



Technology Needs of Climate Change Adaptation & Mitigation in Sri Lanka

Summary of Project Ideas



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Background

The Technology Needs Assessment for Climate Change in Sri Lanka was undertaken by the Climate Change Secretariat of the Ministry of Environment and Renewable Energy from 2011 to 2013. The main objective was to identify and assess environmentally sound technologies that have synergy between reducing the impact of climate change and the rate of Green House Gas (GHG) emissions in Sri Lanka within national development objectives. Transport, Energy, Agriculture, Waste and Industry are the highest GHG emitting sectors in Sri Lanka.

The priority sectors identified for climate change adaptation were Food, Health, Water, Coastal and Biodiversity. Energy, Transport and Industry were identified as the priority sectors for climate change mitigation. After following an extensive consultative process, a potential list of technologies that contribute to climate change adaptation and mitigation for each sector were identified, and prioritized by using the Multi Criteria Decision Analysis process. Then a barrier analysis was carried out to identify the barriers to implement the prioritized technologies through stakeholder consultations and enabling framework was identified for each technology to overcome the anticipated barriers. Subsequently, the Technology Action Plans and Project Ideas were developed for each technology under the prioritized sectors.

The Project Ideas reports (http://www.climatechange.lk/TNA/tna_reports.html) presents proposed project ideas based on each of the prioritized technologies. For each project idea, an introduction and background, project objectives, outputs of the proposed project, relationship to country's sustainable development priorities, project deliverables, project scope and possible implementation, project activities, timeline for proposed activities, budget and resource requirements, measurement and evaluation, possible complications and challenges, and responsibilities and coordination are provided.

There are 31 project ideas under different priority sectors summarized, proposed time line for implementation of projects range from 01 year to 25 years. Total estimated budget is US\$ 662.88 million including national and international components.



Adaptation: Priority Sectors

1. Food
2. Health
3. Water
4. Coastal
5. Biodiversity



1. Food Sector



Food Sector: Vulnerability to Climate Change

Various elements of the agriculture and food production system are particularly sensitive to climate change. Food security relies on country's ability to make agriculture and food production systems more productive and more resilient to shocks, such as droughts, floods, and pest and disease outbreaks. The food sector in Sri Lanka depends heavily on climatic conditions and it is sensitive to climate change impacts such as variability in monsoon rainfall and temperature changes within a season. Changes in temperature and rainfall have significant negative effects on the production, productivity and the quality of rice, fruits, vegetables, tea, and coconut, etc. Also, the saline intrusion affects quality of river waters and degrades arable coastal paddy fields, causing them to be abandoned. Pathogens and insect populations are strongly dependent upon temperature and humidity, and changes in these parameters may also alter their population dynamics. Climate change is also contributory for lower yields from dairy cattle, decline in fish breeding, and harvests from culture based fisheries. It is clear that the changes in the rainfall pattern is likely to be the most significant factor for the food sector vulnerability. The results of these climate extremes and changes have been experienced in the form of multiple impacts in Sri Lanka food sector.

Prioritized Technologies

- Sustainable Inland Culture Based Fisheries
- Sustainable Land Management
- Crop Diversification and Precision Farming

1.1 Technology: Sustainable Inland Culture Based Fisheries

1.1.1 Project idea: Development of Inland Culture Based Fisheries (ICBF) for enhancing livelihood and food security of communities vulnerable to climate change in the dry zone of Sri Lanka

In Sri Lanka, reservoir fishery as the main aquaculture activity practiced currently provides significant contribution to food and nutritional security especially of the rural areas in the interior regions of the country and has other benefits such as providing supplementary income for farmers by creating new job opportunities in the rural communities, and making available animal protein at affordable prices to avert malnutrition problem in the country.

Objectives: (i) increase the livelihoods of 30,000 beneficiaries engaged in the production of inland culture-based fishery in 3,000 minor perennial and small non perennial reservoirs in the Monaragala, Hambanthota, Anuradapura, Kurunegala, Vavuniya and Kilinochchi districts in the dry zone of Sri Lanka. (ii) increase annual household incomes of beneficiaries by 100% (iii) reduce pressure on land and introduce CBF as an alternative and supplementary source of income in the targeted rural communities.



Budget

The proposed project is scheduled to be implemented for a period of ten years with a total budget of US \$ 54 million.

Outputs

To achieve the targeted increase in production, the project will set up the following infrastructure:

- Five fish breeding farms with 2,000 m² tank area
- Ten hatcheries with 20,000 m² fry to fingerling raising operations
- Supply of 200 fishing vessels
- Provided fishing gear for CBF communities
- Improved marketing networks of inland fisheries

It will also produce the following;

- Manual of operations with guidelines on codes, standards and procedures
- Training manual on best hatchery management practices and fry to fingerling production
- Make available of extension materials for farmers and hatchery owners
- Status reports

Timeline for the project

Activities	Year									
	1	2	3	4	5	6	7	8	9	10
Expand supply of fingerlings										
Increase Research & Development (R&D) and Training Facilities (Research will be undertaken in 2 phases; exploratory phase & targeted outcomes)										
Prevent degradation of water quality										
Enhance availability of financial resources										
Improve investment risk insurance										

Outputs

- Training 25,000 farmers on SLM practices
- Adoption of on-farm soil conservation, sloping agricultural land technology (SALT), etc in 35,000 ha
- Issue grants, subsidies and other direct and indirect assistance to adopting selected SLM
- Establish 5,000 ha of forest plantations in heavily degraded hilly areas
- Promotion of crop-livestock integration and non- and off-farm enterprises for income generation
- Arrange for granting of titles or long leases to land to those in the project area
- Develop capabilities (GIS, databases, etc) to provide information for planning and managing watersheds
- Monitor sedimentation of reservoirs in the project area
- Revise National Land Use Policy and Agricultural Policy to include SLM
- Set up district and sub-district SLM Coordination Committees

Timeline for the project

Activities	Year									
	1	2	3	4	5	6	7	8	9	10
Raise awareness and knowledge on appropriate land management										
Develop land management methods for larger units										
Introduce organic agricultural practices for the fragile eco systems										
Promote land conservation as a national priority in agric and non-agric land uses										
Introduce grants, subsidies, loans and other forms of assistance to practice SLM										
Raise public and private investment on SLM research and development										
Securing land ownership rights										
Develop model SLM packages for diverse land classes										
Introduce alternative livelihoods to reduce pressure on land										
Update land use policy and legislation										
Support to enforcement of land management policies, laws and regulations										
Set up land use planning and independent monitoring system										
Improve coordination among stakeholder organizations										

Implementing agency: Ministry responsible for the subject of Agriculture

Key Stakeholders: Ministries responsible for the subject of Lands and Land Development/ Plantation Industries/ Disaster Management/ Irrigation and Water Resource Management, Department of Agriculture, Sri Lanka Institute of Nano- technologies

1.3 Technology: Crop Diversification & Precision Farming

1.3.1 Project idea: Crop Diversification & Precision Farming in dry zone of Sri Lanka for managing climate change vulnerabilities, livelihood sustainability and food security

The Government of Sri Lanka has placed high priority on achieving self-sufficiency in rice, the staple food. Also, attaining food security extends well beyond increasing rice supply. With urbanization and income patterns are shifting from cereal to edible oil, fruits, vegetables, dairy and products. Therefore, supply of these currently in short supply also helps to nutritional goals.



The proposed project will aim to convert about half of the available land, i.e. 40,000 ha of the marginal rice lands and 50,000 ha of the area facing water shortage, to other food crop cultivation including both seasonal crops and perennials. The diversified area will also include crops adopting precision farming techniques such as drip irrigation, micro-sprinklers, and other automated systems for the cultivation of high-value crops.



Budget

The proposed project is scheduled to be implemented for a period of ten years with a total budget of US \$ 60 million.

Outputs

- Increased production of diversified crop and livestock products:
 - New varieties of crops and cultivation practices- Four drought and flood resistant varieties and four management packages
- New animal breeds and management packages- Two temperature resistant breeds and management packages accordingly
 - Irrigation network restructured to favour diversified crops- Irrigation net work restructured to prepare 9000 ha per year for crop diversification and precision farming techniques
 - Post harvest and processing infrastructure installed
- Develop 10 appropriate cold chain and cold storage facilities for 500 mt capacity
- Develop food processing and post harvest technologies support product promotion

- Establish storage facilities for 30,000 mt of Onion/Grains
- Institutional reform
 - Procedures to reduce fragmentation of land holdings- New land titling and tenancy legislation introduce within 5 years to favour land consolidation
 - Improved marketing system with increase integration of rural markets- Introduce at 10 locations
 - Market information system providing timely and accurate data
- Improved policy coordination
- Diversification friendly land tenancy procedures
- More predictable import policy

Timeline for the project

Activities	Year									
	1	2	3	4	5	6	7	8	9	10
New varieties of crops and cultivation practices										
New animal breeds and management packages										
Restructuring of irrigation network to favor diversified crops										
Develop/Improve post harvest and processing infrastructure										
Amend the legal framework to reduce fragmentation of land holdings										
Improved marketing system with increased integration of rural markets										
Market information system providing timely and accurate data										
Diversification-friendly land tenancy procedures										
Introduction of more predictable import policy										

Implementing agency: Ministry responsible for the subject of Irrigation

Key Stakeholders: Ministries responsible for the subject of Agriculture/ Agrarian Development/ Fisheries and Aquatic Resources Development/ Irrigation and Water Resource Management/ Co-operatives & Internal Trade/ Livestock Development/ Land and Land Development/ Traditional Industry & Small Enterprise Development, Department of Agriculture, Department of Agrarian Development, Department of Irrigation

2. Health Sector



Health Sector: Vulnerability to Climate Change

The Climate Change has both direct and indirect effects on the human health. The common direct health effects are incidents of vector including rodent and water borne diseases. Conditions associated with extremes of temperature in the form of heat waves and cold spells are also considered direct effects. The effect of natural disasters and extreme weather events also contribute to many health impacts such as disability, communicable diseases, psycho-social problems, etc on humans. On the other hand, protracted or sudden weather events indirectly affect human health through crop failure, loss of live stock, livelihoods, etc. Crop failure will lead to food shortage causing macro nutrient and micronutrient deficiency nutritional disorders. Loss of livestock will cause similar effects. There is a fair possibility to alter the health of the people due to the effects of climate change. The sector vulnerability profiles developed for Sri Lanka in 2010 has identified the health sector as one of the most critical sectors for the climate change vulnerability.

Prioritized Technologies

- Technology for early warning systems and networking for information exchange on extreme events and other climate change related events
- Transfer of knowledge and skills to health personnel
- Management of health care waste

2.1 Technology: Technology for early warning systems and networking for information exchange on extreme events and other climate change related events

2.1.1 Project idea: Strengthening the existing health sector Early Warning Systems (EWS) through networking and linking with other sectors and training of health personnel on EWS to adapt to adverse health effects of climate change

An Early Warning System (EWS) which is in existence in Sri Lanka presently has many lapses. This project idea is for the entire island of Sri Lanka. The main agency responsible is the National Disaster Management Centre (NDMC, 2005). Though the Health sector has a dedicated unit for Disaster Preparedness and Response Unit, the linkages with other sectors and intrasector is poor.

