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Completion Report of the Project

Increasing the Resilience of Coastal and Riverine Communities to Climate Change and other Threats, by Conserving the Ecosystems of the Maha Oya and Associated Coastal Wetlands in Sri Lanka



**A Project Funded by
The Mangroves for the Future (MFF) Initiative
Implemented by
Environmental Foundation Guarantee Limited, 146/34, Havelock Road, Colombo 05.**



About the project

Increasing the resilience of coastal and riverine communities to climate change and other threats by conserving the ecosystems of the Maha Oya and associated coastal wetlands in Sri Lanka

Mangroves for the Future (MFF) is a unique partner-led initiative to promote investment in coastal ecosystem conservation for sustainable development. It was established following the impacts of the December 2004 tsunami to provide support to vulnerable countries in south and south east Asia to address future threats of climate change and other natural disasters. MFF supported EFL to implement a 2-year project to protect and conserve the Maha Oya and its associated coastal and riverine ecosystems.

The project took an integrated approach with a focus on strong scientific, advocacy and community components, with the aim of social and economic empowerment of communities and human wellbeing through ecosystem conservation. Project outcomes include influencing policy and decision making for ecosystem conservation, generating scientific data, ecosystem restoration, community empowerment through alternative livelihood training, capacity building of stakeholders and sensitising school children towards environmental conservation.

About the organisation

Protecting and conserving Sri Lanka's environment

Environmental Foundation (EFL) is one of Sri Lanka's oldest public interest organisations working in environmental conservation and protection. Established in 1981 EFL is engaged in conservation through legal and scientific means, and supports poor and disadvantaged communities defend their rights to a clean and healthy environment. The organisation implements donor funded projects, disseminates information on conservation related topics and lobbies for better policies to support a sound environment.



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Executive Summary

The project “Increasing the Resilience of Coastal and Riverine Communities to Climate Change and other Threats by Conserving the Ecosystems of the Maha Oya and Associated Coastal Wetlands in Sri Lanka”, completed implementation on the 30th November, 2011. The project was granted by the Mangroves for the Future initiative and was implemented by the Environmental Foundation Limited (EFL) in collaboration with the Geological Survey and Mines Bureau and the Open University of Sri Lanka. The date of commencement of the project was 1st of September, 2009. The original duration of the project was 2 years (24 months) ending August 2011, however the project implementation agency requested an extension in early 2011 which was approved and extended by 3 months to November 2011 after the second monitoring, learning and evaluation visit carried out by the funding agency in May, 2011.

The project comprised of four key outputs; with a number of activities and sub activities to achieve its objectives. The first two outputs were intended to generate policy and decision support information for river and coastal managers, through a series of scientific research and an economic valuation of ecosystem goods and services. The third output was the preparation of publications for the dissemination of information generated from activities and learning’s in output 1 and 2. These publications were intended to provide scientific and policy relevant information for improved riverine and coastal area management in the future. Through this output, it was also expected to empower the communities and raise the awareness of school children on environmental conservation, as well as raise the awareness of the media on the issues that cause degradation to the riverine and coastal ecosystems. Another key activity of output 3 was to provide alternative livelihood options for sand and clay mining, in order to minimize the stresses on the river. In the fourth and the final output, activities related to restoration were expected to be carried out, in an attempt to restore the degraded areas in the project area.

The first output of the project was to generate scientific information for decision and policy support. Additionally, this information was expected to be used as the baseline information of the river characteristics and coastline. The study encompassed research work including analyzing changes in the river and coastal morphology and land cover, an assessment of the implications of climate change in the project area, studies on the impacts of sand mining, an assessment of pollution of the river and the water bodies in the vicinity, and an assessment of the relationship between river and coastal processes. Many of these studies included extensive field measurements. Some of these studies concluded that more field measurements are required in order to come to conclusions. The study on analysing morphological changes in the river concluded that natural changes were minimal during the timeline considered, from 1956 to 2010. Therefore,

the changes in the morphology identified through the study were attributed to changes caused by human activity. The changes in the land cover in temporal scale, from 1956 to 2010 were drastic and the number of sand and clay mined pits indicated an increasing trend.

A preliminary assessment on the implications of climate change was carried out through two studies, modeling salinity intrusion to the river and modeling and mapping inundated areas due to sea level rise and river runoff. As a result of these studies a model on salinity intrusion was produced using the MathLab software and maps showing the inundated areas. This information will be of future support in land use planning in the project area and in developing solutions to mitigate the salinity intrusion to the river.

In output 1, another series of studies were carried out to identify the impacts of sand and clay mining. These studies included salinity monitoring, studying the lowering of well water levels, carrying out river flow measurements and mined pits. Some of these studies produced baseline data on the river, whereas, other studies concluded that sand mining causes increased salinity levels in the river, lowering the ground water and water table and leads to conversion of productive land into mined pits. A direct co-relation between river bank erosion and mining activities in the river could not be established due to insufficient data collected within the study period.

An assessment on the quality of river and well water was carried out with two studies. The first one was to identify the implications of the fertilizer subsidy granted by the government, on the water quality of the river. A pilot fertilizer runoff study was carried out in one of the sub catchments to the Maha Oya. The study concluded that excess of the fertilizer added to the paddy fields in the Sandalankawa sub catchment finally ends up in the Maha Oya, causing water quality degradations and triggering eutrophication in stagnant conditions. Additionally, this study would be a follow up to the pilot fertilizer runoff study carried out by Wikramanayake et al in 2001 in the same study area. The comparison shows a decreasing trend of the fertilizer runoff, which is a positive fact.

Pollution levels of the river and wells in the vicinity were analysed in the high and low flows of the river. The study concluded that quality of water in the river and some of the wells located in closer vicinity to the river were not acceptable and deteriorated, especially in the areas close to the garbage dump in Kochchikade. Since, the number of samplings and the duration of the monitoring were not adequate, it is recommended to carry out further monitoring in this area before deriving any conclusion. However, the preliminary conclusions indicate the need for a proper environmental management plan not only for the river, but also for the hinterland, as garbage dumping and untreated effluent discharge into the river deteriorate the quality of both river and ground water.

This study was carried out in parallel to the study on investigation of issues degrading the environment. A number of pollution sources of the river were investigated and a comprehensive report was forwarded to the Central Environmental Authority.

Two activities were carried out in order to study the relationship between the river and coastal processes, the coastal inlets and make an assessment of shoreline retreat or advancement. The study concluded that sediment transported by the river is crucial in maintaining the sediment balance of the beaches. In the absence of sufficient sediment load to replenish the sand washed away by the sea, coastal erosion is aggravated and causes a number of environmental and socio-economic problems. As the final activity of output 1, a mapping of the ecologically sensitive areas was carried out. Additionally, the mined pits were categorized and areas to be kept intact without external forces were identified. Two maps were produced in this regard, showing the mangrove plantations and environmentally sensitive areas and a map of categorized mined pits which will be useful in designing a restoration/management plan for the large number of mined pits located in the project area.

In the second output of the study, an economic valuation was carried out for the critical ecosystem goods and services that benefit communities. In this regard, two key values - namely the benefits from ecosystems and cost of degradation of ecosystems were calculated for two scenarios, Business as Usual scenario (BAU) and Ecosystem Restoration and Sustainable Management (ERSM). The value of the ecosystem goods and services per year was calculated, as at least SLR1.7 billion per year for the baseline year. Under the Business as usual model, the net present value (over 25 years) of total benefits to all stakeholder groups which included local communities, business and industry and the government was SLR 16.9 million and costs estimated were SLR 10.0 million. Under the ERSM scenario, the net present value of the benefits to stakeholder groups was SLR16.2 million, and costs calculated were SLR 8.6 million, a reduction in both benefits and costs in comparison to Business as Usual scenario. However, as the reduction in costs is higher than the reduction in benefits, concluding that sustainable management of natural resources in the project area yields positive benefits over time. This conclusion has a number of policy implications; the key recommendation is to prepare a management plan and an action plan for management, conservation and restoration of the Maha Oya and its associated ecosystems, focusing on ecosystem restoration and sustainable management, among other recommendations.

The output 3 of the project is a combination of stakeholder empowerment at various levels through different means. For national level and local level coastal and riverine environment managers, the generated scientific and other information instrumental for management was disseminated, and policy and decisions were directed towards a

scientific rationale. Although, these activities were carried out within a short duration of 2 years, a number of policy changes and decisions based on the information generated through the project could be considered as a positive outcome of the project. As project communication materials, a number of publications were generated including a Technical Summary (Report) of important research carried out, the report on Ecosystem Valuation, a Policy Summary, brochures and posters and a documentary. The main workshop held for the stakeholders was a forum fostering an open discussion at which the publication materials with the findings of the project were disseminated. The media were empowered with a series of forums and through an onsite workshop for both print and electronic media. As a result of these activities, a number of newspaper articles were published and electronic media clips were aired.

School awareness programmes were carried out within 3 schools in the project area for improving the environmental knowledge base of school children and sensitizing them towards environmental issues and promoting environmental conservation. The enthusiasm of some of the school children for these activities was noticeable. They displayed an improvement in the knowledge and behavior than what was evident at the early design stage of the project.

A number of training programmes were carried out for community groups in the downstream of the Maha Oya, with the objectives of increasing their economic resilience and providing alternative livelihood options for sand and clay mining related livelihoods. There were no limitations in selecting groups for these livelihoods within the communities, and both gender groups were targeted for benefits. Eight livelihood options were introduced, and included shoe manufacturing, bag manufacturing, inland aquaculture and yoghurt production amongst other options. These livelihoods proved to be suitable for them, and since then have become the beneficiaries main source of income now, with most of them earning a monthly income of between SLR 8,000 to SLR 15,000.

Additionally, community awareness programmes were held in order to make them understand the value of the environment they live in, make them more environmentally sensitive and inculcate the idea of environmental conservation in them. A number of such programmes were conducted and reduction in illegal mining activities along the river could be partially attributed to these programmes.

In the fourth and the last output, a number of restoration efforts were made to rehabilitate the degraded areas of the river. These included, a scientific approach to restoration through consultation sessions with experts in the field of restoration, establishing a plant nursery and distribution of plant saplings among Community Based Organizations, carrying out a study on the degraded areas of the river and proposing a

restoration strategy to some of them. Two of the sites were restored with tree planting and simple mechanisms to trap sediment.

