

Part V

ANNEXS

I ACRONYMS AND ABBREVIATIONS

ABC	Asian Brown Cloud
AOSIS	Alliance of Small Island States
AUSAID	Australian Agency for International Development
BOBP	Bay of Bengal Programme
C⁴	Centre for Cloud, Chemistry and Climate
CBO	Community Based Organization
CORDIO	Coral Reef Degradation in Indian Ocean
CO₂	Carbon dioxide
DOM	Department of Meteorology
EEZ	Exclusive Economic Zone
EIA	Environment Impact Assessment
ENSO	El Nino Southern Oscillation
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HDPE	
INDOEX	Indian Ocean Experiment
IPCC	Intergovernmental Panel on Climate Change
IRRM	International Reef Resource Management
JICA	Japan International Cooperation Agency
LPG	Liquid Petroleum Gas
MCPW	Ministry of Construction and Public Works
MHAHE	Ministry of Home Affairs, Housing and Environment
MOFAMR	Ministry of Fisheries, Agriculture and Marine Resources
MOH	Ministry of Health
MOT	Ministry of Tourism
MPAS	Maldives Protected Area Systems
MPND	Ministry of Planning and National Development
MPHRE	Ministry of Planning, Human Resources and Environment
MRC	Marine Research Centre
MWSA	Maldives Water and Sanitation Authority
MWSC	Malé Water and Sewerage Company
NBSAP	National Biodiversity Strategy and Action Plan
NEAP	National Environment Action Plan
NEAP-II	Second National Environment Action Plan
NGO	Non Government Organisation
Rf	Rufia
RO	Reverse Osmosis
RRC.AP	Regional Resource Centre for Asia-Pacific
SAARC	South Asian Association for Regional Cooperation
SACEP	South Asia Cooperative Environment Programme
SST	Sea Surface Temperatures
STELCO	State Electric Company Limited
TAR	Third Assessment Report
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
VOC	Volatile Organic Compounds
WHO	World Health Organisation

II PRIORITY PROJECTS

Project Name: APPRAISING COASTAL EROSION IN THE MALDIVES: LAYING THE FOUNDATION FOR ADAPTATION TO SEA LEVEL RISE AND CLIMATE CHANGE

This three-phase project is designed to address the issue of coastal erosion in the Maldives. The initial phases are aimed to enhance the capacity required to formulate a coastal erosion management strategy.

Project rationale and objectives:

The Maldives face severe constraints in adapting to increased erosion expected with the rising sea level. A major constraint is the lack of capacity to evaluate the magnitude of erosion and identify quantitatively the major causes of erosion. Without such knowledge, appropriate adaptation strategies cannot be formulated.

The aims of this project are to build capacity of the Environment Research to:

1. quantify the magnitude of erosion on islands in the Maldives;
2. determine the importance of natural vs. human induced erosion on islands in the Maldives; and
3. quantify changes in process mechanisms promoting erosion.

Expected outcomes:

1. A trained Environment Research Centre that has instigated a network of erosion studies and is actively assessing the magnitude and causes of erosion throughout the Maldives.
2. Technical summaries quantifying long-term rates and importance of natural vs human induced erosion on representative islands in the Maldives
3. Quantitative summaries of the process regimes (waves currents, sediment budgets) that characterise representative types of islands in the Maldives.

Planned activities and outcomes:

1. Provide Environment Research Centre with technical capacity to undertake erosion studies.
2. Train Environment Research Centre in design, implementation and analysis of erosion studies.

ERC to establish a network of monitoring sites that reflect differences in island morphology and undertake detailed studies to document changes in island morphology and the process controlling island change.

Project Name: DEVELOPMENT OF PRACTICAL ADAPTATION MEASURES TO COMBAT EROSION IN THE MALDIVES

Project rationale and objectives:

A major constraint to effective adaptation to climate change and sea level is a lack of appropriate and tested practical solutions to coastal erosion. The history of erosion management in the Maldives is dominated by use of inappropriate hard engineering solutions designed without regard to natural processes. The aim of this project is to develop a range of practical solutions to combat coastal erosion on the islands of the Maldives. The specific objectives are to:

1. use systematically collected environmental data as a basis to design a range of environmentally appropriate solutions to manage coastal erosion;
2. test and monitor each management tool to determine the effect of environmental processes and effectiveness in combating erosion; and
3. develop technical guidelines for the design and construction of different management tools and appropriateness for representative island types.