Objectives: (i) To establish a network in the health sector and between other sectors for information sharing within three years covering 70% of districts and all other sectors at the central level; (ii) To provide training, enhance knowledge and skills to health

personnel for the purpose of proper functioning of EWS to 60 % health workers in eight years; (iii) To promote R & D to ensure sustainability of aforesaid objectives in three years.

Budget

The proposed project is scheduled to be implemented for a period of eight years with a total budget of US \$ 117,150.

Outputs:

- A functioning network made available at the end of three years
- A focal point and a unit established in the Ministry of Health along with focal points at all levels of the health sector
- Training curricula developed and implemented.
- Health personnel trained at all levels over a period of eight years.
- R & D activities conducted, number of R & D findings disseminated to all relevant institutions in three years
- Regular policy, legislation and regulations analyses for climate change related Disaster Management is conducted and required adjustments done.

Timeline for the project

Activities	Year							
	1	2	3	4	5	6	7	8
Assessment and implementation of suitable and sustainable networking methods								
Establish a functioning national focal unit and a linked focal points and functioning network at all administrative levels with instructions to report to the Officer in-Charge (National, Provincial, and District)								
Research, identification and implementation of appropriate and affordable technologies								
Train personnel to use the technologies to be used, including training needs assessment, preparation of training modules, pre-testing, identification of health personnel to be trained as a trainers								
Promote R & D in new innovations to be implemented for EWS								
Carry out an analysis and identify reasons for underutilization of available human and physical resources and find lasting solutions to rectify issues								

Implementation: Ministry responsible for the subject of Health

Coordination: Ministries responsible for the subject of Health/ Disaster Management, National Disaster Management Center

2.2 Technology: Transfer of knowledge and skills to health personnel

2.2.1 Project idea: Capacity building of health personnel to improve performance with regard to climate change related adverse health effects

With the growing impact of climate change, impact on health, the need for increased numbers of skilled, motivated and facilitated health workers is greater than ever. Health workers are the backbone of health systems. Therefore, the Global Health Workforce Alliance calls on governments and partners to ensure health, and the shortage of health workers, are central considerations for any action on climate change.



Objectives: (i) To enhance capacity of health personnel and institutions to ensure all levels of health personal are equipped with required skills to face the challenges of adaptation to climate change; (ii) To establish and strengthen a training coordination unit in the Ministry of Health; (iii) To monitor the progress of activities.

Budget

The proposed project is scheduled to be implemented for a period of ten years with a total budget of US \$ 374,000.

Outputs

- Functioning training coordination unit established in the Ministry of Health at the end of the first year following the initiation of the project period
- An annual training calendar is made available every year since the inception of the project
- Training need assessment is done within the first year of the project
- Training methodologies are identified during the first two years of the project
- Master trainers are identified and/or pooled from other sectors during the first two years of implementation of the project
- 70 % of health personnel at different levels trained in ten years
- Drills/simulations conducted at least one per district in three years
- Monitoring of diffusion of the technology is incorporated into the existing monitoring system during the project period and five years after closing the project



Timeline for the project

Activities	Year									
	1	2	3	4	5	6	7	8	9	10
Strengthening the training coordination unit and appointment of a training coordinator and linking activities in all healthcare institutions										
Training needs assessment										

- Newer, affordable and feasible HCWM technologies identified and implemented with a coverage of 40 % of institutions
- Awareness created among 70 % of relevant health personnel through project period
- HCWM information is included into the existing Health Information System (HIS)
- Installation of clinical HCWM systems in all districts (one General Hospital in each district)
- Improved inter-sectoral coordination for HCWM.

Timeline for the project

Activities	Year			
	1	2	3	4
Establishment of a national Information Center to facilitate partnerships and to explore additional funding sources and to provide necessary information				
Research study to identify and to implement appropriate, sustainable and affordable technologies for HCWM				
Awareness creation on HCWM among health workers at all levels (national, provincial, district and divisional)				
Training of selected health personnel for HCWM activities at all levels				
Setting up of HCWM systems in general hospitals in each district				
Networking of health institutions and linking to other sectors for improving inter-sectoral coordination for HCWM purposes				

Implementation/Coordination: Ministry responsible for the subject of Health (Environment & Occupational Health Division)

3. Water Sector



Water Sector: Vulnerability to Climate Change

Water is the most essential ingredient for the sustenance of all living organisms. Possible impacts predicted on the water sector due to climate change are severe droughts, floods, sea level rise, etc. As temperature increases, evaporation of water increases and it will drive up the demand for irrigation water, contributing to water scarcity especially in the dry zone. More than 90% of the small tank systems in Sri Lanka are clustered into cascades and these tank network systems have been built in water scarce areas particularly

in the Dry Zone by ancient kings mainly for agricultural purposes. The vast ancient reservoirs, minor and medium tanks and canals built by ancestors are supplemented with many recent large scale irrigation reservoir building projects.

When considering the vulnerability to climate change, air temperature in Sri Lanka has increased by 0.450°C over the last 22 years, suggesting a rate of 0.20°C increase per decade and possible impacts predicted on the water sector due to climate change are severe droughts, floods, sea level rise etc. It has been predicted that by 2050, the amount of rainfall receive from the north-east monsoon which is the major source of water for the dry zone of Sri Lanka at present, will be reduced by 34% while that received from the south-west monsoon will be increased by 38%. This would make the dry zone districts more vulnerable to droughts and the wet zone districts to floods and landslides. Prominent change due to low rainfall will be the expansion of the dry zone. Due to such droughts, surface water availability and per capita water availability will be decreased. The floods due to increase in rainfall intensity will reduce ground water recharge and also would affect quality of surface water, sediment generation and transport of sediments. Studies on the sea level rise have shown an increase trend for sea water intrusion in certain coastal areas. As a result salinity of surface water and ground water in such areas will be increased.

Prioritized Technologies

- Restoration/Rehabilitation of minor tank net works
- Rainwater harvesting from rooftops for drinking and household uses
- Boreholes/tube wells as a drought intervention for domestic water supply

3.1 Technology: Restoration/Rehabilitation of minor tank net works

3.1.1 Project idea: Rehabilitation/Restoration and maintenance of minor tank network (cascade) systems in the dry zone of Sri Lanka as an adaptation strategy for climate change

Economy of the dry zone mainly depends on paddy cultivation based on minor tanks network systems. According to climate change projections, water scarcity will be a problem in the dry zone because this region will be more vulnerable to droughts. In addition, high temperature and dry winds will increase the evaporation rate and also affect the ground water resource. Increases in high rainfall events during rainy season will increase soil erosion, which in turn accelerates the silting up of these tank systems. In order to mitigate the above problems it is important to maintain sustainability of these minor tank systems as an adaptation strategy through water conservation, storm water control and capture and groundwater recharge.



Main objective: to provide water throughout/most of the year (80%), for farmers in selected vulnerable areas in the dry zone, through properly maintained ten minor tank network systems.

Budget

The proposed project is scheduled to be implemented for a period of ten years with a total budget of US \$ 44.3 million.

Outputs

- Availability of a list of minor tank network systems which need rehabilitation/ restoration and availability of a data bank (need of water resources, number of beneficiaries, type of restoration/rehabilitation work required, hydrology of the tank systems, amount of funds available, etc.)
- Availability of a collaborative mechanism between Agrarian Service Dept. and Provincial Councils pertaining for restoration/rehabilitation work
- Increased awareness and capacity of Agrarian Service Department, Provincial Councils and Health Department, Farmer Organisations and Cascade Management Teams
- Availability of alternative employments for extended dry seasons due to climate change
- An awards system for Farmer Organisations and Cascade Management Teams who show best tank management practices
- Well maintained 10 minor tanks selected
- Availability of evaluation reports prepared by project management team

Timeline for the project

Activities	Year									
	1	2	3	4	5	6	7	8	9	10
Carry out a survey to collect necessary data in order to identify minor tank net works which need restoration/ rehabilitation.										
Develop a collaborative mechanism between Agrarian Service Dept. and Provincial Councils pertaining to restoration/rehabilitation work										
Awareness creation and capacity building of Agrarian Service Department, Provincial Councils and Health Department, Farmer Organizations and Cascade Management Teams										
Introduce alternative employments for extended dry seasons due to climate change										
Introduce an awards system for Farmer Organizations and Cascade Management Teams showing best tank management practices										
Restoration/ Rehabilitation /Operation and maintenance work of 10 minor tanks selected										

- Availability of demonstration models, audio-visuals, guide books, TV programmes, leaflets and posters on RWH systems; Introduction of this technology in GCE O/L curriculum
- A list of areas for installation of roof top rainwater harvesting systems and availability of data bank (data on needs, amount of rainfall during the past few years, quality of rain water, urgency and results of climate change modeling, etc)
- Capacity of Health Department and NWSDB (80%) to maximize the efficiency and effectiveness of the project.
- Knowledge on water quality of storage tanks and health conditions of people consuming water from above tanks.
- Mitigate flash-floods by 25%. This technology divert a portion of local rainfall into collection tanks and prevents flooding due to discharge of rooftop rain water directly to main drainage systems; e.g. Indonesia
- Reduce water supply costs by 30%.

Timeline for the project

Activities	Year						
	1	2	3	4	5	6	7
Carry out a survey to collect necessary data in order to identify suitable areas in the country for installation of roof top rainwater harvesting systems							
Capacity building of Health Department, NWSDB and relevant general public							
Formulate standards, codes, certification and annual license system for roof top rainwater harvesting systems							
Raise awareness on this technology							
Strict enforcement of national rainwater harvesting policy							
Install 400 quality controlled RWH systems							
Provide necessary equipment at a concessionary rate							
Promote R & D to improve this technology							
Project management							

Implementing Agency: Ministry responsible for the subject of Water Supply and Drainage

Collaboration: Ministries responsible for the subject of Environment (Climate Change Secretariat)/ Health/Education/ Science & Technology, NWSDB, Urban Development Authority, Central Environment Authority, Lanka Rain water Harvesting Forum, Dept. of Health, Component prefabrication companies, architects, engineers, universities, research institutes, INGOs, NGOs

3.3 Technology: Boreholes/tube wells as a drought intervention for domestic water supply

3.3.1 Project idea: Promote measures for sustainability of boreholes as an adaptation method for climate change

When surface water is not available/ not sufficient/bad quality, ground water can be abstracted for domestic purposes through tube wells/boreholes. Boreholes/tube wells consist of a narrow, screened tube (casing) driven into a water bearing zone of the subsurface.

Objectives: Provide potable water throughout the year (100%) for 20% of households and general public in selected vulnerable rural areas having hydrogeologically

suitable sites in the dry zone by promoting sustainability of boreholes. 50 boreholes will be installed for this purpose.



Budget

The proposed project is scheduled to be implemented for a period of eight years with a total budget of US \$ 27.5 million.

Outputs

- Well maintained 50 boreholes installed at hydrogeologically suitable sites in the dry zone.
- Annual license scheme for boreholes
- Availability of a list of qualified borehole constructing organizations registered at Water Resources Board (WRB)/NWSDB
- Guidelines for safe and sustainable use of groundwater
- A certificate course on construction of successful boreholes offered by NWSDB/WRB
- Awareness programmes for consumers on this technology
- Adequate capacity of WRB and NWSDB for successful implementation of the project
- Availability of a data bank and list of suitable areas where boreholes should be installed.