All of the above activities were carried out as sub activities of an integrated approach adopted in ecosystem conservation. In comparison to the conditions that prevailed in the project area two and half years ago, the conditions have improved in terms of the following aspects: the number of illegal sand and clay mining activities were reduced, the total of sand and clay mining related income earning people were reduced, the river is very slowly regaining the originality, but this would take more than a decade to come to the original condition. Further, the attitude of the communities has changed, as they opted to engage in livelihoods other than sand and clay mining activities. The influential personnel in the project area including the political authority were given awareness and sensitized towards environmental issues and conservation. Additionally, the research activities of the project have triggered a number of other research activities among the research community, including the academia. Some of the impacts of the project are long-term, especially where the objectives related to policy changes and the drafting of a management plan for the river. Within this short time, a number of cases were brought to our notice where the information generated by the project was instrumental in policy recommendations. These incidents were reported from the Geological Survey and Mining Bureau, the Coast Conservation Department of Sri Lanka, the Road Development Authority, the National Water Supply and Drainage Board etc. It is expected to record more policy impacts of the project in the future. Further, the project has triggered a discourse of the river sand mining issue among the stakeholders and it has been given more priority and prominence than before.

As a summary, the project has made a lot of positive impacts and achieved the objectives of the project proposal, but most of these impacts are long term and need to be continuously followed up. Additionally, the information and reports generated by the project are to be used by other stakeholders for implementation. Future follow up is needed in this regard. Finally, this project could be replicated with contextual changes where necessary, and it is recommended to allow project activities to be implemented over at least a 3 year span rather than to hasten implementation as carried out by EFL due to the constraints caused by administration and delaying of funds. This might add more value to the project and more time would be left for follow up work of the activities.

2.0 Introduction: A brief description of the project and its background

Excessive river sand mining has become one of the critical environmental issues in Sri Lanka, with sand being one of the essential raw materials in the construction industry, sourced through river sand mining. Artisan mining which is the traditional method prevailed from historical times in extracting sand from the river beds, but with the rapid economic development and consequent boom in the construction industry, speedier supply of river sand was required and mechanized equipments were deployed for this purpose. This has caused immense degradation to the riverine environment giving rise a number of environmental problems not only in the riverine environment, but to the coastal environment as well due to the unplanned and unsustainable extraction of river sand.

Maha Oya is one of the largest rivers in Sri Lanka and flows into the Indian Ocean from the West coast of Sri Lanka. The area downstream of the Maha Oya is subject to severe degradation due to excessive river sand mining and clay mining in the hinterland. The project was implemented in the downstream of the Maha Oya, about 12 km upstream from the river mouth at Kochchikade and about 25 km along the coastline to the north of the river mouth. An extended area was considered for certain activities and the information has been provided in such occasions. The project area was a semi-urban to rural area which comprised of 04 Divisional Secretariat Divisions; namely Katana, Dankotuwa, Wennappuwa and Negombo. There are a number of environmental issues in the project area, indiscriminate river sand and clay mining being the most devastating problems among others. The downstream of the Maha Oya has been subject to exacerbated sand extraction since the early 1980s with rapid economic development activities in the country. The impacts of river sand mining are multifold and are not limited to the riverine environment only. The destructive impacts are more visible in the coastal stretch north of the river mouth. In the riverine environment, river bank erosion, land degradation, loss of aesthetic value of the river and increased salinity levels of the river were observed. Additionally, it has been proven that river sand mining causes lowering of the river bed and consequently lowering the water table and ground water. When the ground water level is lowered it impacts on communities as water levels in wells too are lowered forcing them to deepen the wells or abandon them.

More devastating impacts were visible in the coastline northwards. Ocean currents move the sand along the beaches towards the north. This causes sand deficits in the coast and this deficit is supplied by the sand transported by the rivers. When this sand is mined out on the traverse of the river from the upstream, beaches do not receive sufficient sand for nourishment and the sediment equilibrium of the coastline is lost. This causes sand deficit on the beaches and results in coastal erosion. The Maha Oya supplies sand to nourish the beaches from the river mouth at Kochchikade to Chilaw,

where the next major river mouth is located. Excessive river sand mining causes severe coastal erosion in this stretch of coastline, displacing hundreds of families living along coastline.

The objective of the project was to increase the resilience of coastal and riverine communities to environmental threats which are locale specific. When the impacts of these locally identified environmental threats are coupled with the impacts of global scale threats like climate change, the overall impacts are more aggravated and severe. The project aimed at building more resilient communities in the project area by ensuring sustained ecosystem goods and services to those who are dependent on them. The project adopted an integrated approach in ecosystem conservation and outputs of the project were designed and planned accordingly. This project was an integration of scientific research, ecosystem valuation, dissemination of policy and decision support information through publications and workshops, stakeholder empowerment and restoration to degraded areas of the river.

Many groups of the stakeholders of the project were identified at the national and local levels. These stakeholders represented government, private sector, community groups, non-governmental organizations, and academia and research organizations. The Geological Survey and Mines Bureau, the Department of Irrigation, the Coast Conservation Department of Sri Lanka, the National Water Supply and Drainage Board, the Road Development Authority, the Central Environmental Authority, the National Aquatic Resources Research and Development Agency, the Sri Lanka Land Reclamation Corporation were among the national level government stakeholders. Divisional Secretariats, Regional Educational Offices and schools, Grama Niladharis and the Bambukuliya water intake of NWSDB were among the local level government stakeholders. Hoteliers operating in the project area, especially the eco-brand hotels were among the key groups with a major stake in the project. There are many others among key stakeholders of the issue of sand mining.

3.0 Project Context: Review of project assumptions and any “missed” opportunities

The project context was described in the project proposal in terms of geography, policy, community and socio-economic context and climate context. At the project design stage, many assumptions were made pertinent to implementation and validity of project impacts.

3.1 Geographical context

The project area is the downstream of the Maha Oya, which encompasses about 10 km along the upstream of the river, the Dutch canal, and the Rathmala Oya. The coastal stretch spans from the mouth of the Maha Oya at Kochchikade to Katuneriya in the Puttalam district. There were no major changes made to the geographical area of the project, but in certain scientific studies, the research area has most of time been expanded, since this expanded area added more value to those studies. Specific information is given when activities are detailed out later in this report and in the Technical Summary. When all of these studies are considered, the area of the project spanned in Gampaha and Puttalam districts, in 5 Divisional Secretariat Divisions, Katana, Negombo, Dankotuwa, Wennappuwa and Nattandiya. Limited activities were carried out in the Nattandiya DS Division.

3.2 Policy context

The project was consistent with, and reflects, national policies. Sri Lanka’s main policy document on the environment is titled “National Environmental Policies and Strategies 2003”. The policy statements mention that resources (including minerals) should be managed in a manner consistent with the viability of ecological processes. It also states that “the economic value of environmental services will be recognised so as to assure the sustainability of such services for the benefit of the people” and that “responsible public-private and community partnerships and linkages will be promoted at all levels of environmental management and conservation”. This project was carried out using private-public partnerships, as it worked with government institutions such as the Geological Survey and Mines Bureau, the Coast Conservation Department, the Department of Irrigation and the Open University of Sri Lanka, whilst also working with already established and newly formed CBOs such as the Sand Miners and Transporters Association and Sithuliya Women’s Organization.

The project activities were completely in keeping with the policies governing the mandated government institutions. In summary, the policies of these institutions states, environmental protection, regulation of sand mining, restoration of degraded areas and conservation of bio-diversity. Most of these policies reflect the government policy,

although no comprehensive assessments were carried out to investigate the costs and benefits associated with the harnessing of ecosystem goods and services including sand and clay. However, through the project, these policies were scientifically and economically rationalized, giving a new dimension to policy and decision. For example, the restoration efforts made by the project have been coupled with the policy of the GSMB, for renewal of mining licenses; the license holder has to rehabilitate/restore the areas degraded with the previous license. Additionally, this adds more sustainability to the project impacts as existing policy has been changed to incorporate improved environmental conservation aspects.

3.3 Community and socio-economic context

This is the area in which most of the components have changed radically from the project formulation stage. The socio-economic context was different in certain ways, and was explained in the project proposal as follows.

The communities along the coastal and river areas mainly depend on self employment. In the Maha Oya, up to 500 metres from the river mouth, the majority are engaged in fishing. From there onwards a large proportion of people earn their living by sand or clay mining, and associated industries. There are significant agricultural areas of paddy, coconut, teak and rubber plantations that have been affected by the lowering of the water table due to sand mining. This demonstrates that the population along the river and coastal areas depend on the associated ecosystems for their livelihoods. The population of the study area according to the census of 2001 was as follows: Negombo 144,274, Katana 222,683, Dankotuwa 59,386 and Wennappuwa 70,817 which totals to 497,160 (EFL proposal of the project).

In May 2010, the project staff carried out a preliminary socio-economic survey for riverine communities with a sample of nearly 50 people. The survey revealed the following information,

- There were many people without a consistent source of income in the project area; most of them had been sand and clay miners who were constrained from income generation with the unavailability of sand, rainfall and high flow of the river
- Now, most of the community were looking for alternative livelihoods to sand and clay mining related ones, however they wanted a matching income to that earned through sand and clay mining.
- River fishing has been diminishing due to the lack of fish stock.

- No changes were observed with sea fishing.

In February, 2011 another survey was carried out for the riverine communities in the form of a structured questionnaire for a sample of 113. That survey revealed that:

- Communities opted to go for alternative livelihoods to sand and clay mining
- At least one male in many of the families work in either the private sector or is self employed in areas other than sand and clay mining
- Most of them wanted their children to work outside the area

Additionally, the observations made by the project team during site visits carried out during last two and a half years showed a considerable reduction in both legal and illegal mining activities. Very few illegal mining activities were observed during the year 2011.

In terms of social context, in some areas a considerable improvement could be observed. One such area was Jambugaswatte; through the Women's organization established by the project, a number of community activities could be seen implying more social integrity within the community. According to the information collected for year 2011, the members of the women's organization celebrated all the religious festivals of Buddhism and Christianity without discrimination. Irrespective of religion everybody celebrated Sinhala and Tamil New year in April where they organized a New Year festival and a fair. Additionally, in the event of a funeral, the Women's organization provided meals according to Sri Lankan custom. These changes indicate favourable improvements in the social system of the village Jambugaswatte.