Expected outcomes:

1. Establishment of an Engineering Support Unit with joint membership from Environment Research Centre, Ministry of Construction and Public Works and Ministry of Atolls Administration, to provide technical guidance on design and construction of specific erosion management tools.
2. Identification of preferred hierarchy of solutions based on field tests and studies of the effects of each option on the environment.
3. Production of technical guidelines on range of options available, design considerations in different island settings and construction.

Planned activities and outcomes:

1. Formulation of an Engineering Support Unit to undertake investigations into appropriate erosion management techniques. The Engineering Support Unit will act in an advisory

capacity alongside Environment Research Centre to assist evaluate erosion management problems and solutions.

2. Use process information on environment (generated by the Environment Research Centre) as a basis to design a range of non-structural and hard structural solutions to erosion.
3. Undertake physical trials on designed solutions on a limited number of islands. Trials will quantify the influence of management solutions (e.g.groynes) on coastal processes (waves, currents, sediment transport). Results will provide valuable information to feedback into the design phase. Field investigations of suitable sand aggregates for beach nourishment will be undertaken.
4. Develop technical guidelines that outline the range of solutions appropriate for erosion management in islands in the Maldives. The guidelines will also provide guidance on the actual design, construction and monitoring for different island settings.

Project Name: COASTL EROSION MANGEMENT STRATEGY FOR THE MALDIVES

Project rationale and objectives:

Effective erosion management in the Maldives is currently constrained by a weak evaluation process that is not mandatory. Improvement of the process must be based on development of a robust series of steps that is integrated within the existing legislative framework and which gains support of all stakeholders. The specific objectives of this project are to:

1. develop a Coastal Erosion Management Strategy that provides clear and practical guidance on steps that need to be undertaken to properly assess an erosion issue and formulate appropriate management solutions;
2. integrate the Coastal Erosion Management Strategy within existing environmental institutional framework and seek legislative support for the Coastal Erosion Management Strategy;
3. raise awareness of all stakeholders (government to community) of the importance of effective

erosion management for sustainable economic development; and

4. implement the Coastal Erosion Management Strategy using planned regional networks in the Maldives

Expected outcomes:

1. Production of a Coastal Erosion Management Strategy to guide effective erosion management.
2. Government endorsement and support of the Coastal Erosion Management Strategy through legislative recognition of the strategy allowing mandatory enforcement of the strategy.
3. Increased awareness and support at all levels of government and community of the importance of appropriate erosion management.
4. An operational network of erosion management officers that co-ordinate the strategy at the regional atoll hubs.
5. Examples of where the Coastal Erosion Management Strategy has been successfully implemented.

Planned activities and outcomes:

1. Development of the Coastal Erosion Management Strategy. This strategy will largely be built on outputs of the previous two programmes and will identify linkages to specific agencies (Environment Research Centre and Engineering Support Unit) to facilitate effective management.
2. Training focused at a range of stakeholders (government agencies, private sector, and local community) to raise awareness of the erosion issue and advantages of following a consistent process for erosion management.
3. Train-the-trainer component so Environment Research Centre can deliver ongoing awareness programmes on erosion.
4. Identify and appoint a network of officers throughout the Maldives to act as liaison on erosion issues and who have the capacity to trigger the process on the Coastal Erosion Management Strategy.
5. Provide subsidies for erosion works to 5 islands to trial the Coastal Erosion Management Strategy and monitor its success. Outcomes can be used to raise awareness of the issues and solutions.