Timeline for the project

Activities	Year							
	1	2	3	4	5	6	7	8
Carry out a survey to collect necessary data in order to identify suitable sites								
Provide necessary equipment at a concessionary rate, Provide incentives								
Capacity building of NWSDB/ WRB/ Health Department								
A certificate course on construction of successful boreholes offered by NWSDB/WRB								
Formulate a mechanism by WRB/NWSDB to grant approval for installation of boreholes								
Awareness programmes on this technology for general public								
Preparation of guidelines for safe and sustainable use of groundwater								
Install 50 boreholes								
Promote R &D for further improvement of this technology								
Introduce a mechanism to prevent/minimize ground water pollution								
Introduce suitable technologies for ground water recharge								
Project management								

Implementing Agency: Ministries responsible for the subject of Irrigation and Water Resources Management

Collaboration: Ministries responsible for the subject of Water Supply and Drainage/ Finance and Planning/Environment, Climate Change Secretariat, NWSDB, WRB, Central Bank, Treasury, private sector, registered organizations as tube well constructors, Dept. of Health

3.4 Combination of Technologies

3.4.1 Project idea: Improve availability of drinking and irrigation water for the dry zone of Sri Lanka as an adaptation measure for climate change

The three technologies described in the above were included as sub projects under this project idea.

Main objective: Provide water throughout/most of the year (100%), in the North Central Province in the dry zone for agricultural and drinking purposes through properly



maintained ten minor tank network systems, 100 quality controlled roof top rain water harvesting systems and 25 sustainable boreholes.

Budget

The proposed project is scheduled to be implemented for a period of ten years with a total budget of US \$ 71.2 million.

Outputs

- Availability of the following lists for the North Central Province.
 - Minor tank network systems (cascade systems) which need rehabilitation/ restoration and availability of relevant data bank
 - Areas for installation of roof top rainwater harvesting systems and boreholes and availability of relevant data banks
- Increased awareness and capacity of Department of Agrarian Development, Provincial Councils and Health Department, farmer organizations and Cascade Management Teams, WRB, NWSDB to maximize the efficiency and effectiveness of the project.
- Well maintained 10 minor tank networks (cascades) selected, 100 Quality controlled RWH systems and 25 boreholes in the North Central Province
- Accepted standards and an annual license system for roof top rainwater harvesting systems and boreholes in Sri Lanka and guidelines for safe and sustainable use of groundwater
- A method to register consumers of roof top rainwater systems and boreholes at NWSDB/WRB
- Awareness programmes for consumers on good operation and management practices
- Mitigate flash-floods by 45 % and reduce water supply costs by 50%.
- A certificate course on construction of successful boreholes offered by NWSDB/ WRB and as a result, availability of a list of qualified borehole constructing organizations registered at WRB/NWSDB.

Timeline for the project

Activities	Year									
	1	2	3	4	5	6	7	8	9	10
Carryout a survey to collect necessary data in order to identify suitable areas/ sites										
Increase awareness and build capacity of relevant parties										
Introduction of standards/ annual license/ guidelines										
Awareness programmes for consumers										
Strict enforcement of policies/ mechanisms										
Introduction of strategies to promote the sub projects identified										

[illegible]

Implementing Agency: Jointly by Ministries responsible for the subject of Agrarian Services/ Irrigation and Water Resources Management/ Water Supply and Drainage

Collaboration: Ministries responsible for the subject of Local Government and Provincials/ Health/ Finance and Planning/ Fisheries and Aquatic Resources/ Science & Technology/Environment (Climate Change Secretariat), Dept. of Agrarian Development, Provincial Councils, Dept. of Health, NWSDB, WRB, Medical Officers of Health, local and international NGOs, private sector institutions, farmer organizations, Cascade Management Teams, Urban Development Authority (UDA), Central Environment Authority (CEA), Lanka Rain water Harvesting Forum, inland fisher communities, universities, research institutes, Central Bank, Treasury, private sector, registered organizations as tube well constructors

4. Coastal Sector



Coastal Sector: Vulnerability to Climate Change

Coastal belt of Sri Lanka is a very dynamic transitional zone and is formed as a result of sea and atmospheric forces on the land mass and the supply of sediments to the coast. Coastal belt of Sri Lanka is 1620 km and it includes several sensitive ecosystems.

Climate change effects such as sea temperatures and sea level rise (SLR), increased frequency and magnitude of tropical storms and other extreme events will have negative impacts on both ecosystems (coral bleaching, salt water intrusion, flooding, erosion) and human well-being (loss and/or reduced productivity in goods and services provided by ecosystems). Sensitive ecosystems such as coral reefs, sand dunes, sea grass beds

and mangroves are not only economically and ecologically important to Sri Lanka but they also act as buffers against wave action, storm surge, tidal variations and sometimes against severe conditions such as tsunami which was evident during the 2004 tsunami. Climate change may also cause increases in both extreme wave heights and in the intensity of storms, which can be uncertain, especially in the tropics where storms may become more intense but less common. Sea level rise scenarios for Sri Lanka suggest a shoreline retreat of 10m by 2050. The sector vulnerability profiles developed for Sri Lanka in 2010 has identified coastal sector as one of the most critical sectors for the climate change vulnerability.

Prioritized Technologies

- Restoration of sand dunes
- Rehabilitation of mangroves
- Restoration of coral reefs

4.1 Technology: Restoration of sand dunes

4.1.1 Project idea: Rehabilitation and restoration of sand dunes in North Western, Southern and Eastern Provinces of Sri Lanka as a soft barrier against sea level, while improving socioeconomic status of coastal communities

The series of mounts/hills/ridges formed by this continuous landwards pushing of the sand by wind, are known as dunes and are formed over many years. Sand dunes are distributed along the South-Western, South-Eastern and Eastern coasts of Sri Lanka. Coastal dune flora plays an important role in dune stabilization and restoration due to their root and vegetative systems, which are adapted to hold the dune sand. However, restoration of sand dunes and its vegetation were given least attention.



Objectives: (i) Restoration of sand dunes and its vegetation subjected to anthropogenic destructions to develop soft barriers against SLR, storm surges, inundation, etc. and as wind belts where ever it is applicable; (ii) Conserve natural sand dunes and turtle nesting sites in their vicinity; (iii) Reduce unemployment among coastal communities depend on dune resources and improve their socioeconomic status through sustainable management of sand dunes and their resources; (iv) Uplift the country's economy through eco-friendly tourism within coastal belts with sand dunes.

Budget

The proposed project is scheduled to be implemented for a period of seven years with a total budget of US \$ 2.63 million.

Outputs

- Rehabilitation of sand dunes with dune vegetation in 10 suitable sites with an area of 2 ha in each site.
- Train at least 100 persons from all three coastal districts as trainers for rehabilitation and sustainable utilisation of sand dunes and its resources, tissue culture, small & medium scale enterprises (SMEs) related to dune resources, ecotourism, etc.

- Establishment of 3 tissue culture laboratories in research/academic institutions
- Establishment of at least four SMEs in each of the coastal districts selected.
- Establishment of sand dune nature trails and herbal gardens with clusters of tourist resorts.
- In areas affected by strong winds development of wind belts using dune vegetation
- 25% reduction of sand dune extraction for construction purposes.
- Measurable output of the project would be around 25% reduction of unemployment among coastal communities by 4th quarter of year 2015 (Second year).
- Elevation of the coastal belt at least by 10cm height.

Timeline for the project

Activities	Year						
	1	2	3	4	5	6	7
Selection of suitable sites	■						
Awareness/training	■	■					
Establishment of tissue culture laboratories & nurseries		■	■				
Planting sand dune vegetation and monitoring performance (2ha in 3 sites)		■	■	■			
Establishment of SMEs and development of community participatory programmes			■	■	■	■	
Adoption to wider area (10ha in each of the 3 sites)				■	■	■	■
Evaluation of success			■			■	■

Executing agency/Main key stakeholder: Coast Conservation Department

Coordination: Ministries responsible for the subject of Environment/ Agricultural Development/ Indigenous medicine/ Local Government and Provincial Councils/Technology and Research/ Industrial Development, universities, Tourist Board, tourist hoteliers, National Physical Planning Department, CEA, Agrarian Research Institutes, Sri Lanka Council for Agriculture Research Policy (SLCARP), Botanical Garden, coast guards, community based organizations, Marine Environment Protection Authority (MEPA), INGOs and NGOs, Institute of Construction Training (ICTAD), National Building Research Organization (NBRO), Sri Lanka Land Reclamation and Development Cooperation (SLLRDC), National Science Foundation (NSF)

4.2 Technology: Rehabilitation of mangroves

4.2.1 Project idea: Rehabilitation of mangroves as soft barriers against sea level rise in the North Western, Eastern and Southern coastal belts of Sri Lanka, while maintaining the ecological balance and sustainability of socioeconomic activities

Total land area in Sri Lanka covered by mangroves is around 12,570 Acres. This unique ecosystem is home to over 20 true mangrove species of Sri Lanka. In addition to the

true mangroves there are several species of plants found in association with mangroves and they are known as “Associated Mangroves”. Until recent times, mangrove areas have received very little or no attention in terms of their conservation or sustainable management. As a result, most of the mangrove areas have been lost due to indiscriminate clearing and reclamation for industrial, urban, tourist resorts, roads, aquaculture ponds, and fishing ports development.

There are four major problems to be addressed and they are; inadequate financial assistance for rehabilitation of mangroves; inadequate awareness among all stakeholders on the importance of non extractive uses of mangroves; inadequate knowledge on suitable floral species, composition/ diversity and density to be used for restoration of mangrove vegetation; lack of alternatives to communities who depend on mangroves for socioeconomic activities and poor coordination among stakeholders when rapid development programmes are undertaken in mangrove areas.



Objectives: (i) Restoration of mangroves and its vegetation, to develop soft barriers against SLR, storm surges, inundation, etc. and as wind belts where ever it is applicable. (ii) Conservation of natural sand dunes and turtle nesting sites in their vicinity to promote eco-tourism (iii) Reduce unemployment & to uplift socioeconomic status of coastal communities. (iv) Explore the possibilities of introducing economically important exotic species of mangrove plant species (e.g: *Rhizophora mangle*) to Sri Lanka and also the possibilities of using other *Rhizophora* spp available in Sri Lanka for such small-scale industries. (v) Uplift the economy of the country, through development of eco-friendly within coastal belts with mangroves.









Budget

The proposed project is scheduled to be implemented for a period of five years with a total budget of US \$ 767,800.

Outputs

- Ten (10) suitable sites with an area of 2ha of mangroves will be rehabilitated.
- About 100 persons will be trained as trainers for future rehabilitation programmes, tissue culture techniques, plant propagation, sustainable utilization of dune resources, for SMEs, ecotourism, etc.
- Three (03) tissue culture laboratories will be established.
- Suitable technology will be developed to utilize mangrove resources (e.g. from *Sonneratia* sp & *Rhizophora* spp.) to promote SMEs based on mangrove resources.
- Establish nature trails close to clusters of tourist resorts within mangrove areas.
- Unemployment among coastal communities depending on mangrove ecosystems will be reduced by 10%.