However, in the other sections of the project area, no visible changes were observed. This is due to the fact that community component of the project was more focused on the village Jambugaswatte due to the limitation in time, funding and other resources.

3.4 Climate context

According to predictions, the coastal and riverine ecosystems in the project site will mainly be affected by sea level rise. In Sri Lanka's First Communication to the United Nations Framework Convention on Climate Change (UNFCCC) in 2000, sea level rise was identified as a major impact envisaged affecting the country's densely populated coastal areas. Among the impacts associated were inundation, coastal erosion and salt water intrusion. According to the Communication to UNFCCC, the projected sea level rise in Sri Lanka is 1 meter by 2070.

The climate has been affecting project work in a considerable way. Since the project area is located in the intermediate zone of Sri Lanka, it receives rainfall during the both

inter monsoon periods. But, unlike identified historical weather patterns, rainfall to this area has become more erratic and unpredictable. A considerable rainfall was noticed throughout the year and low flow of the river was observed only during a short period. The low flow observed was also not adequately low. (Usual low flow records show a flow of 2 m³/s). These weather patterns affected ground level implementation of some of the project activities and caused delays.

3.5 Missed opportunities

The duration of the project; 24 months was barely adequate for the implementation of the project activities effectively. There were also many auxiliary activities that could have been implemented with the core activities, which would have added more value to the project. Some of these, were tree planting programmes with school children and communities in the project area, strengthening of river banks with the Department of Irrigation, more training on alternative livelihood options amongst other things. At the latter part of the project, many people in the community were ready to undergo training and start self employment, however due to the insufficient time available for post-training support and insufficient financial and human resources available with the project at that time, it was not possible to support the communities more fully with alternative livelihood options.

There were other programmes on community training and awareness raising conducted by local councils of the project area, which could have incorporated aspects of the project activities but could not take place due to limitations of project time and human resources availability.

4.0 Project Results (Outputs): Review of all project outputs

There were four key outputs of the project; with the objective of environmental conservation and increased community resilience. They were:

- Generation of scientific data on the river and coastline which are policy relevant and useful in decision making and a valuation of critical ecosystem services that benefit communities
- Dissemination of information generated in output 1 and 2 to stakeholders of the project through publications, with the objective of stakeholder empowerment in order to direct policy and decision towards a scientific rationale
- Design a restoration strategy for some of the degraded areas of the river

A number of activities were planned and implemented in achieving the above outputs. In this report, each result of the activity is explained with its relevance to the project objective.

4.1 Results of output 1

Output 1 of the project was designed as an integrated assessment of ecological, hydrological-livelihood and a model to identify the nature, magnitude and distribution of current and future threats to ecosystems, including those linked to climate change. The objective of this output was to generate practical and policy-relevant information to strengthen improved coastal and riverine environmental conservation and livelihood development planning and management. It was envisaged that once the activities under this section were carried out it would support future conservation activities, mainly through assessments involving tests, measurements, modeling and mapping of current and future threats, including climate change risks. The assessments carried out would support future and interactive activities within the local government areas and influence in key policy making in terms of sustainable extraction of resources, and conservation of sensitive ecosystems. Additionally, it was expected that this output would provide some baseline for future strategies to ensure human wellbeing through better conserved ecosystems in the years to come. It was envisaged that policy makers, river and coastal managers and communities affected would be better empowered to deal with the threats.

To achieve the above said objectives, research/activities have been planned under key subject areas of:

- Mapping changes in river and coastal morphology, ecosystems and land use
- Assessing the impacts of climate change
- Assessing threats from sand and clay mining
- An assessment of river pollution
- Assessing the relationship between coastal and river processes
- Identifying and mapping environmentally sensitive areas

4.1.1 Mapping changes in river and coastal morphology, ecosystems and land use

This activity was carried out in order to identify the changes of:

- River morphology
- Coastal morphology
- Land cover

This activity was carried out by an independent consultant recognized in the field and EFL project staff involved in taking periodic field measurements. The analysis was carried out using aerial images of the years 1956, 1972, 1994 and 2006, and Google Earth images of the year 2004 and 2010. Additionally, ground truthing was carried by the field staff of the consultant and project staff. The Geological Survey and Mines Bureau supported the study in carrying out two surveys in this regard - two GPS surveys of mined pits along the river and location of the river banks. These two surveys were supervised by a senior geologist at GSMB and were carried out by a few technicians using Differential Global Positioning System (DGPS) equipment.

The study of analysis of changes of the river morphology was carried out for a stretch of 15 km along the river at the first phase and another stretch of 15 km along the river at the second phase. Therefore, the area of the study was 30 km in total along the river from the mouth. For the analysis, aerial images, Google Earth images and the results of the DGPS survey carried out by GSMB were used. The analysis concluded that river morphology and the flow path have not been changed considerably over the considered 54 years from 1956 to 2010. The results are depicted in the time series comparison mapped in Annex 1a. For more details please refer to Report 1 on this study.

An analysis of the coastal morphology was carried out along a stretch of 25 km along the coastline to the North from the mouth of the river at Kochchikade. The study

concluded that severe erosion has taken place starting from the river mouth and due to the coastal mitigation structures constructed by the Coast Conservation Department; the erosion propagates northwards while the southern stretch was slowly getting stabilized. In some of the previously eroded areas, land accretion was observed, resulting in a net gain of land.

The net loss of land was 29.5 Ha within this period. 41% of the total erosion had taken place from Toduwawa to Chilaw due to the construction of Groyne at Toduwawa outlet in 2007. Since this area had been eroded before 1972, it has not been realized by the public, and no record could be found. 34% of the land loss has occurred close to the Maha Oya outlet up to Taldeka. Highest length averaged erosion rate is 1.32 m/yr in Wellamankara. The erosion rate from Wellamankara to Taldeka is 0.69 m/yr. Since Toduwawa to Chilaw shoreline reached a stable status by 1972, the erosion rate in the area was 2.13 m/yr. In the other areas the erosion rates varied from 0.20 to 0.41 m/yr.

In the analysis, carried out over a period of 54 years from 1956, a huge land/ beach accumulation could also been detected. The total accumulation is about 405,000 m² (40.5 ha, 100 acres). 76% of the accumulation has been observed from Marawila to Toduwawa. As it was observed that the accumulation has occurred before 1972, the rate of accumulation was 1.86 m/yr. Please refer **Report 1** for more detailed conclusions and methodology.

Changes of the land cover were analyzed using the aerial images, Google Earth images and field observations. The comparison of images concluded considerable changes in the land cover depicted by the map given in Annex 1b.

In the years of 1956 and 1972, the changes in the land cover were minimal, but the map obtained for year 1994 showed considerable number of clay and sand mined pits. The map developed for year 2010 showed increased land area degraded with mined pits indicating the exacerbated mining activities. Additionally, more changes in the land cover were visible with shrimp farms replacing wetlands and teak plantations replacing forest patches.

This study showed the relationship between mining activities and its impacts on coastal environment and riverine environment detailed to be river bank erosion, land degradation, mined pits and river enlargement. Further, this study opened up a new area for legal and policy research, the ownership of land which became a part of the river due to mining.

Please refer to **Report 1** for more information.

4.1.2 Assessing the impacts of climate change

There were 3 sub activities planned under this assessment,

- A bathymetric survey to generate baseline data on the bed level and as field data for salinity intrusion modeling and inundation modeling
- Salinity intrusion modeling, to identify the length of the river from the river mouth which would be affected by salinity due to sea level rise considering the existing river bed as a constant bed level
- Inundation modeling to identify the areas inundated due to sea level rise and changes in river flow

A bathymetric survey was carried out by the Hydrographic division of the National Aquatic Resources Development and Research Authority. The survey was carried out by single beam echo-sounding technology and a longitudinal profile and 13 profiles across the river were subject to the survey. These 13 profiles were within the river segment of 8 km from the river mouth and Dutch canal. The results of the survey showed that there were pits in the river with a depth of more than 60 feet with reference to the mean sea level.

Please refer to **Report 2** for more information.

Modeling of the salinity intrusion to the river was carried out by Dr. Nalin Wikramanayake and a Master's degree student from Lund University in Sweden. The model accounted the dynamic conditions of the river and climate change predictions. This model was developed using MathLab software and was calibrated using the data collecting during salinity monitoring. The model is capable of producing salinity values along the longitudinal distance of the river. This information is extremely important in getting the salinity values along the river. With more frequent salinity measurements the model could be refined further in future. The detailed methodology and operation of the model is given in the **Technical Summary**.

Inundation modeling was carried out by the Coast Conservation Department of Sri Lanka. The permanent flooding due to Sea Level Rise and seasonal flooding due to surface runoff at extreme weather in coastal regions have been analyzed in the study. The flood hazard assessments, in particular to the flood due to sea level rise, need elevation data at finer vertical resolution. The high resolution Digital Elevation Model, which is extracted from the coastal LiDAR survey, has been used in the study.

It was shown in the study that for the scenarios considered; mostly the same coastal areas were vulnerable to flood hazard in the Maha Oya low land corridor. Those areas

were laid in the downstream end of the corridor. The sea level rise impacts were only on the downstream end and flood hazard due to heavy precipitation would occur at both downstream areas and in the sand pits which were distributed over the entire area. However, due to the excess water accumulated in the sand pits, the vulnerabilities for flood hazard due to heavy precipitation in the downstream areas were reduced.

The flood hazard vulnerabilities due to precipitation shall be analyzed in a probabilistic approach, as it required more detailed measurements both in precipitation and topography. For this purpose, there are more advanced models for the assessment of flood hazard vulnerabilities. The methods adopted for this study could be considered as primitive, but the maps indicate the vulnerable areas qualitatively. **Report 3** provides more details on this study.

These 3 studies assess the synergistic impacts of climate change and sand mining activities in the river. With the changing river related parameters or climate dependent parameters, the conclusions derived could be changed.