Project Name: FEASIBILITY STUDY FOR A NATIONAL POPULATION CONSOLIDATION STRATEGY AND PROGRAMME

Major efforts have been and are continuing to be made to provide populations with the social and physical infrastructure required to raise standards of living and to improve the quality of life. Although major progress has been recorded, the costs of providing and maintaining infrastructure and services are extremely high and there are still many islands in which populations are inadequately serviced and, as a consequence, are both disadvantaged and vulnerable.

Project rationale and objectives:

The main objective of the project is to undertake a feasibility study to identify the main elements of a National Population Consolidation Strategy and Programme with particular attention being given to:

1. increasing the opportunities of small, isolated and vulnerable island communities;
2. assessing the social implications, social acceptance and social costs of resettlement initiatives;
3. identifying of inhabited and uninhabited islands that could serve as the basis for settlement consolidation, taking into account the longer-term carrying capacity of alternative locations;
4. assessing the environmental implications of settlement consolidation and measures required to protect island populations from the negative impacts of predicated climate change and sea level rise.

5. identifying of the main alternatives for population consolidation, taking into account initiatives in respect of the nations capital and the development of regional growth centres;
6. developing of recurrent costs associated with different settlement alternatives;
7. formulating of guidelines for sectoral investment programmes and the programmes of line ministries involved in the provision of infrastructure and services in atolls and islands.

Expected outcomes:

The project will result in a report, to be entitled National Outline Population Consolidation Strategy and Programme, that will serve as a basis for political discussion and decision-making at the national, atoll and island levels. The selected alternative will be finalized following the process of review and consultation.

Planned activities and outcomes:

The project will consist of four main interrelated phases covering:

1. Output oriented review and analysis of databases and existing sources of information;
2. Thematic and issue-oriented studies and analysis;
3. Identification and evaluation of main population consolidation alternatives; and Elaboration of selected alternative and preparation of provisional investment priorities and guidelines.

Project Name: UPGRADING OF GAN AIRPORT FOR INTER NATIONAL OPERATIONS

Upgrading the airport at Gan in Addu Atoll, for international operations would lead to higher use of the existing infrastructure at Gan airport. Increasing the international passenger and freight transport and communication lines, would facilitate faster atoll development. It would also enable uninterrupted international air traffic in case of a closure of the Malé International Airport, the only gateway to the Maldives.

Project rationale and objectives:

The proposed project has 2 main objectives, which are to:

1. provide the infrastructure required for international medium to long haul aircraft charter operations; and
2. train the staff of government agencies responsible for providing aircraft handling, clearance, passenger handling, clearance, customs and security services.

Expected outcomes:

The upgrading of the airport will have positive effects on efforts to achieve selfsustaining growth at Addu Atoll, adding to the attraction of the atoll for investors, especially in the tourism and garment sectors.

In addition, the Maldives will have an alternative international airport in the event of an accident or other events leading to the temporary closure of Malé International Airport.

Planned activities and outcomes:

1. Upgrading the terminal building, including the terminal security service, to handle up to 350 passengers at one time.
2. Upgrading fuel storage facilities.
3. Equipping the airport with ground handling equipment, upgrading rescue and fire fighting services to CAT 7, and increasing the power generation capacity.

Project Name: PROGRAMME FOR FISHERIES CONSERVATION MEASURES AND COMMUNITY-BASED REEF RESOURCE MANAGEMENT

The nation 's rapid social and economic change, combined with open access to coastal aquatic areas and the lack of sufficient management, is one of the main causes for environmental damage being inflicted on the nation 's fragile resource base. The absence of an efficient strategy for managing reef resources is leading to a decline in catch rates throughout the country, especially in reef areas. The Government of the Maldives has taken many individual measures to protect marine life, often being ready to surrender short-term economic gains to ensure effective environment protection.

Project rationale and objectives:

The main objectives of the project are to:

1. develop appropriate methodologies for assessing the biological impacts and cost

effectiveness of fisheries conservation and management measures, such as closed areas for resource enhancement purposes;

2. conduct a baseline survey of areas identified for reef enhancement to continue a well developed monitoring programme; and
3. increase awareness of the fishing community and the general public about the importance of reef resource management.