Timeline for the project

Activities	Year				
	1	2	3	4	5
Selection of sites and suitable species for replanting mangroves					
Awareness/training for all stakeholders					
Collection & preparation of propagules (tissue culture, nurseries, etc) for replanting and planting them in selected sites					
Establishment of community participatory SMEs & eco-friendly tourism based on mangroves & their products					
Research for development of low cost technologies for mangrove based products					
Evaluation of success					

Executing agency/Main Key Stakeholder: Coast Conservation Department

Coordination: Ministries responsible for the subject of Environment/ Agricultural Development/ Industrial Development/ Technology and Research, universities, Tourist Board, tourist hoteliers, National Physical Planning Department, CEA, Local Government and Provincial Councils, Agrarian Research Institutes, SLCARP, coast guards, community based organizations, MEPA, INGOs and NGOs, SLLRDC, NSF

4.3 Technology: Restoration of coral reefs

4.3.1 Project idea: Restoration of coral reefs of Southern and South western coastal belt of Sri Lanka, as a soft barrier against sea level rise and coastal erosion and as a tourist attraction to promote eco friendly tourism

Coral reefs deliver ecosystem services to tourism, fisheries and shoreline protection. Coastal belt of Sri Lanka is blessed with near shore patchy fringing reefs and offshore bar reefs and they are unevenly distributed along the Southern, North-western, Northern, Eastern and South-Eastern coastal belts of Sri Lanka. Major causes of reef degradation are sedimentation, destructive fishing methods such as the use of explosives and bottom - set nets, mining of coral from the sea for lime production and uncontrolled harvesting of reef resources. Pollution and sewage released to reef sites have also contributed to the overall degradation of the marine environment.

Objectives: (i) Restoration of coral reefs as soft coastal barriers against SLR; (ii) Reduce the impact of anthropogenic activities on the reef ecosystems; (iii) Provision of ecofriendly alternative employment opportunities to coastal communities to reduce destructive socioeconomic activities and unemployment problem among coastal communities through SMEs and promotion of ecotourism through community -based organisations.

Budget

The proposed project is scheduled to be implemented for a period of seven years with a total budget of US \$ 2.678 million.

Outputs

- One hectare of corals transplanted in each reef site after the 5th year of the project.
- One hundred persons trained for scuba diving, coral restoration and coral growth monitoring activities and at least 25 youth trained as tour guides from each reef site selected for restoration.
- Two responsible community participatory organisations established for each coastal district related to reef sites to provide information, disseminate knowledge, promote ecotourism and research and to manage reef related activities.
- At least one artificial reef in each of the sites selected to be used for ecotourism.
- Reduce unemployment of coastal communities depend on reef resources by 25% at the end of 5 years.
- Adoption of environmentally friendly policies for coastal development programmes after 1 year.
- Improved awareness among government officials on the importance of collaborative approach on development programmes within the coastal region, for their sustainability.
- Preparation of unbiased IEEs and EIAs to grant approval to all coastal developmental activities and economic programmes after 0.5 years.
- Twenty five to ninety percent reductions of unsustainable socioeconomic activities from 2 to 7 years.
- Twenty five to seventy percent recovery of natural reefs from by 1.5 to 7.0 years.
- Ten (10) trained persons available in each reef sites to serve as trainers to handle all training activities related to reef restoration programmes after 1.0 year.
- Availability of a long-term management plan for coral reef ecosystems, acceptable to all stakeholders after 2 year.
- Sustainable management of coral reefs through stakeholder participation from second year onwards.
- Existence of a data base with baseline information, on coral biodiversity and physicochemical conditions required for each reef forming organism to maintain a live reef.
- Identifying early signs of bleaching and hazards after 0.5 years.
- Healthy coral reefs, growing satisfactorily without or less disturbances from exotic materials, from year 1 to year 7 and onwards.
- Severe punishments imposed to persons/organizations involved in coral reef destructive activities.



Timeline for the project

Activities	Year						
	1	2	3	4	5	6	7
Awareness to all stakeholders & training for 10 persons from each selected sites	■	■					
Selection of suitable sites & transplanting corals	■	■	■		■	■	
Formation of community participatory organizations			■	■			
River basin management programmes and control of land use patterns			■	■	■		

Development of a seasonal monitoring & resilience programme and a sustainable management plan									
Evaluation of success									

Executing agency/Main key stakeholder: Coast Conservation Department

Coordination: Ministries responsible for the subject of Environment/ Local Government and Provincial Councils/ Technology and Research, universities, Tourist Board, tourist hoteliers, National Physical Planning Department, CEA, coast guards, community based organizations, MEPA, INGOs and NGOs, NSF

5. Biodiversity Sector



Biodiversity Sector: Vulnerability to Climate Change

Sri Lanka has a varied climate and topography which has resulted in a rich biodiversity, distributed within a wide range of ecosystems. It is one of the most biologically diverse countries in the Asian region and considered as one of the 34 biodiversity hotspots identified in the world. The conservation of biological diversity is of special significance to Sri Lanka in the context of its predominantly agriculture-based economy and the high dependence on many plant species for food, medicines and domestic products.

The biodiversity sector in Sri Lanka has been identified as one of the most vulnerable sectors to climate change. Sri Lanka is vulnerable to the risk of sea level rise and increased frequency of storms that can bring major impacts on coastal biodiversity. Additionally, analysis of climate data indicate a change in rainfall regimes, and a trend for increasing air temperature, which can also have impacts on the country's biodiversity. It is also expected that climate change will cause changes in onset of flowering/fruitletting and flushing in terrestrial plants and breeding and reproduction in animals having implications on species survival, and ecosystems. The "Sector Vulnerability Profile" for the biodiversity sector has also identified vulnerability enhancing factors; the main anthropogenic factors that currently threaten biodiversity would reduce resilience of ecosystems and species to withstand impacts of climate change.

Prioritized Technologies

- Restoration of degraded areas inside and outside the protected area network to enhance resilience
- Increasing connectivity through corridors, landscape/matrix improvement and management
- Improve management, and possibly increase extent of protected areas, buffer zones and create new areas in vulnerable zones
- Focus on conservation of resources and carry out special management for restricted range, highly threatened species and ecosystems
- Ex-situ conservation for highly threatened species and possible re-introduction

5.1 Technology: Restoration of degraded areas inside and outside the protected area network to enhance resilience

5.1.1 Project idea: Study on identifying and prioritizing critical areas for restoration

The ability of degraded ecosystems to cope with the effects of climate change is low. Furthermore, the existing threats that these systems face are likely to be exacerbated in the future due to the stresses of climate change. Therefore, the restoration of



degraded ecosystems is a key strategy to enhance the resilience of these ecosystems to climate change, and mitigate the impacts of changing climatic conditions. At present, there is no prioritized list of critical areas to be restored in Sri Lanka. Furthermore, there is no national mechanism in place to identify and prioritize such areas.

Objectives: (i) To identify and prioritize critical areas for rehabilitation and restoration. (ii) Demonstration of rehabilitation and restoration through pilot interventions

Budget

The proposed project is scheduled to be implemented for a period of three years with a total budget of US \$ 2 million.

Outputs

- A comprehensive study identifying and prioritizing critical areas for rehabilitation and restoration covering terrestrial, inland aquatic and coastal and marine areas.
- A prioritized list of critical areas for rehabilitation and restoration.
- Public availability of the prioritized list of critical areas for rehabilitation and restoration and updated information on rehabilitation and restoration work.
- Demonstration of pilot activities at least in three representative habitats.

Proposed timeline for the project

Activities	Yr1	Yr2	Yr3
Literature survey and development of modeling	■		
Analysis of results of climate change modeling	■		
Ground truthing and identification of areas for rehabilitation and restoration	■		
Prioritization of areas for rehabilitation and restoration		■	
Development of list of representative priority areas for rehabilitation and restoration		■	
Pilot implementation of rehabilitation and restoration of three sites		■	■
Development of website giving information on priority list of areas for restoration			■

Key implementing agencies: DWLC, FD and NARA

Executing agency: Biodiversity Secretariat, Ministry responsible for the subject of Environment, Coordination: Committee of Department of Wildlife Conservation (DWLC), Forest Department (FD), Climate Change Secretariat (CCS), Ministry responsible for the subject of Environment, universities, environmental organizations, Panel of climate change and biodiversity experts will review outputs along with committee.

5.2 Technology: Increasing connectivity through corridors, landscape/matrix improvement and management

5.2.1 Project idea: Identification of critical areas to be connected and prioritization of required corridors



Apart from the direct destruction of habitats, development activities affect biodiversity by fragmenting existing natural habitats. This fragmentation results in the creation of 'islands' or pockets of natural habitat which are spatially and functionally isolated from each other. Habitat fragmentation can also occur as a result of habitat loss or degradation due to the effects of climate

change. The impacts of habitat fragmentation are often significant. The dispersal of seeds and pollen from flora is likely to be hindered. Furthermore, the small habitats created by fragmentation will have a low carrying capacity and will not have the space and resources necessary to support a high number of individuals. As for fauna, fragmentation can result in reduced reproduction or inbreeding within isolated fauna populations. Portfolio of strategic conservation sites: proposed corridors to connect PAs (MENR, 2006) identified a priority list of corridors. Changing climatic conditions can be brought in to prioritize the existing list and to introduce any new areas of importance.

Objectives: (i) To identify and prioritize critical areas to be connected in light of climate change impacts. (ii) To facilitate the inclusion of four critical areas in the protected area network.

Budget

The proposed project is scheduled to be implemented for a period of three years with a total budget of US 1.85 million.

Outputs

- Climate change modeling data.
- Critical areas to be connected identified.
- Required corridors prioritized.
- Four critical areas included into the protected area network.

Timeline for the project

Activities	Yr1	Yr2	Yr3
Literature survey and development of appropriate climate change modeling	■		
Analysis of modeling results and identification of critical areas to be connected	■		
Ground truthing and prioritization of corridors required for connection of critical areas	■		
Development of a list of priority areas for corridors	■		
Pilot implementation of interventions at least three corridors		■	■

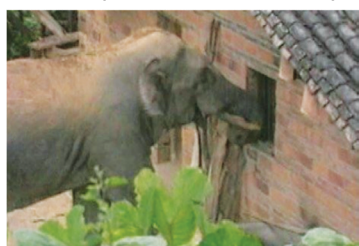
Key implementing agencies: DWLC, FD and NARA

Executing agency: Biodiversity Secretariat, Ministry responsible for the subject of Environment, Coordination: Committee of DWLC, FD, CCS, Ministry responsible for the subject of Environment, universities, National Aquatic Research and Development Agency (NARA), M/Fisheries and Aquatic Resources, environmental organizations. Panel of climate change and biodiversity experts will review outputs along with committee

5.3 Technology: Improve management, and possibly increase extent of protected areas, buffer zones and create new areas in vulnerable zones

5.3.1 Project idea: Awareness programme, capacity building and development of materials to promote coexistence with biodiversity

With increasing human populations and the associated increase in the need for land, communities often come in to conflict with the local biodiversity; conflicts with macro faunal species, such as elephants, result not only in the destruction of property but



also loss of life and species such as wild boar, hares, porcupines and monkeys can cause significant damages to crops, resulting in a loss of income for local communities. Given this conflict, a negative perception of these species is perpetuated, and the coexistence of communities with their local biodiversity becomes an uneasy one. As many important ecosystems and their associated biodiversity lie outside protected areas, and as many

of the threats facing endangered species are anthropogenic in nature, involvement of local communities in conservation activities is pivotal to the maintenance of biodiversity. Furthermore, given that existing threats to biodiversity are likely to be exacerbated due to climate change, it is vital that these ecosystems and their biodiversity are strengthened and conserved, so as to mitigate the effects of the additional stress of climate change.