4.1.3 Assessing the impacts of sand and clay mining

Sand and clay mining are associated with a number of impacts on the coastal and riverine environment. Almost all the studies of Output 1 were related to impacts of sand and clay mining, but under this study, more direct and other impacts which were not captured elsewhere were studied. Under this, several activities were planned as follows:

- Studying the water levels of the wells in the hinterland of the river
- Monitoring of salinity levels of river water and water in wells in the neighborhood
- River flow measurements
- Assessment of river bank erosion
- Identification of mined pits

It has been scientifically proven that the lowering of the river bed caused lowering of the water table in grounds in the vicinity. Sand mining in the river results in lowering of the river bed. Therefore, it could be expected that this has affected the water levels of the wells in the vicinity of the river. This was investigated in the project through a number of field measurements. The study was carried out by the Open University of Sri Lanka, by a team lead by Dr. Nalin Wikramanayake. Students of OUSL and EFL project staff were involved in carrying out field measurements under the supervision of Dr. Wikramanayake. Since, the data collection could not be completed within the project period due to unfavourable weather conditions (high flow of the river), further data

collection is being carried out by the OUSL. Therefore primary data is available and included in the **Technical Summary** with the preliminary findings.

Salinity monitoring of the river and the wells in the vicinity was carried out with the objective of obtaining field data for modeling salinity intrusion (under the impacts of climate change) to the river and getting an idea of the salinity levels of the river and wells in the vicinity. Salinity intrusion to the river might create saline conditions in the ground water causing salinity in the wells. Salinity was monitored in 46 wells in the project area and in the river for 4 km from the mouth of the river.

It was observed that some of the wells were detected with high salinity although they were located a few kilometers away from the sea. There were wells closer to the sea than those which were detected with salinity, but those were recorded with less saline conditions. Most of the wells located closer to mined pits were detected with high salinity.

The salinity levels of wells and river water in the dry season were much higher than the values in the wet season. In the river water, high saline conditions were recorded in both dry and wet seasons, even 4 km away from the river mouth. The salinity barrier constructed in 1984 at the river about 4 km away from the mouth of the river, where the NWSDB water intake is located is a good indication of the high salinity values recorded even a few decades back. These salinity values have been included in the **Technical Summary**.

Daily river discharge is very important hydrological information which could have multiple uses. Recording river discharge of Sri Lankan rivers is the responsibility of the Department of Irrigation. Since the 1950s, the Department of Irrigation had been calculating river discharge using Stage (height) – Discharge curves, measuring only the height of the water level. For the Maha Oya, river flow measurements had been calculated for two main stations, Badalgama and Giriulla. A Stage–Discharge curve is usually developed once a year. In the Maha Oya, discharge values were calculated until year 1998, but thereafter, this exercise was given up due to the fact that sand mining severely affected the accuracy of the Stage-Discharge curve. As a result of constantly changing river bed level, more frequent calculations were required to correlate the stage to the discharge of the river, which was not possible. Thereafter, no river discharge data was available for the Maha Oya apart from the calculations carried out using the Stage-Discharge curve developed by the Western River Sector Project in 1999. After 1999, no river flow data has been available for the Maha Oya. Due to the importance of availability of river flow data for the river, an attempt was made to develop the Stage-Discharge curve, measuring the low flow measurement of the river at Bambukuliya and Badalgama. Flow measurements were intended to be carried out in the dry season, with

the objective of capturing the low flow of the river. The attempts to take low flow measurements in year 2010 failed due to the erratic rainfall in the project area in August, 2010. Again it was expected to carry out the measurements in February, 2011, but it was possible only for Bambukuliya. By the time the study team reached to Badalgama, which is a more upstream station, higher flow was observed hindering the field measurements. In August, 2011, again flow measurements were carried out for the stations at Bambukuliya and Badalgama. The field measurements were concluded in August 2011, with two flow measurement readings at Bambukuliya and one measurement at Badalgama. Therefore, sufficient data could not be collected to derive the curve between height of the water level and discharge value. But with the available data, a preliminary curve was developed and details have been included in the **Technical Summary**. With few more data sets, the collected data could be used for more accurate and precise curve development.

Erosion of river banks has been identified as one of the key impacts of river sand mining and an activity was designed under the project to study the erosion of river banks. This activity was coupled with two other studies - the analysis of morphological changes of the river and the geological and soil analysis. As per the results obtained in the analysis of morphological changes of the river, the change of the river banks over time was minimal. It could have been due to the characteristics of the river inherited naturally with the geology and soil, river flow etc. At the same time, until late 1980s, the river was not subject to much stresses from outside. Additionally, it was observed that when the river flows across bends, the inner curve gets more sediment deposited and outer curve of the river is subject to erosion. This phenomenon is one factor that causes changes in the river flow path. Additionally, soil samples were collected from the places subject to erosion. The analysis of soil samples were carried out for determining the soil texture and conclusions were derived accordingly. The study was carried out in collaboration with an independent consultant who carried out the analysis of changes in river morphology and a team from OUSL led by Dr. Prasanna Rathnaweera, who carried out the geological and soil analysis. The river embankment materials were subject to sieve analysis and hydrometric tests. The following results were obtained through the geological and soil analysis with reference to the erosion of river banks. In addition to the technical field measurements, video recording of the river banks were carried out in order to establish the baseline conditions of the banks.

The results showed that no robust relationship could be established between the river bank erosion and embankment materials. But, it established the baseline information on the river embankment materials (soil type and their texture and composition). Detailed results and data are given in the Technical Summary produced by the project.

Mined pits are results of excessive mining of the sand or clay deposits in the inland or land adjacent to the river. Abandoned mined pits cause degradation of the land, and create other environmental and socio-economic problems. A mined pit survey was carried out in order to assess the degradation caused by mined pits. This activity was carried out in collaboration with GSMB and an independent consultant. In 2010, February, a GPS survey was carried out for mapping the mined pits in the project area. The results of the survey were compared against the time series aerial images and Google images available for the year 1956, 1972, 1994, 2004 and 2010 respectively. Additionally, more ground truthing activities were carried out to verify the information derived through the analysis of images. Final maps were prepared with the distribution of mined pits in the project area over the years starting from 1956 to 2010. Please refer to **Report 1** for more details and maps.

In addition to the mapping of mined pits, their area, average depth and water quality were analysed for some of the water quality determining parameters. The largest mined pit in the area was about 137 acres large and the deepest one was about 13 meters in depth from the datum level. Water quality results provided that salinity in most of these mined pits were high and in the pit closer to garbage dump at Kochchikade, the COD values were very high. Some of the pits were abandoned, and not all pits were filled with water. An additional survey was carried out in another study to categorize these pits in order to provide more useful information for their future management. The data and results of the analysis are given in the **Technical Summary**.

4.1.4 Assessment of river and coastal pollution

Pollution of the river can be either direct (point source) or indirect (non-point sources). The Maha Oya is subject to both point source pollution and non-point source pollution as per the information available with previous studies. Under the project, two studies were designed to assess the pollution of the river, both from point sources and non-point sources.

A pilot fertilizer run off study was designed to assess the level of pollution contributed by agricultural activities in one of the sub catchments to the Maha Oya. Paddy cultivation in Makandura, Sandalankawa sub catchment, which is about 100 Ha was selected for the study and fertilizer run off was assessed during the Maha season, which is mainly rain-fed agriculture. This study was a continuation of the study carried out by Wikramanayake et al in 2002, to assess the impacts of fertilizer subsidy granted by the government on pollution levels of Maha Oya. This study too was carried out by Dr. Nalin Wikramanayake of OUSL while EFL project staff supported with data collection and analysis.

Field data on fertilizer application, agriculture, land, area and other relevant information were collected through a structured questionnaire. Rainfall measurements and the runoff measurements were carried out on the field; the rainfall data was verified with the rainfall measurements carried out at Makandura Agriculture Research Centre. Data analysis was carried out by Dr. Nalin Wikramanayake and it concluded that fertilizer runoff from the paddy fields located at Sandalankawa sub catchment contaminate the Maha Oya and that over time, the fertilizer runoff is in a decreasing trend with comparison to the study carried out in 2001. This is a positive fact since river water contamination by the fertilizer applied to paddy fields in the catchment is decreasing. Further details on the methodology and fertilizer load have been given in the **Technical Summary** on Output 1.

A number of water quality assessments have been carried out for the upstream of the Maha Oya by various research groups. But the studies carried out for the downstream were not many, thus it was planned to carry out an analysis of water quality of the river and wells in the vicinity during both the wet season and dry season. It has been observed that Maha Oya is subject to point source pollution at a number of locations along its traverse. A number of industries discharge both treated and untreated effluence to the river illegally, causing deterioration of the water quality of the river and ground water associated with.

In July, 2010, wet season sampling was carried out in collaboration with the Institute of Fundamental Studies (IFS) at Kandy. Samples along the river and few wells selected were collected and analysis was carried out on site and at the IFS laboratory. In August, 2011, when the river flow is low, the dry season sampling was carried out again with Institute of Fundamental Studies. In addition to the water samples, a sediment sample and a predator fish were analyzed for heavy metals.

The results of these two sample analyses showed that the river water was polluted to a considerable degree. Wells located closer to the garbage dump in one of the abandoned mined pits of the river were detected with the worst water quality. The sample collected from the river closer to the garbage dump was again detected with high COD and BOD₅ values and conductivity values. But the number of samplings carried out and the duration of the monitoring were not adequate to derive conclusions upon this study. More detailed information is given in **Report 4** of the project. It is recommended to carry out more frequent sampling over a period of at least 3 years to conclude the quality of the water in these wells and river.

4.1.5 Assessing the relationship between river and coastal processes

In the Maha Oya, there are two inlets to sea - the river mouth and the inlet opened after the 2004 Tsunami, which is located about 1 km from the river mouth of the Maha Oya. Through these inlets the river connects to the sea, where the river processes and coastal processes are interlinked. These processes could basically be identified in two aspects, sediment transport and salinity intrusion.