Expected outcomes:

1. More consistent methodologies and a more systematic information base to develop Integrated Reef Resources Management related concepts of fisheries conservation and management.
2. Increased awareness among groups of the importance of reef resources and the need for

their more effective management. This awareness should increase the feasibility of conservation and enhancement measures.

3. The methodologies and information base developed under the project will be replicated throughout the Maldives as a means for actively promoting community-based Integrated Reef Resources Management.

Planned activities and outcomes:

The proposed project will have four distinctive components covering methodology development, baseline surveys of selected areas, and increasing public awareness and training of key personnel at the atoll and ministry levels.

1. Development of appropriate methodologies for assessing of biological and economic affects of reef resource management measures.
2. A baseline survey will be conducted in Vaavu and Meemu atolls.
3. Support for the public awareness programme through the design of a fisheries information package that will be distributed to different population groups.
4. A series of training workshops at the atoll level as well as at the national level in the research, monitoring, surveillance and enforcement techniques associated with Integrated Reef Resources Management.

Project Name: DEVELOPMENT OF FOOD SECURITY IN THE MALDIVES

Soil characteristics in the Maldives are major constraints towards the development of successful conventional agricultural production systems. Limited availability of arable land also suggests that an alternative crop production system should be looked into. Hydroponics is one method that can increase the production of agricultural products.

Project rationale and objectives:

Hydroponics agriculture in the Maldives on a sustainable basis, at a commercial and household level can improve food security and reduce dependence on imports of various types of vegetables and fruits. It will also enhance income and employment opportunities for the new generation in rural islands, and direct domestic investment towards promoting food security.

Expected outcomes:

- Development of hydroponics production systems on a commercial scale; and
- Reduce dependence on imported vegetables and fruits to achieve accessibility and availability.

Planned activities and outcomes:

1. Train the staff already working in established hydroponics systems in Hanimaadhoo Agriculture Centre as trainers. The trainers will train the required staffs for the projects by using the training facilities in Hanimaadhoo Agriculture Centre.
2. Set up three greenhouses with hydroponics systems in three different regions of the country, each with a total built up area of 8,000 ft² or 2 unit of greenhouse with similar built area but each unit having four compartments of 1000 ft².

Project Name: THE USE OF INFILTRATION GALLERIES TO SUPPLY GROUND WATER IN THE ISLANDS

Project rationale and objectives:

The groundwater in the islands of the Maldives is found in shallow and relatively thin water lens. In some

islands, a large quantity of groundwater is pumped from a few wells in the island. Due to the high extraction rate and associated draw down effect, the pumped water becomes very saline. It becomes more saline in

the dry periods as the demand for groundwater increases. Increasing the area available for extraction of groundwater can reduce the draw down effect and improve the quality of the supplied groundwater.

To develop an appropriate design system for centralised infiltration galleries to supply the fresh groundwater to meet the water demands for the island communities through out the year.

Expected outcomes:

A properly designed, constructed and operating infiltration gallery for extracting large amounts of freshwater from the water lens of the islands.

Planned activities and outcomes:

1. Construction of a designed infiltration gallery in a densely populated island to supply groundwater.

Project Name: CLIMATIC INFLUENCES ON THE SPREAD AND TRANSMISSION OF VECTOR BORNE DISEASES

Project rationale and objectives:

The vulnerability and adaptation assessment done on the effects of climate change on the health sector identifies vector borne diseases as an area where further research is required. Dengue and dengue hemorrhagic fever, both transmitted through vectors, have been identified as endemic in the country and in recent years morbidity has increased. Therefore, this project proposes to undertake a study with the main objectives to:

1. systematically collect and manage climatic and health data for use in a climate impact analysis; and
2. undertake a study on the effects of climate change on the spread and transmission of vector borne diseases based on the collected data.

Expected outcomes:

1. Enhanced capacity at the Ministry of Health to undertake an analysis of the climatic influences on the spread and transmission of vector borne diseases.