Objectives: (i) To create awareness promoting coexistence with biodiversity. (ii) To build capacity to promote coexistence with biodiversity. (iii) To provide materials necessary to promote coexistence with biodiversity.

Budget

The proposed project is scheduled to be implemented for a period of one year with a total budget of US \$ 275, 000.

Outputs

- A detailed action plan on promoting coexistence with biodiversity.
- The successful completion of over 80% of the awareness programmes identified in the action plan.
- The successful completion of five case studies on strategies to enhance biodiversity while promoting coexistence of communities with biodiversity.
- Successful training and capacity building of key stakeholders in strategies to promote coexistence with biodiversity.
- A mechanism for the provision of materials necessary to implement strategies to promote coexistence with biodiversity.

Timeline for the project

Activities	Q1	Q2	Q3	Q4
Development of an action plan to promote coexistence with biodiversity				
Training and capacity building on strategies to promote coexistence with biodiversity				
Awareness programmes to promote coexistence with biodiversity				
Compilation of leaflets on strategies to promote coexistence with biodiversity				
Distribution of leaflets on strategies to promote coexistence with biodiversity and provision of necessary materials				
Case studies				

Key implementing agencies: Ministry responsible for the subject of Environment/ Fisheries and Aquatic Resources Development/ Wildlife and Agrarian Services

Executing agency: Biodiversity Secretariat, Ministry responsible for the subject of Environment, Coordination by a committee of: DWLC, FD, Dept of Agriculture, and relevant environmental organizations.

5.4 Technology: Focus on conservation of resources and carryout special management for restricted range, highly threatened species and ecosystems

5.4.1 Project idea: Awareness programme on point endemics and critically endangered species, and the importance of their conservation



Point endemic species consist of a single population that is found at one location alone. Point endemic species have a restricted distribution; they are often threatened with extinction. Furthermore, given that their distribution is extremely restricted, the destruction or degradation of the locality in which they are found will result in the loss of its sole habitat and as such, is likely to result in the complete loss of the species. These species are extremely vulnerable

to the effects of climate change as their populations are often fragile and vulnerable to changes in conditions.

Objective: To create awareness of the importance of point endemic species and their conservation through preparation of awareness materials and disseminating them. Targeted audience includes members of the public, policy makers and other key stakeholders.

Budget

The proposed project is scheduled to be implemented for a period of one year with a total budget of US \$ 270, 000.

Outputs

- Preparation and dissemination of awareness materials on web.
- Conduct at least five national level awareness workshops per year, each with a capacity of 50 individuals.

Timeline for the project

Activities	Q1	Q2	Q3	Q4
Development of an awareness programme and awareness materials				
Review meeting				
Two awareness workshops to government officials				
Two mass media events				
Two awareness workshops to local communities				
Two awareness workshops to NGOs				
Two awareness workshops to students				

Key implementing agencies: Ministry responsible for the subject of Environment/ Fisheries and Aquatic Resources Development/ Wildlife and Agrarian Services

Executing agency: Biodiversity Secretariat, Ministry responsible for the subject of Environment, Coordination by a committee of: DWLC, FD, universities and relevant environmental organizations.

5.5 Technology: Ex-situ conservation for highly threatened species and possible reintroduction

5.5.1 Project idea: Studies to identify and prioritize species for ex-situ conservation, and climate change modeling to identify species vulnerable to climate change

In the future, it is likely that certain habitats, such as montane and coastal ecosystems, will be altered, damaged or lost disproportionately due to climate change. Species that are supported by



these habitats, particularly point endemic species which are restricted to a single locality, will be affected adversely as a result. Given that in-situ conservation efforts are likely to be insufficient, or ineffective, for these species in such instances, ex-situ conservation efforts will be crucial to their survival. As such, the identification of species that are vulnerable to climate change, and as such, likely to become priority species for ex-situ conservation in the future, is crucial. Once these species are identified, their populations can be monitored in-situ so as to gain insight into the ways in which they are affected by climate change, while the chances of their survival can be enhanced by establishing ex-situ populations.

Objective: (i) To identify and prioritize species for ex-situ conservation. (ii) To identify species vulnerable to climate change through climate change modeling.

Budget

The proposed project is scheduled to be implemented for a period of three years with a total budget of US\$ 2 million out of which 10% local funding.

Outputs

- A comprehensive study of species requiring ex-situ conservation
- A list of priority species for ex-situ conservation in light of climate change vulnerability.
- Capacity building and development of expertise on climate change modeling.
- Modeling data and maps predicting the habitats that are vulnerable to climate change in future.

Timeline for the project

Activities	Yr1	Yr2	Yr3
Compilation of the priority list of species for exsitu conservation			
Training of personnel in climate change modeling and capacity building			
Climate change modeling and identification of vulnerable habitats			
Identification of species vulnerable to climate change			
Review of outputs by biodiversity and climate change experts			
Dissemination of information gathered during the studies with stakeholders and policy makers			

Key implementing agencies: Department of National Zoological Garden, Department of National Botanical Garden, Plant Genetic Resources Center.

Executing agency: Biodiversity Secretariat, Ministry responsible for the subject of Environment, Coordination by a committee of: DWLC, FD, Climate Change Secretariat, Ministry responsible for the subject of Environment, universities and relevant environmental organizations.

5.6 Combination of Technologies

5.6.1 Project idea: Climate Change Adaptation for biodiversity; a ridge to reef approach in building climate resilience along the Mahaweli river



Sri Lanka is one of the most biologically diverse countries in Asia, with its biodiversity considered to be the richest per unit area in the region with regard to mammals, reptiles, amphibians, fish and flowering plants. The Sector Vulnerability Profile for the biodiversity sector states that, as an island nation, Sri Lanka is vulnerable to the risk of sea level rise and increased frequency of storms that can bring major impacts on coastal biodiversity. Additionally, analysis of climate data indicate a change in rainfall regimes, and a trend

for increasing air temperature, which can also have impacts on the country's biodiversity. Thus there is an urgent need to carry out the above interventions if climate change impacts on biodiversity are to be minimized, and for biodiversity to adapt accordingly.

Project location: The project will be implemented at a number of sites - Knuckles Conservation Forest, Wasgamuwa National Park, Somawathiya Sanctuary, Flood Plains National Park and Pigeon Islands National Park – spanning four districts in three provinces.

Objective: To increase the resilience of biodiversity for climate change adaptation, by taking a ridge to reef approach in building resilience. This will be done through localized climate change modeling, biodiversity surveys, restoration, improving connectivity and by conserving highly threatened restricted range species.

Budget

The proposed project is scheduled to be implemented for a period of three years with a total budget of US \$ 475, 000.

Outputs

Phase 1

- Results of the climate change modeling for a pilot area in the Knuckles Conservation Forest—including the identification of the most vulnerable ecosystems and species.
- Preliminary activities necessary for restoration and conservation of the most vital ecosystems and species carried out.

Phase 2

- Detailed climate change modeling along the ecosystems adjacent to the Mahaweli River – which will include various forest types, wetlands, coastal and marine ecosystems.
- Selected vital ecosystems restored.
- Selected highly vulnerable species are conserved.
- Connectivity improved by working with local communities, landowners and plantations.
- Training and capacity building carried out on climate change adaptation strategies for those working in the biodiversity sector.
- Results shared and publicized to enable replication.

Timeline for the project

Activities	Yr1	Yr2	Yr3
Phase 1			
Detailed pilot climate change modeling in the Knuckles area (external technical input will be necessary)			
Preliminary activities for pilot restoration of selected ecosystems			
Preliminary activities for pilot conservation of highly threatened/vulnerable species			
Phase 2			
Expanding climate change modeling using the ridge to reef approach			
Restoration of vital ecosystems			
Conservation of highly threatened species			
Facilitating connectivity between different types of land use			
Training and capacity building			
Sharing and publicizing results			

Key implementing agencies: FD, Mahaweli Authority of Sri Lanka, DWLC and NARA

Executing agency: Biodiversity Secretariat, Ministry responsible for the subject of Environment, Stakeholders: CCS, Ministry responsible for the subject of Environment, FD, DWLC, Coast Conservation and Coastal Resources Management Department, National Aquatic Resources Research and Development Agency, Ministry of Fisheries and Aquatic Resources Development and Central Environmental Authority; environmental organizations and universities, local communities and landowners in the area

Mitigation: Priority Sectors

1. Energy
2. Transport
3. Industry



6. Energy Sector



This sector includes energy industry, refinery operations and household & commercial sectors. Emissions from fossil fuel combustion in electricity generation (energy industries), refinery operations, and household & commercial sectors are considered as emissions from the energy sector.

Prioritized Technologies

- Conversion of biomass and waste to energy
- Smart grid technology for wind, solar and small hydro for grid integration
- Building management systems

6.1 Technology: Conversion of biomass and waste to energy

6.1.1 Project idea: Co-Firing of Biomass with Coal

In the proposed technology, it is intended to use biomass and coal as fuels utilizing a part of the machinery already installed to generate electricity. Use a separate biomass boiler to generate steam at the same temperature and pressure as that of the steam produced at the coal boiler. Steam produced in the biomass boiler is connected to a common steam header. Steam from this header is used to drive the existing steam turbines. It is proposed to install this boiler adjoining the 300 MW coal fired boiler in Nurachcholai, in Puttalam District in Sri Lanka.



Objectives: (i) To reduce GHG emissions. (ii) To reduce the consumption of coal in the generation of electricity. (iii) To increase the share of electricity generation using indigenous resources. (iv) To enhance the rural economy by providing a market for locally cultivated biomass.

Budget

The proposed project is scheduled to be implemented for a period of twenty five years with a total budget of US \$ 15.3 million international component and US \$ 15 million local component.

Outputs

- Availability of a Feasibility Report on Co-Firing of coal with biomass.
- Reduction of imported coal by 96,000 tonnes /year.
- Generation of biomass based steam equivalent to 240 GWh of electricity per year.
- An annual income of US\$ 31.2 million to the local community by way of purchase of wood for steam generation.

Timeline for the project

Activities	Yr1	Yr2	Yr3 to 25
Direct Activities			
Feasibility Report on Co-firing biomass and coal			
Investment, construction, operation and maintenance of a 30 MWe biomass fired boiler and supplying steam to an existing 300 MWe coal-fired boiler through a PPP.			
Donor agencies to provide funds at low interest rate for renewable and energy efficiency project			
Making arrangements for the investors to cultivate Gliricidia as an agro-energy crop in underutilized lands.			
Establishment and operation of agro-energy plantations in underutilized lands and in home gardens by the investors of this project			
Supporting Activities			
Elimination of government taxes on local construction			
SEA to incorporate co-firing as an option for electricity generation in Sri Lanka.			
SEA to invoke the provision in the Act to impose a levy on fossil fuels and use this revenue to finance renewable energy and energy efficiency projects			
During generation planning the costs of impacts fossil fuel use on external entities to be added to the direct costs of electricity generation.			

Implementation: By a private or state sector project developers identified by a process formulated by the Sustainable Energy Authority, Ceylon Electricity Board, Ministries responsible for the subject of Power and Energy/Finance.