The sand in the beaches are transported northwards by the waves and the deficit of the sediment in the coast is supplied by the rivers to maintain the sediment equilibrium in beaches. The Maha Oya transports and supplies sand to nourish the coastline from the river mouth at Kochchikade to Chilaw. Additionally, during the ? tidal period and dry flow of the river, saline water inflows and river water becomes more saline and brackish. These phenomena are controlled by the width of the inlets which is seasonally variable. Therefore, under the project, two activities were carried out, a study to identify the relationship between river processes and coastal processes in terms of varying inlet width, and changing shoreline and salinity intrusion to the river. Frequent measurements of the width of the inlet and retreatment of the coastline for a stretch of 25km from the river mouth to the northwards were carried out. For the first 15 km to the north of the river, measurements of the retreatment or advancement of the coastline were carried out in 100m intervals and for the next 10 km, measurements were carried out in 500m intervals.

The study concluded, that with the varying river inlet width (including river mouth), the rate of sediment transport to beaches changes which consequents in changing rate of erosion of the coastline. During the second inter-monsoon period at October each year, the mouth of the river is at its widest position and erosion rate becomes the highest. In the June-July season where the South West monsoon prevails, the inlet closes and erosion rate becomes low.

Salinity intrusion to the river occurs from the inlets to river, including the river mouth and during the periods of South West monsoon, the river mouth closes and salinity intrusion is remarkably low. During the periods of second inter monsoon in October, the river mouth is at its widest position and salinity intrusion is very high.

Detailed results and primary data are given in the Technical Summary.

4.1.5 Collate of results and producing a map of sensitive areas

It was planned to collate all the results of the activities carried out under the Output 1 and declare environmentally sensitive areas, however, with the information gathered through the project and considering the results obtained through the research activities, it was decided to carry out an additional preliminary ecological survey. In October, 2011, this survey was conducted by an independent consultant, and the results were passed to the consultant who carried out mapping. Additionally, mined pits in the project area were identified as one of the crucial areas that should be attended to by the river basin and environmental managers. Therefore, the mined pits in the area were categorized in order to provide information for future management of these pits. Two maps were produced under this study.

More information and the maps on this study are given in **Report 5**.

4.2 Output 2

The second output of the project is an economic justification to conservation of ecosystems which provide ecosystem goods and services. The project area in the Maha Oya comprises of a number of ecosystems including the riverine, estuarine and coastal wetlands. In general, services provided by these ecosystems are rarely valued and not subject to discussion in monetary terms. Economic valuation of ecosystem goods and services provides important information for management and policy, and also estimates the cost of degradation which occurs in harnessing the ecosystem goods and services.

For the Maha Oya, the values were calculated for different stakeholder groups; local communities, business and industry and government. The components under valuation were scoped to water, fisheries, sand and clay, land, tourism and recreational activities due to the limitations posed by availability of data and information, time and financial resources. The study was carried out by an independent consultant and EFL project staff under the supervision of Lucy Emerton, an independent consultant and Dr. Nalin Wikramanayake.

The study found that the current values associated with water use, fisheries, sand and clay extraction, and tourism in the study area were worth at least LKR 1.7 billion per year. The economic costs of ecosystem degradation, including those associated with land degradation, coastal protection, river rehabilitation and displacement of people, were estimated to be almost LKR 1.2 billion in 2010.

The economic impacts of ecosystem conservation and degradation to various stakeholders were assessed through modelling two different scenarios. These were 'Business as Usual' (BAU) – a situation where ecosystem degradation progressively

worsens over time, and 'Ecosystem Restoration and Sustainable Management' (ERSM) – a situation where sufficient investments are made to improve and safeguard the integrity and health of the ecosystem. The study showed that overall, there is a clear economic gain from ERSM as compared to a continuation of BAU. Calculated over 25 years, it yields an incremental benefit of LKR 849 million: the net present value of ERSM (LKR 7.6 billion) is 1.13 times that of BAU (LKR 6.8 billion). ERSM leads to a significant reduction in the damage costs associated with ecosystem degradation and loss, while maintaining (and even in some cases increasing) the economic values generated from the sustainable use of land and resources. Under BAU, costs are incurred to government and local communities as ecosystem service provision declines, undermining income and employment, as well as giving rise to a range of physical expenditures and losses. Under the ERSM scenario, all stakeholders benefit.

The results of this study show that the stakeholder groups that are driving ecosystem degradation and loss – primarily the mining industries that operate in and around the river – are not bearing its costs. These accrue as externalities to society at large and the broader economy, mainly affecting government and local communities. The study recommends the preparation of a Management and Action Plan for the Maha Oya and its associated ecosystems, focusing on ecosystem restoration and sustainable management. It calls for a multi-stakeholder approach to problem solving, including the effective coordination and cooperation between responsible government agencies such as the Geological Survey and Mines Bureau, Irrigation Department, Coast Conservation Department and local administrative bodies. The enforcement of existing laws and policies to minimise illegal activities that exacerbate the externalities of environmental degradation is also essential. It recommends the use of a variety of economic instruments which would internalise environmental externalities, and provide incentives for sustainable land and resource management. These basically aim to penalise those whose activities contribute to ecosystem degradation, so as to raise funds for restoration and compensate for the costs of environmental damage. It is also essential to prepare a compensation scheme for those in riverine and coastal areas that suffer from the impacts of environmental degradation. Additionally, it is important to ensure that adequate economic incentives are provided to those who contribute towards ecosystem conservation and restoration, through the provision of funding, livelihood support and other rewards. These recommendations if incorporated into policy and action plans, and if implemented effectively, can help to ensure that the resources of the Maha Oya can be utilised in a sustainable manner, benefitting all stakeholders, minimising environmental degradation and preserving ecosystem services. The findings

of the study were disseminated through a publication to the relevant stakeholders influential in decision making and policy formulation.

4.3 Output 3

The Output 3 of the project was aimed at dissemination of policy and decision support information to stakeholders and empowering stakeholders in ecosystem conservation. A number of activities and sub activities were carried out under this output.

4.3.1 Publications

The first activity was to produce communication materials of the information generated through the project for dissemination. Four publications were made available as a result, a Technical Summary which is an amalgamation of important research findings of output 1. Although the original plan was to produce a combined report of output 1 and 2, later, two separate reports were published for each output. The scientific information generated and economic valuation carried out raised a number of implications regarding the existing policy and legislation. These findings were documented and disseminated through a Policy Summary. It is expected that this document would be instrumental in a number of changes to the existing policy and legislation targeting conservation of the important ecosystems of the project area.

Three (03) brochures and three (03) posters were printed for dissemination among school children and other stakeholders as awareness materials. A brochure and a poster were printed in Sinhala for school children. For the other stakeholders at local and national level, a brochure and a poster were printed in Sinhala and English. These materials highlighted the issues affecting the health of ecosystems associated with the Maha Oya, and their impacts on communities and other stakeholders. These communication materials were disseminated in number of workshops organized for school children and other stakeholders.

A documentary of 30 minutes was produced on the issue of sand mining and its impacts on the riverine and coastal environment. The documentary is a summary of the issues and impacts and the solution attempted through the project. In addition to the other publications and project communication materials, copies of the documentary were distributed among the interested parties, media personnel and other stakeholders.

4.3.2 Workshops for coastal and river basin planners and decision makers at different levels

Three workshops were held in this regards: two project introduction meetings at the inception stage of the project and a final forum for dissemination of the project findings to the national and local level stakeholders. The first two meeting were targeted at national and local level stakeholders respectively. The objectives were to introduce the project to the stakeholders and get their suggestions and comments which could be incorporated into the implementation of the project. Additionally, it was intended to get their future support in implementing the project activities. As expected, local stakeholders who were more aware of the issues and who were affected by the impacts were more enthusiastic on providing suggestions to improve the outcomes of project activities. Their comments were considered and some of the suitable suggestions were incorporated in activity implementation.

As the last activity of the project, a forum was organized for stakeholders representing the government sector, academia, non-governmental organizations and private sector. Most of the invitees representing these sectors participated and contributed to fruitful discussions. The Geological Survey and Mines Bureau, the Coast Conservation Department, the Department of Irrigation, the National Water Supply and Drainage Board, the Police, the University of Moratuwa, and the Sri Lanka Water Partnership were among the important organizations present. The findings of the project were disseminated among the participants through publications and presentations. The forum provided a platform for discussion among stakeholders, and as a result, a number of ideas were put forward. Many stakeholders were made aware about the availability of information on the Maha Oya, and a number of networks were formed by the participants for future action.

More information on the outcomes of the project is given in the **Report 7b**.

4.3.3 Awareness and capacity building of school children and media

School awareness programmes were carried out in three schools in the project area with the objective of raising their awareness on environmental conservation and sensitizing them towards the environment. These three schools were

- Sindarthyia Sindukumari Vidyalaya
- Muruthana Kanishta Vidyalaya
- Katana Vidyaloka Vidyalaya.

About 125 students participated in school programmes representing these three schools.

School awareness programmes were carried out for nearly 15 months in these three schools from July 2010 to September 2011. Activities were started with simple waste management and home gardening, and in between these activities awareness programmes were also carried out. These awareness programmes comprised of simple lectures on environmental conservation, biodiversity in Sri Lanka, valuable ecosystems of the Maha Oya and threats to ecosystem services. At the same time they were made to carry out simple science projects on bird surveys, water level of the river, rainfall measurements etc. At the end of these activities, a programme ending workshop was organized in Sindarthyia Sindukumari Vidyalaya with the participation of students of all three schools who were trained under the school programmes of the project. Officers of the regional education offices also participated in this programme. Certificates were awarded to students and the teachers support was appreciated. More information is given in **Report 8**.

During the project implementation period, EFL worked in close collaboration with the media, in order to give prominence to the indiscriminate sand mining issue among other environmental problems. In September 2011, a news clip was aired in Derana TV as a result of the EFL's media campaign on the sand mining issue. In November 2011, EFL organized an onsite workshop at the Maha Oya project site. 13 media representatives from the printed and electronic media participated. They were taken on a boat ride on the river and community meetings were arranged. Thereafter, they were shown the eroded areas in the coastline and the linkage between river sand mining and coastal erosion was explained. In the afternoon session, presentations were given on policy and legislation, and the science behind the impacts of indiscriminate sand mining on coastal and riverine environment. The documentary, drafts of policy document, brochures, posters and other maps useful in their communication of the issue were distributed among them. This programme was held at the end of November, but within a period of 1 month, two newspaper articles in the Rivira and Vidusara newspapers were published. Another video clip on the Maha Oya issue was aired on the Rupavahini news telecast in the first week of December, 2011. In November, a half an hour programme was broadcast on Sri Lanka Broadcasting Cooperation's "Mihithalaya" programme. It is expected that these articles and news clips will create a voice within the general public, that the authorities will pay more attention to the degradation of rivers in Sri Lanka due to river sand mining, and create a resistance to river sand mining within the communities and it will be recognized as equally important as deforestation, air pollution or climate change. More information is given in **Report 7a**.