2. Continuous, short term and long term reporting on the status of vector borne diseases in the Maldives.

Planned activities and outcomes:

1. Provide Ministry of Health with the technical capacity to undertake such a study.
2. Train Ministry of Health personnel in design, implementation and analysis of such a study. Specific trainings to be given on the use of GIS, data analysis and background on climate change and vector borne diseases.
3. Establish and maintain a database of vector borne diseases in a climate change context.
4. Ministry of Health to establish a network with the Department of Meteorology, and other environment related agencies, to incorporate relevant climate information into the health database.
5. Produce short term and long term reports on the effects of climate change on vector borne diseases in the Maldives.

Project Name: ALTERNATE/RENEWABLE ENERGY SOURCES FOR THE OUTER ISLANDS OF THE MALDIVES

This project is aimed to introduce renewable energy sources in outer islands and thus help the nation in achieving its objective of economic and social development. Demonstration projects will be run in

one or more of the selected islands making appropriate reference to similar projects being run in other island nations.

Project rationale and objectives:

Although the Maldives does not contribute much to the production of GHGs, we will be one of the most effected places in the world when climate change occurs. Since the use of diesel in energy generation system is not environmentally sound, the Maldives is seeking alternative sources of energy that are environmentally sound and sustainable.

This project identifies the alternate power generation system(s) in the Maldives. The main focus of the project is aimed at producing energy with minimal emissions of GHGs and due consideration to price and social acceptability. The project investigates the current technologies for efficient energy generation with emphasis on cost and environmental factors. Finally, recommendations and futures scopes will be proposed.

This project will provide alternate /renewable sources of energy such as solar energy, biogas and photovoltaic systems.

Expected outcomes:

1. Provision of energy on a sustainable basis and at an affordable price.
2. Further savings on running costs like fuel and lubricants.
3. Minimisation of GHG emission.
4. Reduction of co-production of other sources of pollution such as noise and waste.

Planned activities and outcomes:

1. Carry out survey and campaign to estimate and reduce energy consumption from domestic use.
2. Review the ongoing atoll electrification programme.
3. Introduce renewable energy options as a source of energy to the industrial sector, resort owners and other related committees in the Maldives.

Project Name: THE USE OF SOLAR DISTILLATION AS SOURCE OF FRESHWATER FOR OUTER ISLANDS AND MALÉ

This project is aimed at acquiring appropriate technology to provide freshwater to populated islands in the Maldives.

Project rationale and objectives:

Acquiring appropriate technology to provide portable freshwater to populated islands is a priority area identified in the NEAP II. The Maldives lies on the equator and receives on average seven hours of daily sunshine. Populated islands have limited space for harvested rainwater storage. The groundwater cannot meet the demand for water for these islands.

To acquire appropriate technologies for solar distillation for desalination as a source of freshwater, which can meet the demand in the dry season for the population of the islands.

Expected outcomes:

1. The islands will have desalinated water as a source of water even in the dry season.
2. The amount of GHG emission will be reduced
3. The risk of diesel polluting the groundwater will be reduced.
4. The production of water would be less vulnerable to the fluctuating price of diesel.

Planned activities and outcomes:

1. Carry out a study on the water demand in the medium densely populated islands.
2. Quantifying the water demand, taking into consideration the increase of demand for water for the predicted climate change for the region.
3. Identifying the appropriate technology for the Maldives and educating the communities for their acceptance for the new technology.

Project Name: DEVELOPMENT OF SUSTAINABLE INTERISLAND SEA BASED MASS TRANSPORT TION SYSTEM

One of the main sectors, which contribute to CO₂ emission, is the transport sector. The sea transport system, which currently exist, is not operated on a scheduled basis. The National Development Plan identifies regions to be developed as regional centers in the Maldives. Establishing a mass transportation network between these regions can develop a sustainable transport system in the Maldives.

Project rationale and objectives:

The development of a scheduled transport system would reduce the need for the ad hoc movement and has the potential to reduce the emission of carbon dioxide from the transport sector. Development of such network work would help to achieve the goals of sustainable development. The main objective of this project is to establish a mass transportation network for passengers and cargo between the regional centres in the country.