Coordination: Committee consisting of representatives from the institutions; private sector developer, Sustainable Energy Authority, Ceylon Electricity Board, Ministries responsible for the subject of Environment/Finance/Plantation Industries

6.1.2 Project idea: Compact biogas digester for urban households

In this technology, a compact biogas digester and readily purchasable renewable feed materials are proposed to be introduced for the urban household as an alternative to LPG (Liquid Petroleum Gas). As feed materials, it is proposed to use dried and powdered Gliricidia leaves. University of Moratuwa has conducted trials and confirmed its suitability. Such leave powder need to be manufactured by the private sector and marketed through super markets.

Objectives: (i) To reduce the national consumption of LPG consumed by the urban household sector for cooking of food and water heating. (ii) To provide an elegant and compact biogas digester at an affordable price suitable for an urban household. (iii) To ensure that a convenient renewable feed material is available to be purchased by urban households as feed material for the biogas unit.

Budget

The proposed project is scheduled to be implemented for a period of twenty five years with a total budget of US \$ 13 million international component and US \$ 0.01 million local component.

Outputs

- Availability of a Feasibility Report on the use of compact biogas unit by urban households.
- Use of 100 numbers of compact biogas units in the country by the year 2014 and 60,000 units in 5 years.
- Reduction of consumption of imported LPG by 18 tonnes/year by 2014 and 8760 tonnes in 5 years.

Timeline for the project

Activities	Yr1	Yr2	Yr3 to 25
Preparation of a feasibility report on the technical and financial viability of using compact biogas digesters and Gliricidia leaf powder			
Making arrangements for cultivation of Gliricidia as an agro-energy crop in underutilized lands.			
Donor agencies to provide funds at low interest rate for renewable and energy efficiency projects.			
Establishment of agro-energy plantations in underutilized lands and in home gardens by the private sector.			
Research institutions in Sri Lanka to resolve the issues in the production and use of feedstock for urban household biogas digesters			
Supporting Activities			
Eliminating the taxes imposed on local construction in respect of renewable energy and energy efficiency projects.			
Sustainable Energy Authority to invoke the provision in the Act to impose a levy on fossil fuels and use this revenue to finance renewable energy and energy efficiency projects.			

Implementation: Research institution / Non Government Organization

Coordination: Committee consisting of representatives from the institutions; Sustainable Energy Authority, research institution / Non Government Organization responsible for the research and propagation of the technology, Ministry responsible for the subject of Finance and Planning

6.1.3 Project idea: Waste to energy

The major difficulty encountered when Municipal Solid Waste (MSW) is combusted to generate energy is the production of dioxin (a highly toxic substance). The introduction of the manufacture of Residue Derived Fuel (RDF) from MSW would obviate the above issue.

Objectives: (i) To develop a technology to dispose MSW by converting it into RDF to be utilized by the cement industry as a fuel for the manufacture of cement. **(ii)** To reduce the consumption of imported coal in the manufacture of cement.



Budget

The proposed project is scheduled to be implemented for a period of twenty five years with a total budget of US \$ 0.65 million international component and US \$ 0.5 million local component.

Outputs

- Availability of a Feasibility Report on the Production and use of RDF from MSW.
- Development of a technology to produce RDF from MSW in a cost effective manner (Cost of production of 1 tonnes of RDF should not exceed US\$ 150).
- Establishment of a RDF manufacturing facility with a capacity of 50 tonnes per day in 5 years time.
- Reduction of consumption of coal in local cement manufacture by 50 tonnes per day.

Timeline for the project

Activities	Yr1	Yr2	Yr3 to 25
Direct Activities			
Preparation and publication of a Feasibility Report on the Financial and Technical viability of a 50 tonne per day Residue Derived Fuel (RDF)			
Donor agencies to provide funds at low interest rate for renewable and energy efficiency project			
The Waste Management Authority of Western Province to ensure that 100 tonnes of Municipal Solid Waste (MSW) are available per day to an identified private investor.			
State sector collaborating with the private sector in the investment and operation of a 50 tonne per day RDF facility through a PPP (public private partnership) program.			
Establishment and operation of a 50 tonne per day a Residue Derived Facility (RDF) and sell RDF to the local cement manufacturers or to export it.			
Supporting Activities			
Elimination of taxes on local construction			
SEA to invoke the provision in the Act to impose a levy on fossil fuels and use this revenue to finance renewable energy and energy efficiency projects			

Implementation: Private sector developer identified by the Waste Management Authority

Coordination: Sustainable Energy Authority, Ministries responsible for the subject of Finance/Commerce & Industries/Local Government/Environment, Western Provincial Council, Waste Management Authority, private sector project developer

6.2 Technology: Smart Grid Technology for wind, solar and small hydro for grid integration

6.2.1 Project idea: Smart Grid Technology for wind, solar and small hydro for grid integration

The potential for wind and solar PV based electricity generation in Sri Lanka is very significant. However, recent experiences in Sri Lanka with these two technologies have resulted in difficulties in balancing the supply and demand of the national grid and maintaining system stability. The reason for this phenomenon is that unsteady or variability of energy outputs of these two energy sources. This problem has been resolved in some countries, the variability in the supply side of wind and solar PV systems are managed by adjusting the demand side by varying the loads of identified consumers through Smart Grid Technology. It is proposed to introduce these technologies to the electricity network in Sri Lanka with the view of increasing the share of wind, solar and small hydro based generation.

Objectives: (i) To develop a set of technologies to balance the varying outputs of wind, solar and small hydro power plants with varying demand in the electricity network in Sri Lanka. (ii) To enhance the capacity of various components in the electricity network to enable it accept a larger share of input from wind, solar and small hydro power sources. (iii) To enhance the capability of the Metrological Department in Sri Lanka to enable it to provide more accurate and early weather forecasts. (iv)

To build the capacity of all relevant institutions in Sri Lanka to enable these institutions to acquire adequate knowledge to deploy modern technologies to enhance the share of energy from wind, solar and small hydro power plants.



Budget

The proposed project is scheduled to be implemented for a period of twenty five years with a total budget of US \$ 121 million international component.

Outputs

- A comprehensive Feasibility Report on the Financial and Technical viability of enhancing the share of wind, solar and small hydro through smart grid and infrastructure improvement and improved weather forecasting technologies.
- Enhancement of national electricity network with the ability to absorb (3761 GWh/y) 20% of the total generation capacity from solar, wind and small hydro sources.
- Enhancement of weather forecasting facility at the national Metrological Department with the ability to forecast accurately the weather parameters to enable the electricity producers of solar, wind and small hydro to optimize their electricity generation.
- Enhancement of knowledge base of officials in electricity generation and weather forecasting sectors to enable them to optimize electricity generation from solar, wind and small hydro power plants.

Timeline for the project

Activities	Yr1	Yr2	Yr3 to 25
Direct Activities			
Feasibility Report on the Financial and technical viability of enhancing the capability of the electricity network (As described in activity 1)			
Technical colleges and universities should include Smart Grid/ Smart Meter technologies in their curricula.			
Relevant officials of institutions involved in the implementation of these technologies to be provided with relevant training (As described in activity 3)			
Enhance the facilities at Meteorological Department to enable it to forecast accurately and quickly the weather parameters to facilitate the energy sector.			
Improve the shape of the daily electricity load curve as described in activity 5.			
Ensure wider consultations prior to environmental legislations.			
Supporting Activities			
Eliminating the taxes imposed on local construction in respect of renewable energy and energy efficiency projects.			
Donor agencies to provide funds at low interest rate for renewable and energy efficiency project.			
SEA to invoke the provision in the Act to impose a levy on fossil fuels and use this revenue to finance renewable energy and energy efficiency projects.			
During generation planning the costs of impacts of fossil fuel use on external entities (such as health, agriculture) to be added to the direct costs of electricity generation.			

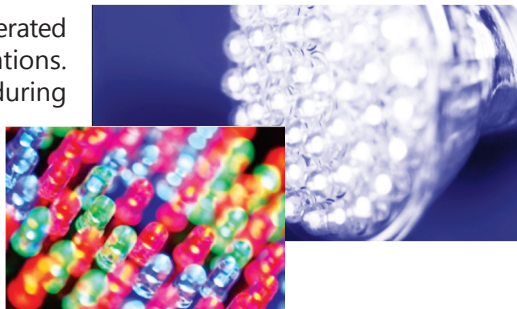
Implementing agency: Ceylon Electricity Board (CEB)

Key Stakeholders: Ceylon Electricity Board, Ministries responsible for the subject of Power & Energy/Finance/Environment/Higher Education and Vocational Training, Department of Meteorology, Sustainable Energy Authority

6.3 Technology: Building Management Systems

6.3.1 Project idea: LED Lighting

Over 10% of the total electrical energy generated in Sri Lanka is utilized for lighting applications. A larger part of this energy is consumed during daily peak time. Hence it is imperative that for lighting purposes the most efficient technology should be utilized. A new lighting technology utilizing Light Emitting Diode (LED) has been in many countries slowly entering in Sri Lanka.



Objectives: To assist the Sustainable Energy Authority to accelerate and enhance the promotion of LED lamps for appropriate applications in Sri Lanka.

Budget

The proposed project is scheduled to be implemented for a period of twenty five years with a total budget of US \$ 0.6 million international component.

LED lamps have the following advantages:

- The efficacy (light output in lumen per watt of electricity consumed) is much higher than any other type of lamp. Hence the energy consumption is much less for a given application.
- The life of the lamp is much longer. Typically LED lamps last 40,000 to 50,000 hours compared to 1000 hours for Incandescent and 10,000 hours for Compact Fluorescent Lamps (CFLs).
- Lower cost of manufacturing the desired colour of illumination.
- Harmonics introduced in the power supply, if any, is very small compared to lamps such as CFL.
- LED lamps gives adequate indication of lamp failure by very gradually lowering their light outputs, instead of stop functioning all of a sudden. This feature of LEDs is very desirable in situations such as surgical operating theatres, where failure of lamps while in use could cause serious disruptions.
- LED lamps do not emit any ultraviolet or any other undesirable radiation. Hence health hazards associated with such radiations are eliminated.
- The disposal of discharge lamps (such as CFL, fluorescent lamps, mercury/ sodium vapour lamps encounters heavy metal pollution. Disposal of LED lamps do not encounter such problems.

Outputs

- A comprehensive feasibility report on the financial and technical viability of replacing Incandescent, Compact Fluorescent Lamp (CFL), Cold Cathode Fluorescent Lamp (CCFL), linear florescent and discharge lamps such as sodium, mercury lamps with Light Emitting Diode (LED) lamps for appropriate applications.
- Enhancing the knowledge on the merits of LEDs to relevant sections of the population.

Timeline for the project

Activities	Yr1	Yr2	Yr3 to 25
Preparation and publication of a Feasibility Report on the Financial and Technical viability of introducing LEDs for appropriate lighting applications.			
Introduce and operate a labeling scheme for LEDs			
Introduce a scheme to ensure replacement of defective LEDs			
Support the Awareness Programme initiated by SEA on LEDs			

Implementing agency: Sustainable Energy Authority

Key Stakeholders: Sustainable Energy Authority, Ministries responsible for the subject of Finance/Higher Education and Vocational Training

6.3.2 Project idea: Solar assisted air conditioning



Over 10% of the total electricity generated in Sri Lanka is utilized for air conditioning of buildings. Almost all these air conditioners utilize the electrically operated vapour compression technology. In the proposed technology, solar heat is used to provide a part of the energy needed for this application which would result a reduction about 20% of the electrical energy used for air conditioning.