4.3. 4 Alternative livelihoods

Life and livelihoods of communities in the downstream of Maha Oya are intricately linked and related to the river in one or many ways. Since the 1980's, people have been engaged in sand and clay mining related activities in this area. With the onset of rapid economic development, sand and clay mining and associated activities became one of the most popular livelihoods in these localities. In the project area, which comprises a 12 km long stretch of the river, it was estimated that over 5,000 people depend on sand and clay mining as their primary livelihood. In the mid 80s, due to the minimal cost of production and high selling prices, additional business groups with clout entered into the business, suppressing the traditional miners. These business groups were often empowered with political power and wealth; they deployed sophisticated equipment to mine out sand in bulk quantities. Traditional sand miners were unable meet the financing requirements to purchase mechanized mining equipment and were unable to compete with the business groups in harvesting this natural resource.

Community programmes of the MFF Maha Oya Project were carried out in two ways: the first one being proposing alternative livelihood options to communities in the area, with special emphasis on sand and clay mining communities. The other community work will be discussed in the next section of this report.

As a method of supporting communities who lost their income earning opportunities due to the degradation of the river, and as an incentive for switching their livelihoods (of sand and clay miners) to an alternative, EFL introduced a number of alternative livelihoods to the communities in the project area. Due to limitations in time and available resources, EFL envisaged piloting this programme in two of the villages in the Katana project area, namely Jambugaswatte and Thoppuwa. During the initial community meetings held in these villages, people were introduced to nearly 25 alternative income earning activities with details of preliminary market research and return on investment analysis. Considering the market available, capital investment required, and skills demanded among other things, people selected different livelihood options. EFL agreed to carry out free training and provide support to commence business etc. The following is a brief account on each of these activities:

a. Shoe manufacturing

Twenty four (24) males and females received this training and initially 2 groups and a few individuals commenced business. EFL provided financial support to the two groups engaged in shoe manufacturing, to upgrade their manufacturing facility by donating a sum of Rs. 100,000. Currently, the two groups, consisting of 10 and 4 employees respectively, supply shoes to "The Lover" business

organization. One group manufactures around 1,200 pairs of shoes per month. Their monthly income varies between Rs. 10,000 – Rs. 15,000 per member. The second group consisting of 10 is hoping to improve their manufacturing facility with additional machines under the patronage of the Member of Parliament in the area, Dr.(Mrs). Sudarshani Fernandopulle. Sixteen (16) months since the initial training, more than 18 former sand miner's families have begun to reap the benefits of this training and provide support to their families to enjoy better living standards with the supplementary income earned.

b. Inland fishing

This training was carried out for 9 people (males) in the area. They work as a group with one individual leading the group. The third cycle is currently ongoing and four cages of 1,000 fingerlings are currently in stock.

c. Bag manufacturing

Bag manufacturing training was given for four (4) people in Thoppuwa. Of them, one individual, a former sand miner who had been engaged in mining for over 14 years, has commenced his own bag manufacturing business and has opened a shop under the support of EFL. He is also able to provide bags in bulk for private orders. The others in the group manufacture bags and supply to shops in the local market.

d. Yoghurt manufacturing

This training was given to 4 people and they currently carry out the business in two groups. EFL supported both groups to purchase raw materials. One group was supported to purchase an incubator worth Rs. 76,000. In total, 3 families are able to have a better life with this business and the groups are looking at expanding the business with other milk products.

e. Anthurium Cultivation

A training on anthurium cultivation was carried out for 6 people in the Jambugaswatte area in Katana. The capital investment per group was around Rs. 150,000 and loans were arranged through some of the banks operating in the area. Both groups that commenced business are currently doing well and will receive their first profits in the coming months.

f. Ladies garments, door mats and handcrafts

Ten (10) women in the area were provided with the opportunity and are now grouped in to three groups that manufacture ladies garments, door mats and various handicrafts. Their products there are sold in the local market and it has been identified as a substantial income earner.

g. General Support

Other than the forms of support mentioned above, EFL provides all the business groups/individuals supported under the project, a 3 hour workshop once a month, on financial management, marketing tips, accounting and book keeping, promote savings and behavioural and attitudinal change favourable for socio-economic development and environmental sustenance. Additionally, EFL introduced organic home gardening concept to this area supporting them with the techniques, seeds and an initial lot of organic fertilizer.

h. Women's Organization

As one of the first activities under the project, EFL formed a women's organization in July, 2011 with 14 members. Most of them represented the families of traditional sand miners. All the female trainees for alternative livelihood are selected from this organization. Anybody interested in getting the training should become a member of the women's organization and should participate in their monthly meetings for 3 months. Today, it has grown to a 32-member organization and is very active in the area. They represent various religions and cultures. During their one year operation, they had various functions to celebrate Christmas, Sinhala and Tamil New Year, Vesak and Poson Poya days. Additionally, they organised fairs, from time to time, to sell their products. They promote environmental conservation in the project area. Manufacturing and selling environmentally friendly cloth bags for grocery shopping is one such activity.

For sustenance and to harness better opportunities, this women's group was linked to the District Women's Association backed by the government and local politicians in the area. In August 2011, they celebrated their first year anniversary on a grand scale with the presence of local politicians, government representatives, officers from the Local Councils and officials from the other women's organizations in the neighbouring areas.

More information is given in **Report 9**.

4.3.5 Provision of advocacy and supporting conflict resolution activities to aggrieved communities

Due to the indiscriminate sand extraction from the Maha Oya and adjacent lands, river banks were eroded and the land became unusable due to large mined pits. Those who lived adjacent to the river lost their land, and were often innocent victims who had nothing to do with mechanized sand mining. Their issues were further exacerbated with the loss of fish breeding sites, diminishing fish stocks, and the loss of income from tourism. Not having a proper knowledge on how to handle the situation and the redress available, it became a very chaotic and desperate situation. The degradation of the river impacts in multiple of ways and the majority of people suffered due to the activities of a few who benefited immensely. This was the prevailing situation when EFL commenced its community awareness programmes, environmental advocacy and conflict resolution activities in the Maha Oya downstream area.

Under this activity, EFL supported communities with environmental advocacy work. The communities were empowered through raising their awareness on environmental rights and responsibilities. They were informed that just as there are rights for the individual, there are also responsibilities the individual must fulfill towards the environment and the country in general. Additionally, they were given awareness on redress and relief available to them under the current legal framework. EFL updated communities on the changes in the legislation regarding sand and clay mining, as a majority of the community members are sand and clay miners and EFL is a party to the ongoing sand mining case in the Supreme Court. In this regard, EFL organized a series of community meetings, meetings with Police and GSMB and communities and carried out awareness programmes for the Police, Grama Niladhari and Divisional Secretariats. For these conflict resolution activities, EFL obtained the support of politicians in the area, local authorities and other influential people in the area. After two years, a noticeable rapport has been built among communities and authorities, but it is recommended to support the communities and other local level stakeholders in strengthening these relationships. More information is given in **Report 10**.

4.4 Output 4

4. 4.1 Pilot restoration and rehabilitation of river banks and mining pits

Pilot restoration of some of the degraded areas was one of the formulated activities in the original plan of work of the project. This activity was planned to commence after the completion of a substantial part of the scientific research, specifically the geological and soil analysis and study on river bank erosion. Before, the commencement of the restoration activities, EFL organized a consultation session on restoration in order to get

the views of experts in the field in terms of suitable mechanisms, socio-economic requirements, community and other stakeholder involvement and suitable plant species to re-create the original ecosystems in the area. As an outcome of this event, a set of guidelines were developed that should be followed in river restoration. A comprehensive report on the outcomes of this consultative session has been given as **Report 11**.

In January 2011, a plant nursery of about 1,500 plants was established in the area to be planted through the restoration programme. The plants which do not grow fast in the established nursery were bought from other nurseries outside. Two plots were selected for the first phase of restoration. For the selected plots, pegging was carried out to trap the sediment and, tree planting was carried out on the river banks. Tree species were selected as per the guidelines developed during the consultative session. More details on the restoration programme have been given in the **Report 12**. The observations made after a few months on the restoration sites proved that the tree planting was a success when it was coupled with pegging to trap the sediment.

After the second Monitoring, Learning and Evaluation (MLE) visit, the recommendation was given to stop the physical restoration programme. Instead, a desk study on river restoration strategy of a few degraded areas in the Maha Oya was recommended. In the restoration strategy, it was recommended to select a few plots for which the different restoration mechanisms should be adopted. For each plot, a suitable restoration strategy was to be proposed based on a scientific rationale.

To start with this new activity, the river banks were video recorded. Then about 9 experts in the field of river restoration, geology and soil and plant species were selected for consultation. With these consultants, a colloquium on river restoration was organized in Negombo in the first week of August 2011. The consultants were taken to the site and the degraded river banks were shown to them during the boat ride. Thereafter, their expert views applicable to the project site were obtained through presentations and documentation. In parallel to these activities, the geological and soil analysis was carried out in order to understand the phenomena associated with river bank erosion and possible solutions in strengthening the river banks. The river flow characteristics were also studied since the results would be useful in understanding the erosion mechanisms. With information shared during the colloquium and information gathered through literature, the restoration mechanisms were proposed for the selected plots. The results of the output 1 also have been used in this exercise. The detailed document prepared on the restoration strategy has been given in **Report 13**.

This report would be useful to the Department of Irrigation, Central Environmental Authority or any other private, government or non-governmental organizations who wish to carry out restoration of river banks with a technical approach. It is a comprehensive

document on the restoration mechanisms and guidelines on the processes. It is expected to disseminate this report to interested parties as a soft copy. It is also envisaged that the funding agency would also collaborate in disseminating this knowledge to a wider audience.

