restoration finally taking part in a mangrove restoration project in Ranong.

Dec 07 – Feb 08

- * 21 000 seedlings planted in Tirukkivil
- * Workshop on Mangrove Restoration and Climate Change as part of the Tirukkivil School children Awareness Programme. Held at AK/Vinayagapuran Maha Vidyalaya (school) on 27th Jan 2008. 110 children took part; the next training will take place in Panama in April 2008.
- * Beach Forest seedling collection from the southern coast. Major varieties of Pandanus, Scaevola, and Casuarina seeds were collected

3. RESULTS

The project is not due to end until May 2008. As part of the project proposal Sewalanka plans to undertake an impact survey at each of the project sites so although there are few quantitative results at the moment these may be available in the future.

To date:

In total a 8km belt (30m depth) of mangroves has been planted in the project areas which involved the planting and raising of 44 000 mangrove seedlings.

The process of introducing beach vegetation has begun with 2 500 Pandanus seedlings being raised in nurseries to be planted in the future.

Timeline

Sewalanka Foundation estimates that with assisted regeneration mangroves and beach vegetation should have re-grown enough to offer significant coastal protection within ten years; and the accretion of sand and sediment should make a significant difference within fifteen years. The re-establishment of coastal vegetation offers a permanent solution as long as the areas are not overexploited or degraded.

4. SUSTAINABILITY

The planted mangrove / beach vegetation areas are not formally protected. Prior to the project, all stakeholders were consulted and gave their consent for the project; this was important as previous replanting schemes had failed due to failure to consult with livestock herders who used the area to graze their cattle. The project is a participatory project with Sewalanka Foundation working directly with communities through the local Fisheries Cooperatives. Sewalanka Foundation has worked with the cooperatives on previous occasions and throughout the project has focussed on community capacity building. Through awareness raising, education and training, the project aims for the local communities to take an active role in managing and protecting the restored mangrove areas as well as the wider environment. The reliance of the villagers on mangrove resources together with an awareness of the ecosystem's importance for fisheries has led communities such as within the Tirukkivil lagoon system to plant mangrove seedlings in the past but often seedlings were planted in unsuitable areas and so failed. By working on capacity building and improving the communities' knowledge of restoration and nursery techniques the project hopes to provide local communities with the skills to become 'wardens' of the local environment.

5. LIMITATIONS ON THE USE OF ECOSYSTEMS IN THIS PARTICULAR HAZARD

A number of limitations on using mangrove ecosystems in Sri Lanka as DRR options in view of the hazards listed previously exist. These are as follows:

The mangrove in Sri Lanka are all fringing mangroves and as the tidal range is very low between 0.4 and 0.6 m they typically extend 10 to 25 m before soils change and more terrestrial vegetation takes hold. This means that the natural zone for mangroves in which they can become established is very limited.

Due to irrigation practices, there is increased freshwater runoff that is affecting the mangroves in some areas⁶. For example in the Tirukkivil lagoon system, the back lagoons are not saline enough to support mangroves. Should the amount of freshwater entering the lagoons increase it is likely to lead to the degradation of the mangrove areas thereby reducing the DRR potential.

The planted vegetation needs to mature before it is able to offer significant risk reduction / storm attenuation. Sewalanka Foundation estimates that with the assisted vegetation techniques used during the project significant risk reduction from average storm conditions will occur within 6 years.

Due to the lack of alternative livelihood options (in part a result of the ongoing conflict in the region), the local communities are heavily dependent on natural resources including the mangrove resources. This dependence could lead to future degradation of the mangrove and beach vegetation for example through over harvesting. However, in view of the participatory nature of the project, the interest of local communities involved in improving the coastal vegetation together with Sewalanka's community capacity building and environmental education work through the project this hazard is likely to be less significant than if re-vegetation had taken place without consultation or active participation of local stakeholders.

6. IMPLEMENTATION COSTS

The budget secured for the Sewalanka project was US\$ 157 000 with approx US\$ 61 000 spent on training and community capacity building and the remaining US\$ 96 000 spent on staff salaries and re-vegetation costs e.g. nursery construction, site preparation, baseline reports.

The nursery manager's salary will be paid throughout the project period, by the time the project draws to conclusion alternative income generation methods such as fisheries contribution will be in operation to continue funding his salary and the mangrove restoration process, thus increasing the sustainability of the project (ensuring sustainability will be a non cost item for this project).