Objective: To install a Window Type Solar Assisted Air Conditioner at the office of the Sustainable Energy Authority to monitor and verify its performance and disseminate the

merits of this technology to all prospective users of this technology in Sri Lanka.

Budget

The proposed project is scheduled to be implemented for a period of twenty five years with a total budget of US \$ 0.3 million international component and US \$ 1 million national component.

Outputs

- A comprehensive Feasibility Report on the Financial and Technical viability of Solar Assisted Air Conditioning Technology.
- Diffusion of Solar Assisted Air Conditioning Technology amongst all users of air conditioning systems in Sri Lanka.

Timeline for the project

Activities	Yr1	Yr2	Yr3 to 25
Preparation and publication of a Feasibility Report on the Financial and Technical viability of Solar Assisted Air Conditioning Technology.			
Eliminating the taxes imposed on local construction in respect of energy efficiency projects.			
Donor agencies to provide funds at low interest rate for energy efficiency projects.			
Sustainable Energy Authority to invoke the provision in the Act to impose a levy on fossil fuels and use this revenue to finance energy efficiency projects.			
Technical colleges and universities should include Solar Assisted Air Conditioning System technology in their curricula.			
Procurement, installation, operation and monitoring of a Solar Assisted Air Conditioning System.			
Diffusion of Solar Assisted Air Conditioning System to all users of air conditioning system in Sri Lanka			

Implementing agency: Sustainable Energy Authority

Key Stakeholders: Ceylon Electricity Board/ Ministries responsible for the subject Power & Energy/Finance/Higher Education and Vocational Training, Sustainable Energy Authority

7. Transport Sector



Transport is the major greenhouse gas emitting sector in Sri Lanka. About 60% of air pollution in Colombo City and 48% carbon dioxide (CO₂) emissions from the energy sector comes from the transport. The overarching goal of selecting the technologies is to lower the CO₂ emissions and enhance fuel energy use efficiency through reducing congestion due to heavy traffic including the large number of single- and low occupancy vehicles, and promoting mass transportation & non-motorized transportation.

Prioritized Technologies

- Integration of non- motorized transport methods along with regularized public transport system
- Promote carpooling and park-and-ride systems during rush hours and on roads with heavy volumes of vehicles
- Electrification of the existing railway system.

7.1 Technology: Integration of non - motorized transport methods along with regularized public transport system

7.1.1 Project idea: Non-motorized transport methods with regularized public transport system for better climate benefits in Sri Lanka

Transport sector is one of the major greenhouse gas emitting sectors in Sri Lanka, and there is a need to reduce the emissions through reduced burning of fossil fuels in vehicular transport by discouraging the use of low-and single-occupancy vehicles and promoting non-motorized and public transport.

Objectives: (i) Having properly designed pedestrian facilities in suburbs of Colombo within a radius of ~ 10 km where currently such facilities (sidewalks, walkways connecting public transport terminals to main roads, and proper road furniture and traffic signals at pedestrian crossings) are lacking. (ii) Promote better road discipline and law enforcement. (iii) Awareness creation on the need for lower number of personal vehicles on the road and reduced burning of fossil fuels, and health benefits of non-motorized transport. (iv) More research & development measures on cleaner/low GHG-emitting technologies for public transport

Budget

The proposed project is scheduled to be implemented for a period of three years with a total budget of US \$ 28.42 million.

Outputs

- Developing pedestrian facilities and road furniture
 - Sidewalk construction in a road length of ~100 km
 - Better traffic signals at pedestrian crossings (3 per km; total length 100 km)
 - Walkway fragments as connections between main roads and public transport terminals (total length of walkways 20 km)
 - Fencing of bad sidewalks: Fencing with florescent coloured metal blocks and/or widening of selected narrow sidewalks accommodating all bus bays, and replacement of poor quality sidewalks/ shoulders in selected suburban areas of Colombo
 - Pedestrian friendly road furniture: proper yellow lines and florescent/yellow poles by pedestrian crossings for visibility at night; tactile tiles for visually impaired people
- Improvement of road discipline by law enforcement and other means and increase the awareness creation
 - At least 2500 people trained on road discipline and the enforcement of road rules
 - Weekly programs on TV and radio
 - Biweekly advertisements on TV and radio
 - A proper monitoring mechanism for strict road discipline and penalties for road rule violators
- Amendment/s to the national policies and legislation and establishing an automated fine system with synchronized traffic signals
 - Installation of automated surveillance cameras and examining changes in accidents and violation of pedestrian rights after the installation of the same at Automatic Traffic Signal (ATS) junctions
 - Necessary amendments in legislation/s relevant to road transport

- Research and Development (R & D) activities on mitigating vehicular emissions and health impacts
 - Research projects and studies on cleaner technology options for public transportation systems,
 - Research on better road construction and paving material, and overall GHG mitigation in road transport

Timeline for the project

Activities	Yr1	Yr2	Yr3
Developing pedestrian facilities and road furniture			
Establishing sidewalks and traffic signals at necessary pedestrian crossings in a road length of 100 km			
Identification of the road segments requiring such pedestrian facilities			
establishing sidewalks and traffic signals (100 km total road length; 3 traffic signals per km)			
Construction of walkways connecting sidewalks to main bus stations and train stations, along with attractive pedestrian facilities such as benches and bicycle racks			
Identification of the locations			
Establishment of walkway fragments connecting the public transport terminals and the sidewalks on main roads, while trying to bring all the public transportation (i.e. bus and train) terminals in close proximity			
Fencing and/or broadening of existing narrow sidewalks with florescent coloured metal blocks and/or widening of selected narrow sidewalks accommodating all bus bays, and replacement of poor quality sidewalks/ shoulders in selected suburban areas of Colombo			
Identification of the locations			
Land acquisition based on availability			
Fencing and repairing sidewalks/shoulders			
Provision of all required road furniture			
Establishing proper yellow lines and yellow/luminous poles by pedestrian crossings for visibility at night; tactile tiles for visually impaired people)			
Improvement of road discipline by law enforcement and other means and increase the awareness creation among road users including the drivers of different categories of vehicles			
Quarterly workshops for government and provincial council officials and monthly workshops for new licensees			
Weekly TV and radio programs and advertisements			
Amendment/s to the national policies and legislation and establishing an automated fine system with synchronized traffic signals			
Regularization of private bus transport to have strict schedules and stricter times for container transport			

Introducing an automated fine system for motorists who violate pedestrian rights			
Traffic signal synchronization in busy road segments			
Research and Development (R & D) activities on mitigating vehicular emissions and health impacts			
Calling for proposals and inception			
Implementation			

Implementation: Road Development Authority (RDA), and Urban Development Authority (UDA) under the guidance of Ministry responsible for the subject of Transport

Coordination: A team consisting of the officers from the following institutes: Ministries responsible for the subject of Transport/ Health /private transport/ highways, RDA, Local Authorities, Provincial Road Development Authority (PRDA), Road Passenger Transport Authority- Western Province, National Transport Commission, police, UDA, National Physical Planning Department, Motor Traffic Department (DMT), National Council for road safety, universities, Colombo Municipal (CMC), Construction Equipment Training Centre (CETRAC).

7.2 Technology: Promote carpooling and park-and-ride systems during rush hours and on roads with heavy volumes of vehicles

7.2.1 Project idea: Park-and-Ride systems in Colombo and Gampaha districts of Sri Lanka for greener transport

Park-and-ride lots are parking lots where the commuters can leave their personal vehicles and transfer to a common shuttle or do carpooling for the rest of their journey. Currently, about 60% of the air pollution (especially in Colombo City) comes from the transport sector. Carpooling and park-and ride options can be considered for roads where congestion is extremely high, causing traffic delays and heavy pollution due to vehicular emissions.



Objectives: (i) Promote Park-and-Ride systems in Sri Lanka as a trustworthy mass transportation means which would help reduce GHG emissions and air pollution on traffic congested roads. (ii) Promote better road discipline and law enforcement. (iii) Avoid unnecessary traffic delays caused by single occupancy personal vehicles. (iv) Awareness creation on the need for lower number of personal vehicles on the road and reduced burning of fossil fuels











Budget

The proposed project is scheduled to be implemented for a period of three years with a total budget of US \$ 11.05 million.

Outputs

- Two secure Park-and-Ride systems commuting altogether at least 600 passengers each way a day in better fuel-efficient shuttles; this would avoid a similar or lower number of cars being on the road
- Having proper infrastructure with small shopping complexes and fuel stations will attract more Park-and-Ride users, and will reduce overall GHG emissions by avoiding unnecessary travel to other places in fulfilling such personal needs
- Introducing a tax system for single or low occupancy vehicles at varied rates, with a reduced rate for the vehicles run on cleaner fuel
- Awareness creation through mass media

Timeline for the project

Activities	Yr1	Yr2	Yr3
Land purchase and clearance			
Purchase and clearance of two-acre land pieces in suburbs of Colombo and Gampaha districts			
Purchase of better shuttles, possibly run on greener fuel, and reduction of the importation taxes for public transport vehicles			
Import of ten shuttles per Park-and-Ride lot (altogether 20)			
Development of infrastructure and amenities within the parking lots, while ensuring the security			
Establishing useful infrastructure and amenities within part of the carpooling and park-and-ride lots			
Proper electronic display of information related to bus transit (delays, on-time arrival, etc.) and establishment of proper signboards by the main road			
Establishment of security cameras and lighting systems, appointment of security personnel, and introducing insurance schemes for the parking lots			
Establishment of a proper regulatory and management system for sustainable operation			
Establishment of a proper registration system for regular users and maintenance of databases on the functionality			
Introduction of direct management regulations for carpooling and shuttle transit and initiative action by the Transport Ministry in collaboration with the Ministry of Provincial Councils			
Publishing manuals or directories with all the relevant information (i.e. guidelines and regulations on driver/passenger credit sharing, responsible authorities and officials, etc.)			
Develop a facility to use a smart card and online ticket purchasing ability			
Strict enforcement of the suggested tax system for single- or low-occupancy vehicles during the peak hours on roads with high congestion, along with a strict enforcement of a point system for disciplining the drivers			
Strict enforcement of the suggested tax system during the peak hours on roads with heavy traffic congestion, and strict enforcement of a point system for disciplining the drivers			

Weekly TV and radio programs and advertisements on the establishment and benefits of the Park-and-Ride systems			
Weekly TV and radio programs and advertisements			
Evaluation of the applicability and success of this pilot project			
Evaluation by an independent expert committee, considering the socioeconomic and environmental benefits			

Implementation: Ministries responsible for the subject of Transport/Provincial Councils, in collaboration with the private sector and Police Department.

Coordination: A team consisting of the officers from the above institutes and academia

7.3 Technology: Electrification of the existing railway system

7.3.1 Project idea: Electrification of five percent of the existing railways of Sri Lanka for reduced greenhouse gas emissions

The railway network in Sri Lanka, which has a length of ~1500 km, was initially built and used only for transporting export plantation products, and with increasing population and traffic needs, rail transport became more passengers oriented. Currently the existing trains are diesel powered, and electrification of part of the railway network has been proposed. In the past, during the first half of the twentieth century, an electric tram car system was operating in certain parts of Colombo. This early tram system is the



only electrified rail experience Sri Lanka has had so far. Therefore, the proposed electrification of ~5% of the existing railway system to meet the current passenger transport needs will bring a different experience with reduced greenhouse gas emissions. A feasibility study has been already done on electrification of the railway system.