Other than the activities carried out as mentioned, above plants in the nursery were distributed among Community Based Organizations, and EFL organized tree planting campaigns in collaboration with GSMB and CBOs. These CBOs include Traditional Sand Miners and Transporters Association and the Women's Organization established in the area. Additionally, trees were distributed among school children to get them involved in tree planting. In all these programmes, the technical knowledge in tree planting and maintaining the planted trees has been given to them. Community participation was considered as high priority and the ownership of these activities was vested with them for sustainability.

4. 4.2 Investigating issues of environmental degradation which affect communities

The objective of this activity is to prevent illegal environmentally degrading activities in the project area. EFL investigated issues based on the complaints received from the general public in the project area through site visits and meetings with key informants. Throughout the project implementing period of 19 months, from January 2010 to August 2011, EFL investigated the following issues:

Illegal garbage dumping in one of the mined pits located along the Maha Oya Downstream

EFL investigated the issue and it was brought to the notice of the relevant authorities including the Western Province Waste Management Authority and the Negombo Municipal Council. EFL facilitated a meeting between these two parties and created a platform for resolving this problem. Details in this regard have been sent in previous progress reports.

Illegal mining activities near the water storage tank in the Bambukuliya water intake area

This issue was brought to EFL's notice by the Gampaha Regional Office of the National Water Supply and Drainage Board. Immediate results were obtained following meetings with GSMB in this regard. A "No Mining Zone" for the zone subjected to illegal mechanized mining was declared as a result. Details in this regard have been sent in previous progress reports.

Illegal mining activities carried out in the river

At the initial stage of project implementation, EFL observed many incidents of illegal mining activities in the project area. From time to time, this was brought to the notice of the GSMB, and a series of meetings were conducted in this regard. EFL participated in stakeholder meetings at which the GSMB, Dept. of Irrigation, Central Environmental Authority and Environmental Authority of North-Western Province participated. It was decided to label the boats of those who have legal mining licenses so that anyone can easily identify illegal mining activities. The second decision was to carry out a sand survey which could be used as a basis for issuing mining licenses in future. This activity was completed with the participation of relevant stakeholders.

Illegal garbage dumping adjacent to a tributary of Maha Oya in one of the sub catchments of Maha Oya downstream

This information was provided by a Grama Niladhari officer in the project area. EFL carried out a site visit to this area located in Dummaladeniya and interviewed a few key informants including the Chief Priest of the temple located in the area and a villager. They provided valuable information and EFL found out that the garbage dumping were carried out by the local council in that area. EFL corresponded with the relevant local council formally requesting them to stop this activity and explaining the adverse impacts. Subsequently, the local council identified an alternative site for dumping the municipal waste and the problem is now resolved.

Illegal discharge of industrial effluents to Maha Oya downstream

During, the survey conducted by EFL for data collection in relation to the Ecosystem Valuation Study, a number of households mentioned that the river water could no longer be used for domestic purposes due to poor water quality. Later, EFL carried out 3 site visits to gather information and identified 8 industries that discharged untreated industrial effluence into the Maha Oya. EFL interviewed a few key informants and collected available data within the legal framework. EFL carried out two subsequent boat rides to identify the discharging points and recorded the sites with GPS coordinates. The information collected was documented and forwarded to the Central Environmental Authority for further investigation and action. This report is given as **Report 14**.

5.0 Project Inputs

Inputs were made to the project in terms of staff, consultants, equipments and facilities.

Although the project was intended to be implemented with only two full-time staff namely the Project Manager and Science Officer, these plans were changed according to the requirements of the time. During the initial stage of the project, only the Project Manager worked fulltime, with the support from the Environmental Scientist, Communication Officer and Legal Officer contributing 25% of their time for the project. Additionally, the Accountant and Driver contributed 25% of their time to the project. There was a fulltime Accounts Assistant for the project. Although an Environmental/Science Officer was required for the project, recruitment was delayed until the project funds were received in January 2010. From January 2010 onwards, an Environmental Officer was recruited full time for the project. In July 2010 a Research Assistant was employed for the project full time, and in December 2010, he was promoted as a Field Officer. In December 2010 the Environmental Scientist of EFL who functioned as the Environmental Scientist of the project resigned from her post and started working as an external consultant for the Ecosystem Valuation study. In January 2011 another fulltime Environmental Officer was employed since the workload for the first Environmental Officer and Field Officer was extensive. In May 2010, the service of a full time Community Officer was obtained. In July 2010 a part time Environmental Education Officer was employed for carrying out school programmes. Since, January 2011, the service of the full time Community Officer was not available due to insufficient funds allocated for administration expenses. Since then, the part time Environmental Education Officer, who had the competency of a Community Mobilizer, worked full time for the project carrying out both school programmes and community activities. Since June 2011, the service of the Community Officer was no longer available due to the lack of funds in continuing his service however, he worked as a consultant for school and community activities of the project until the date of completion. In early October 2011, the Field Officer resigned from the position. Whenever, the services of the Community Officer and Legal Officer were more than 25% of their official time to EFL, they were paid for extra hours. All the staff which could be paid with the MFF Budget allocation was paid by the EFL under co-financing. Other than the above mentioned, EFL staff, many consultants provided their services to the project; payments were made on activity or target basis. Dr. Nalin Wikramanayke was contributing to the project in overall project development and implementation in addition to his inputs to Output 1 and 2.

In addition to the above human resources, a number of consultants representing government sector, academia and other sectors contributed to the project in carrying out various activities.

In terms of equipments, two laptops, a camera and a salinity meter were purchased from the funds granted by MFF. EFL co-financed with two other laptops (for the field officer and community officers), and a desktop computer.

EFL co-financed with the office space, related facilities and other administration services. .

6.0 Financial statement

The financial statement together with the details of co-financing is given separately. Other than the designated activities for co-financing, EFL expenditure on project activities was considered as co-financing. GSMB and Open University of Sri Lanka also contributed to some of the project activities without payment for their services. These services were valued at the rate of market prices and included in the co-financing statement.

7.0 Impact Assessment

The project completed 2 years implementation on 30th November, 2011. The time available for observing the impacts of the project is short, but still a number of positive project outcomes were recorded with high effectiveness.

Overall, it could be stated that there is a considerable reduction in mining activities in the river, which is partially attributed to the project. Jambugaswatte, which was a totally degraded area in 2009, has now been naturally restored to an extent due to the minimized illegal mining. In the first 2 km of the river from the mouth, mining is totally banned by the Coast Conservation Department. In 2009 and the first half of 2010, a number of illegal mining activities were observed. Over time, the number of illegal mining incidents reduced. Over these two years, the number of license holders in the project area as well as another 10 km upstream from the project area has reduced as per records of the GSMB. An obvious reduction in the mining community was evident. The other factors that contributed to reduction in mining activities were erratic climatic factors, unavailability of sand, inconsistent income and a more effective law enforcement process. Proper law enforcement is also a result of the project.

As a result of reduction of stresses to the river and positive impacts in terms of restoration, the environmental quality of the river is in the process of very slow improvement. Newly eroded river banks were not visible; some of the previously degraded areas were slowly getting in to natural status. As mentioned earlier, Jambugaswatte river meandering site, one of the most degraded areas, has been much improved compared to the conditions that prevailed in latter part of 2009. It is still too early to give the improvement of the river as a percentage as it requires a proper survey with a lot of resources.

With reference to the output 1, it generated a vast amount of scientific information as baseline data and useful information for management. This baseline data is expected to support future research in the project area on the aspects covered under output 1. In this regard, EFL got one opportunity to collaborate with two eminent researchers in the University of Moratuwa to work with one of the research problems investigated under the project, which is in the process of materialization. As mentioned above, 5 researches on the project area have been in progress, the research questions have been triggered through the project.

In terms of using the information generated through the project, the following occasions could be recorded.

- The time series analysis of the changes in the coastal morphology has concluded that coastal erosion propagated more northwards in parallel to the construction of

groyones and other stone structures to mitigate the erosion in the existing area. Using this information, CCD has made changes to their coastal erosion mitigation activities by deciding beach nourishment with offshore sand instead of constructing stone structures.

- The information generated through the project was passed to GSMB from time to time and understanding the devastation caused by excess mining activities, GSMB decided to carry out a sand survey and issue mining licenses based on the sand availability. This could be recorded as another impact of the project, which took place within the project duration itself.
- As a result of the restoration programme that EFL carried out under output 4 of the project, EFL got the support of GSMB to incorporate the restoration/rehabilitation aspects as one of the terms of the existing permitting system. That is another outcome of the project which would continue for a long time. This is a result of the map developed after time series comparison of land cover changes, which depicted a drastic increase in the number of mined pits in the project area.

Other than the use of generated information for decision making, the project has made impacts in other aspects also. During the project implementation stage, EFL and project partners had frequent meetings with other stakeholders. These meetings helped other stakeholders to meet and share their ideas, and number of networks has been built up. This provided more effective ways of managing ecosystems, since the different components of the ecosystems have been managed by different mandated institutions separately, in the previous case. The linkage and relationship between components within an ecosystem are intricate and cannot be considered in isolation. Therefore the managerial interventions should be more planned and these components need to be considered holistically. Thus, in managing these components, more integrated management is required and proper communication among these institutions should be established. This requirement was identified and highlighted through the project and it has been enabled to a certain extent. For example, EFL urged the necessity on consulting other institutions in the decision making process of EFL, thus most of the meetings held for important decisions, GSMB consulted Department of Irrigation, Central Environmental Authority, EFL and North Western Environmental Authority. Due to the effectiveness of this process, it is expected that GSMB would continue with this process and EFL attempted to promote this process among other stakeholders as well. More improvements are required in this process, which will be discussed under recommendations.

In certain cases, it was reported that in spite of good rapport among the stakeholders, information required for decision making and implementation of certain activities did not flow well among them. This undermines the effectiveness of certain activities, which was experienced with Police Stations in the project area and GSMB. Information on new permit systems were not communicated to the Police Stations properly and information on law violations were not passed to GSMB for cancelling their licenses or blacklisting license holders. Under the project, EFL tried to bridge this information gap, but still more improvements are deemed necessary.