7. CARBON BENEFITS

The managed mangroves of Matang in Peninsular Malaysia have been estimated to sequester 1.5 tonnes of carbon per ha per year in the sediments⁷. The carbon benefits resulting from re-vegetation of the project areas has the potential of being measurable as the date of planting is known and it is probable that sediment deposited during the 2004 tsunami will clearly demarcate organic carbon buried before and after the tsunami thus differentiating between carbon sequestered by the planted vegetation and the pre-tsunami mangroves. Since the total planting area is quite small (0.24 km²) the carbon sequestration factor is limited. Similarly, the planting of beach forest will take place in previously un-vegetated areas. However, this is outside the scope of the current project.

8. CONCLUSIONS AND LESSONS LEARNED

Conclusions and lessons learnt are not currently available as the project is not due to end until May 2008. Sewalanka Foundation will undertake an impact study six months after the end of the project.

Sometimes where the actual rehabilitated area is relatively small or the mangrove width (tidal zone) limits the buffering capacity of fringing mangroves like in Sri Lanka the importance of mangrove rehabilitation for fisheries, (food & livelihood security), erosion control, nutrient filtering and for local resource use may have greater immediate importance than for natural disaster protection.

REFERENCES

- Danielson, F. Sørensen, MK. Olwig, MF. Slevam, V. Parish, F & Burgess, ND. (2005) *Brevia Science*: 310: 643
- Lewis, RR (2005) Mangroves, Hurricanes and Tsunamis. *Environmental Concern: All About Wetlands* 1: 3-5
- Wolanski, E (2007) Protective functions of coastal forests and trees against natural hazards. IN: *Regional Technical Workshop on Coastal Protection in the Aftermath of the Indian Ocean Tsunami: What Role for Forests and Trees?*, Khao Lak (Thailand), 28-31 Aug 2006. Chpt 6
- Stone, R (2006) A Rescue Effort for Tsunami-Ravaged Mangrove Forests. *Science* 314: 404
- Kinver, M (2005) Tsunami: Mangroves 'saved lives' BBC NEWS online
- Dahdouh-Guebas, F. Hettiarachchi, S. Lo Seen, D. Batelaan, O. Sooriyarachchi S, Jayatissa LP & Koedam N (2005) Transitions in ancient inland freshwater resource management in Sri Lanka affect biota and human population in and around coastal lagoons. *Current Science* 15: 579-586
- Ong JE (1993) Mangroves – A carbon source and sink. *Chemosphere* 27: 1097-1107
- Binney F. Disaster mitigation and prevention through restoration of littoral vegetation. Phase one project report 1st Sept 2006 – 30th Nov 2007
- IUCN Sri Lanka (2007) Socio Economic Study of Panama Village in the South Eastern Coast of Sri Lanka
- IUCN Sri Lanka (2007) Biodiversity Assessment of Panama Lagoon Area.
- Wickramarachchi G. Disaster mitigation and prevention through restoration of littoral vegetation. Phase two project report 1st Dec 2006 – 28th Feb 2007
- Wickramarachchi G. Disaster mitigation and prevention through restoration of littoral vegetation. Phase three project report 1st March 2007-31st May 2007
- Wickramarachchi G. Disaster mitigation and prevention through restoration of littoral vegetation. Phase four project report 1st June 2007-31st Aug 2007
- Wickramarachchi G. Disaster mitigation and prevention through restoration of littoral vegetation. Phase five project report 1st Sep 2007 – 31st Nov 2007
- Wickramarachchi G. Disaster mitigation and prevention through restoration of littoral vegetation. Phase six project report 1st Dec 2007 – 29th Feb 2008

ACKNOWLEDGMENTS

The Mangrove Action Project would like to thank Ms. Gayani Wickramarachchi of Sewalanka Foundation for providing all project reports which were utilized to extract information for this case study.

CONTACT DETAILS

Jim Enright, Mangrove Action Project - MAP Asia Coordinator

Email: mapasia@loxinfo.co.th

Tel: +66 75 226-258

Sarah Hornby, Mangrove Action Project - MAP Volunteer

E-mail: volunteer.mapasia@gmail.com

Project personnel

Gayani Wickramarachchi, Sewalanka Foundation - Mangrove Project Manager

Email: mangroject@gmail.com