Objectives: (i) Establish a better, electrified railway system in a selected fragment of the existing railways of Sri Lanka, through installing necessary infrastructure changes, new locomotives and signal systems for efficient railway system with reduced GHG emissions. (ii) Training and capacity building for proper and sustainable operation of the electrified railway system

Budget

The proposed project is scheduled to be implemented for a period of three years with a total budget of US \$ 47.61 million.

Outputs

- ~70 km of the existing railway track electrified with better infrastructure, locomotives, and signal systems
- The number of personnel (mostly engineers, technical officers, and planners) trained in the countries within the region (e.g. Singapore, Japan) and other developed countries

(e.g. Europe, USA) are expected to contribute to the sustainable functioning of the electrified railway system

- Improvements and capacity building within the overall transport sector in Sri Lanka

Timeline for the project

Activities	Yr1	Yr2	Yr3
Identification of the fragment/s for electrification and electrification links			
Identification of the fragment/s for electrification			
Obtaining the support from the Transport Ministry to identify electrification links			
Installing necessary infrastructure changes, new locomotives and signal systems			
Provision of electricity through overhead lines (25 kilovolt) drawn above the railway lines and loops, better tracks, new locomotives, and signal systems, as needed			
Fulfilling the maintenance requirements of the system			
Periodic maintenance of the system for smooth functioning			
Capacity building and institutional strengthening through required training in collaboration with the countries with better experiences on electrified train systems.			
Training of the relevant government officials needing specialized training, considering their area of expertise, qualifications, and experience			

Implementation: Sri Lanka Railways and the Ministry responsible for the subject of Transport

Coordination: A team consisting of the officers from the Ministry responsible for the subject of Transport, Sri Lanka Railways, The Institute of Engineers, Sri Lanka (IESL), Arthur C Clarke Institute of Sri Lanka, Ceylon Electricity Board, and academia

8. Industry Sector



Sri Lanka is not an industrialized country. The industrial production of the country has been rather low and this is reflected by the relatively low emission of 493 GgCO for the entire industrial processing sector of Sri Lanka. Most of the local industries can be categorized into medium or small scale industries and none is considered large. Most of

these industries have a real concern on the high cost of energy, and hence they prefer low cost technologies which reduce energy cost and keen in improving energy efficiency through environment friendly GHG mitigation technologies.

Industry sector of Sri Lanka is not a high energy and resource consumer. The key industries contributing to GHG emissions are cement manufacture, lime production for construction industry, and industries using lime stone (CaCO containing material) and soda ash. The energy required for industrial purposes is generated from several sources such as biomass, petroleum oils and electricity. Biomass is used in tea and rubber factories, bakeries, tile and brick industries and other small scale industries. Petroleum oil is used for operating boilers, ovens and furnaces in other industries.

The main fraction of GHGs in the industrial sector is CO and it contributes about 86% of the total GHG emitted by the sector. Of this amount, about 63% is emitted from the industrial energy consumption and about 37% emitted from industrial processes.

Prioritized Technologies

- Energy Efficient Motors
- Variable Speed Drives
- Residue Biomass Combined Heat and Power

8.1 Technology: Energy Efficient Motors

8.1.1 Project idea: Facilitation of emission reduction in industries by changing to high efficiency motor drives through availability of financial instruments and loan granting schemes, subsidies and green credit lines.

According to global energy surveys, it is estimated that two thirds of electrical energy in the industry is consumed by motors and hence high efficiency requirement is inevitable in view of overall energy efficiency. If every installation could contribute even by a fractional improvement of efficiency, the gross saving would be enormous. The motors that have higher efficiency by 2% – 8% than the standard efficiency motors are categorized as “Premium Efficiency Motors”. Energy efficient motors have other benefits in addition to energy savings. They have better life due to high quality insulation, magnetic circuits and bearings. These properties with high quality manufacturing processes; also lead to very low vibration and more susceptible to voltage unbalances and overloading. Energy Efficient Motor technology is identified as a mitigation technology because of its high potential of green house gas emission reduction at electricity power generation. This technology helps to improve electrical energy efficiency especially at industries and generally at service sector.

Objectives: (i) Increase the amount of energy efficient motor use in local industry and service sector applications. (ii) Facilitate to industries and service organizations to use energy efficient motors and mitigation technologies to reduce their GHG emissions and cost of production/service. (iii) Develop capacity of banking sector on mitigation technologies and its benefits.









Budget

The proposed project is scheduled to be implemented for a period of three years with a total budget of US \$ 0.18 million.

Outputs

- Availability of low interest credit schemes for mitigation technologies such as Energy Efficient Motors. Output will be one credit scheme and one grant scheme.
- 30% increase of Energy Efficient Motor usage in local industrial sector.
- GHG emission reduction per grant given.
- Replacement of existing motors with EEM and expect to reduce energy consumption by 10 – 13 percent in 10 years period
- Expected GHG reduction is about 130,000tCO₂e.

Timeline for the project

Activities	Yr1	Yr2	Yr3
Conduct a comprehensive survey (using technical university students) on the usage pattern of all the motors, Variable Speed Drives (VSDs).			
Estimate the total energy consumption and GHG emission based on these results			
Develop a data base of global suppliers of energy efficient motors			
Obtain the pricing details and the total funds requirement for all replacement of low efficient motors to be estimated			
Submit findings to all potential donors and financial institutions for consideration to start a green/low interest credit lines			
Develop comprehensive training programme with lessons, presentations and other information to educate banks officials on how to evaluate new loan application on mitigation technologies such as Energy Efficient Motors (EEM) and VSD			
Identify and develop financial mechanism based on stakeholder consultation			
Forward all the relevant documents to treasury and Ministry of Finance and Planning through Ministry of Environment for further action.			

Implementation: Sri Lanka Sustainable Energy Authority

Coordination: Development banks and technical service providers such as National Cleaner Production Centre, Sri Lanka Energy Managers Association and National Engineering Research and Development Centre.

8.2 Technology: Variable Speed Drives

8.2.1 Project idea: In country capacity development through strengthening of institutions/organizations for reducing carbon emissions in industry through switching to modern green drives.

Constant speed motor drives are associated with various losses due to its inability to adjust the speed to suit the application. It is possible to save energy as much as 60% depending on the application using speed control. The variable speed control system or an electronic drive can adjust the speed to suit the application not only by adjusting the speed but also torque characteristics of the motor. Since the speed controller is electronic, the energy loss in the controller is very much less than that of a mechanical speed controller and also very compact. Motor driven pumps and fans controlled by variable speed drives, can achieve high energy savings according to the theory.

Objectives: (i) Increase the amount of VSD use in local industry and service sector applications. (ii) Strengthen institutions to facilitate to industries and service organizations to use VSD, EEM and mitigation technologies to reduce their GHG emissions and cost of production/service. (iii) Develop in house capacity for industry service providers to promote, implement and maintain mitigation technologies such as EEM, VSD.






Budget

The proposed project is scheduled to be implemented for a period of three years with a total budget of US \$ 0.21 million.

Outputs

- Strengthened, enforced and expanded ESCOs and regulatory agencies. Expected output is to strengthen SLSEA and CEA officers and 30 ESCOs.
- Strengthened public private partnerships, joint ventures among ESCOs, universities, government institutes and private organizations. Expected output is to develop ten partnerships.
- Technical and financial facilitation for upgrading in-house capacity of institutions. Expected output is to enhance in house capacity of ESCOs.

Timeline for the project

Activities	Yr1	Yr2	Yr3
Survey of all Energy Service Companies (ESCOs), service providers to identify their capacities, in-house facilities			
Conduct a need/gap analysis to identify the inadequacies and the shortcomings			
Develop training programme for capacity development of selected ESCOs and service providers			
Develop a registration mechanism for all the suppliers of electrical drives with their technical capacities			
Select ten companies for installing VSD/ VFD demonstration units and assess the requirement including specifications for equipments.			

Conduct a survey on in-house facilitation available with the ESCOs, suppliers and service providers		■	
Prepare specification for a standard toolkit set and fixture requirements for upgrading facilities at ESCOs		■	
Obtain quotations for demonstrations VSD/VFD units and toolkits		■	
Submit funds requirements for ten demonstration VSD/VFD units 25 toolkits to UNFCCC climate technology centre and network and green climate fund		■	
Conduct one training programme to test the effectiveness of the capacity building training package			■
Install demonstration VSD/VFD units at month 27 to 8 months Demo units installed selected companies using trained ESCOs			■
Prepare a report on institutional building of ESCOs, service providers, suppliers for further funding			■

Implementation: Sri Lanka Sustainable Energy Authority

Coordination: Ministry responsible for the subject of Environment, Sri Lanka Sustainable Energy Authority, technical and vocational universities, industry chambers and professional associations

8.3 Technology: Residue Biomass Combined Heat and Power

8.3.1 Project idea: Reduce dependence of fossil fuel and resentment carbon emissions from process industries by building confidence to use Combined Heat and Power (CHP) for in-situ electrical and thermal energy generation through development of champions

Biomass is the term used for all organic material originating from plants (including algae), trees and crops. Biomass energy, or bio-energy, is the conversion of biomass into useful forms of energy such as heat, electricity and liquid fuels. Biomass for bio-energy comes either directly from the land, as dedicated energy crops, or from residues generated in the processing of crops for food or other products such as pulp and paper from the wood industry. Another important contribution is from post consumer such as construction and demolition wood, in transportation, and the clean fraction of waste (MSW). CHP is applicable in Sri Lanka. Through this technology GHG emissions could also be reduced by the equivalent of about 11,300 t CO₂ per year. The lower cost of energy from cogeneration systems could be a key to the survival of local industrial plants in today's competitive environment.



residue streams
pallets used
municipal solid

Objectives: (i) Increase the renewable energy share in local industry sector and reduce GHG emissions as well as cost of production. (ii) Reduce the cost of oil imports and

give more income opportunities for local biomass producers and farmers. (iii) Develop local technologies, technology modifications, business models for biomass supply and popular this renewable energy technologies in Sri Lanka.













Budget

The proposed project is scheduled to be implemented for a period of three years with a total budget of US \$ 2 million.

Outputs

- No. of industries implement biomass CHP projects in Sri Lanka. Expected output is to install and run three demo projects.
- Total amount of energy requirement fulfilled by biomass CHP. Local industries use about 165 thousand tones of fossil fuel (SLSEA energy balance 2010) for their heating processes.
- Total amount of GHG reduction by applying biomass CHP is about 113,000 tCO₂e

Timeline for the project

Activities	Yr1	Yr2	Yr3
Call for volunteer Industries for setting up 3 CHP demonstration projects			
Call for contracting companies to implement CHP demonstration projects in industries			
Select three industries in 3 different sectors for implementing demo projects			
Select contractor companies to implement the demonstration plants in selected industries			
Study and Develop the demonstration CHP Project for each Industry selected			
Obtain funding through a donor/government to implement demo projects			
Enter into agreements with selected industries and contractor companies			
Procure/fabricate equipment and other necessary materials			
Install demonstration CHP Plants in selected locations			
Commission the plants in Industries and conduct trial runs			
Train personnel in beneficiary industries for effective running of Demo CHP plants			
Document the achievements as a success story			

Implementation: Sri Lanka Sustainable Energy Authority

Coordination: Ministry responsible for the subject of Environment, Sri Lanka Sustainable Energy Authority, Ministry of Industry and Commerce, industry chambers and industries.