Under the project, EFL was able provide the solution for Illegal garbage dumping in one of the mined pits located along the Maha Oya Downstream. EFL investigated the issue and it was brought to the notice of the relevant authorities including the Western Province Waste Management Authority and the Negombo Municipal Council. In this regards, EFL facilitated meetings between Negombo Municipal Council and Waste Management Authority of the Western Province and measures have been planned to avoid the garbage dump from adversely affecting the wellbeing of the communities and the environment.

Illegal mining activities near the water storage tank in the Bambukuliya water intake area was brought to EFL's notice by the Gampaha Regional Office of National Water Supply and Drainage Board. Immediate results were obtained following meetings with GSMB in this regard. A "No Mining Zone" for the zone subjected to illegal mechanized mining was declared as a result. This "No Mining Zone" is effective for 500m on either side of the Bambukuliya Water Intake.

The alternative livelihoods supported by the project were highly successful and it made a huge impact in the project area. At the initial stage, many people were reluctant to accept these livelihoods, since their previous attempts with other parties failed and they presumed that they could not match this to the income they earned with sand and clay mining related livelihoods. But EFL selected a few members of the community including sand miners and members of sand mining related families and introduced the livelihood mentioned in Section 3.4 of this report. They worked out really well and now a number people in the sand and clay mining industry opt to move into new industries like inland fishing or boat services for tourists among other things. Through the project, it has been proved that alternative livelihoods can work well, they are sustainable and are free from other hassles like legal, environmental or social problems, and at the same time provide a substantial income for the family.

8.0 Project sustainability

The sustainability of the project has been taken in to account from the project formulation stage. To ensure the sustainability of the project and project activities, during the project design and implementation stages the following steps were taken.

The designed project activities were not only deemed necessary for understanding the science behind threats and impacts to ecosystems, but also to identify the information gaps of some of the mandated authorities in managing these ecosystems. For an example, CCD has been engaged in mitigation of coastal erosion, but the research activities carried out by the project provided the scientifically rationalized mitigation mechanism. That is a good example of the sustainability of the project activities which was ensured through proper design.

The information generated through the project was disseminated by workshops and publications. It was envisaged that scientific and other information generated through the project would be of support in policy formulation and decision making, so that the project would be taken forward. The publications of the project are also expected to ensure the sustainability of the project as they are a key mechanism of project communication even after the completion of the project.

The networking of stakeholders during the project was another way of ensuring project sustainability. Before the project, most of these stakeholders, who were the managers of these ecosystems, and other interested parties, carried out their activities individually, in a fragmented way. During the project implementation, EFL attempted to network these stakeholders and consult them from time to time for carrying out project activities, with the intention of getting their involvement to the project so that they would feel closer to the project. It is expected that they would continue with some of these activities. For example, CCD expects to continue with the coastal research work, GSMB continues the restoration programmes and Katana local council continues with the alternative livelihood programme. Getting the involvement of already established institutions/ organizations would give project activities sustainability.

For some of the project activities, the participation of the school children and community groups were taken, with two objectives. Firstly, prioritizing environmental issues in their daily agenda and secondly giving them the ownership of the project activities and the project. For example, in tree planting programmes, restoration work, and other community work, in carrying out some of the scientific measurements, their participation gave them the feeling ownership. This motivated them to continue with some of the activities even though EFL was not a part of them. Additionally, they were linked with other organizations/institutions or political or other influential people to support them and

guide them. People who are started businesses under alternative livelihood programmes were linked with The Lover Group, Local Council, Mrs. Sudarshani Fernandopulle, Gampaha District Aquaculture Organization etc.

Additionally, EFL was able to incorporate restoration of the degraded areas to existing mining license systems with the support of GSMB. The exacerbated mining activities resulted in mined pits or degraded river banks in the absence of proper legislation or mechanism to address the issue. With the results of project activities and highlighting the importance of having a management plan to tackle the increasing number of mined pits, EFL had a series of discussions with GSMB and Traditional Sand Miners' and Transporters' Association. It was agreed to include the rehabilitation of mined pits as one of the terms which should be fulfilled in applying renewals to the mining license. Through this outcome, in the future, land degradation with mining pits would be minimal and the mining community would be liable for rehabilitating the land degraded. It could be considered as incorporation of sustainability to restoration efforts of degraded areas in the downstream of the Maha Oya.

Additionally, for several activities like scientific research and restoration activities, EFL worked in collaboration with universities and university students, giving them more exposure to the problems associated with Maha Oya and identifying more areas for research. So far one undergraduate and four Masters Students have been given research areas for their respective courses.

9.0 Project learnings

There are many learnings of the project, experienced through its implementation. The first learning is that the project was too ambitious and the number of activities planned for implementation were too many for a period of 2 years and a budget of USD 170,000. Under the integrated approach project adopted, most of the project activities could not be eliminated, but a few activities could have been planned for a second phase. It would have given more time for the project implementation agency in working towards the success of other activities, and delays in implementing some of the activities would have been avoided. If more budget allocations were granted, more resources in terms of staff and transportation facilities could have been used, but with the existing resources, the project staff underwent a tough period with inadequate staff and facilities in implementing project activities. EFL's co-financing component had to be increased to mitigate the difficulties associated with inadequate staff and other facilities. The project activities demanded much more field work, than planned, however, the dedication and the commitment of the project staff in compromising their comfort and working additional hours enduring the harsh conditions of the field activities with minimal facilities made the full project implementation possible.

Another learning is that there should be resource allocation for post implementation period for follow up work of some of the project activities. This would be to support proper dissemination of information generated through project, more follow up and guidance for communities and follow up with stakeholders to make the expected changes in policy and decisions. At least 6 months post project implementation period could be recommended in this regard.

With reference to the output 1, the key learning is not to plan weather sensitive data collection for a short duration like 2 years. There were a few studies which ended without solid conclusions due to the lack of sufficient data. These studies included river flow measurements and water level measurements for testing the hypothesis of lowering of the water level with lowering of the river bed caused by sand mining. The other learnings are mostly associated with the community work of the project. Before starting the activities of the project, it was vital to understand the dynamics between different community groups in the project area. In this regards, the project team had a number of ad-hoc meetings with different community groups and individuals and even carried out a preliminary socio-economic survey to gather more information. This information helped to understand the lifestyles and their perceptions on different matters related to issues and activities addressed by the project, and it helped the project team in approaching them in the right way and to build up strong relationships. The success of the community work of the project is principally due to understanding them and respecting them, although we did not share the same opinion as them. After building a

rapport with them, the project staff slowly started changing the way they think, cultivating environmental and social values within them, which supported in achieving the objectives of the project.

Another positive learning of the project activities with communities was, getting support of the political authority in a positive way. For some of the community activities, their involvement was vital, since they were in a position to support these people further. For example, a Member of Parliament, representing the project area arranged financial support to obtain machines for the shoe manufacturing and garment manufacturing groups and is in the process of approving a goods transport lorry for the team who carries out inland fishing. This support has ensured the success and sustainability of the community livelihoods and other community work. It was instrumental in guiding the community groups for team work, since the support is assured only for teams, not for individuals.

The other learnings are in the area of getting community involvement in all the possible ways to ensure continuity of the project's immediate impacts and linking them to other organizations, so that they would get more support and guidance for future work in the absence of project implementation agency.

10.0 Recommendations

The first recommendation is to grant a post project implementation period for more follow up activities as mentioned in the section above. It is perceived that more follow up activities are required in the following areas in order to make this project a highly successful attempt in ecosystem conservation and increasing community resilience.

- Dissemination of the information generated through the project among stakeholders and working with them for more changes in the policy and management plans. For example, GSMB still seeks the support of EFL project staff in using the results of the sand survey carried out in issuing permits for sand mining. With the budget limitations, EFL is not in a position to finance human resources for these activities further. But EFL is still working in collaboration with the GSMB and the Police Department and some of the other stakeholders to work out a River Management Plan for the Maha Oya using the information generated through the project. In January 2012, EFL and other stakeholders met in this regards as the first step of this process.
- The study on ecosystem valuation and studies in output 1 came up with a lot of new and policy relevant information on the degradation and the cost of degradation of the activities being carried out in the project area, without much knowledge of the mandated authorities. Therefore, more time spent in this regard would help this information to be made available to them and make them more knowledgeable on the issues. With the stakeholders' workshop, this information was disseminated, however it would be more effective if more time is allocated in reaching the groups who didn't participate in this workshop due to various reasons. For example, only one Divisional Secretary (DS) participated, although there were 3 other DSs in the project area. The other possible reason is limiting the stakeholder meetings to one, if the resources were available for a local level stakeholder meeting, it would have been more effective. Additionally, if the time had been available, more individual meetings would have been of help in achieving this objective.
- With the success of the pilot activities in improving alternative livelihoods, another project or resources in terms of finance, time and humans would be recommended to implement an alternative livelihood programme which would support the people who wish to start new income earning activities moving away from sand and clay mining. This is the best time for such an initiative since the success gained by the people who are engaged with the livelihoods provided by the project has impressed the other community people and they are living in the hope of getting external support to initiate their own.

- Additionally, a comprehensive analysis of socio-economic status of the communities and stakeholders is recommended for obtaining the information on impacts of ecosystem conservation activities on all the stakeholders in the project area. It would be instrumental in adopting mitigation measures for any adverse impacts that would occur due to the future efforts on conservation of ecosystems. Further, it will provide information on effectiveness of the activities carried out the current project.

List of Reports (referred in this document)

1. Report 1- Analysis of Changes in Coastal and River Morphology, Ecosystems and Land Cover
2. Report 2 – Bathymetry
3. Report 3 – Inundation/Flood modeling/Mapping
4. Report 4 – Report on Pollution
5. Report 5 – Environmental Sensitivity Analysis of the Project Area
6. Report 6 – Ecosystem Valuation
7. Report 7a – Report on the Media Programme
8. Report 7b – Workshops for Coastal and River Basin Managers
9. Report 8 – School Programmes
10. Report 9 – Alternative Livelihood Activities and Women’s Empowerment
11. Report 10 – Meeting and Consultations on behalf of Aggrieved Communities
12. Report 11 – Guidelines for Restoration
13. Report 12 – Pilot Restoration of Degraded Areas
14. Report 13 – Restoration Strategy
15. Report 14 – Report submitted to Central Environmental Agency on Activities Causing Environmental Degradation
16. Report 15 – Policy Summary (draft)