Expected outcomes:

1. Availability of goods and services to far away islands.
2. Reduction of GHG emissions in the transport sector.

Planned activities and outcomes:

1. Build up to nine harbours across the nation, with the capacities to handle cargo and accommodate passengers.
2. Establish a feeder service from neighbouring islands to the harbours using the existing fleet of small dhonis and vessels.
3. Select medium size vessels from the existing fleet to establish an intraharbour network
4. Obtain efficient, large, fast ferries to set up a national ferry service network.

Project Name: DEVELOPMENT OF SEWAGE TREATMENT FACILITIES

The current system of sewage disposal constitutes a serious threat to prospects for sustainable development and, in many densely populated islands, it has become a critical problem. One of the few sewerage systems that exist in the Maldives is the sewerage system on Malé. This system consists of nine pumping stations that pump untreated sewage into the sea. Growing population pressures in Malé combined with the technical deficiencies in the present system, pose increasing serious threats to public health, ecologically fragile ecosystems and marine life in coastal areas.

Project rationale and objectives:

The present GHG inventory does not account for the production of methane from sewage treatment, as sewage is not treated in the Maldives. Sewage contributes to the emission of national GHG and the development of sewage treatment facilities would reduce the emission of GHGs.

The main objectives of this project are to review different technological alternatives for raw sewage treatment with methane recovery capabilities and to design the model that would provide the best long-term solution for sewage disposal for the islands of the Maldives.

Expected outcomes:

Establishment of proper sewage treatment facilities with methane recovery units in the densely populated islands.

Planned activities and outcomes:

1. Carry out a review of different technologies available for the sewage treatment for the Maldives.
2. Survey the densely populated islands to design an appropriate sewerage treatment facility.
3. Carry out an education campaign to address the issue of conserving water.

Project Name: THE INTEGRATED WASTE MANAGEMENT SYSTEM DESIGNED TO MITIGATE GHG EMISSIONS

An integrated waste management system has been identified in the National Development Plan and NEAP II as a national priority. An integrated waste management system will improve the existing methods of solid waste disposal thereby not only reducing GHG emissions into the atmosphere, but also improving the quality of the environment.

Project rationale and objectives:

The small size of the islands, the rapid growth in population and changing consumption patterns has increased the problem of solid waste management in the Maldives. The lack of effective solid waste disposal methods has caused serious constraints to sustainable development. The GHG inventory of the Maldives has identified that 0.061 tonnes of methane were produced in 1994 from solid waste disposal.

The main objectives of this project include removing the barriers to implementing an environmentally sound and sustainable integrated waste management system for the Maldives. This is achieved by reducing waste generation by creating awareness on the value of resource use reduction, reuse and recycling. Also, the introduction of effective disposal methods with methane recovery will reduce the emission of GHGs.

Expected outcomes:

The reduction of GHG emissions, as a result of reduced volumes of waste being sent to landfill, more environmentally sound management of waste and the operation of methane recovery and processing systems at key landfill sites.

Planned activities and outcomes:

1. Carry out a waste survey to assess the composition of the waste stream and identify the amounts that can be reduced, reused and recycled.
2. Carry out a waste survey to assess the solid waste disposal problems and opportunities in the inhabited islands, tourist resorts and industrial islands.
3. Identify locations for regional disposal areas and waste transfer facilities in the atolls and islands.
4. Develop fiscal and policy incentives and other measures to encourage importation of environment friendly products and minimal waste or degradable waste content.
5. Design and develop regional landfills with appropriate technology to recover and use the methane produced.
6. Design transfer stations in islands and transport the waste from the islands to the central landfill.
7. Formulate and implement public awareness and education campaigns through the grass root organisations such as the Island Development Committees, designed to enhance local recognition of the value of reducing and re-using waste.

III LIST OF PARTICIPANTS OF THE NATIONAL TRAINING ON SoE DATA COLLECTION AND REPORTING



Dharubaaurge, Malé, Maldives

28 June - 2 July 1999

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IV LIST OF PARTICIPANTS OF THE NATIONAL SoE CONSULTATION



Malé, Republic of Maldives
7-8 August 2000

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