

## **Annex 13 - Environment**

### **Introduction**

#### ***1.1. Background***

At around 7.58 am local time on 26 December 2004 an undersea earthquake, with a magnitude of 9 on the Richter scale, occurred some 250 kilometers off the coast of Sumatra, Indonesia. It triggered a devastating tidal wave or “tsunami” measuring around 10 meters high and traveling at 500 km/hour. It hit several countries in the Indian Ocean, including Indonesia, Sri Lanka, India, Thailand, Myanmar, Bangladesh, the Maldives, the Seychelles, Yemen, Somalia, Kenya and Tanzania. The first quake was followed by aftershocks ranging from 6 to 7.3, themselves large enough to destroy thousands of lives and livelihoods. It is estimated that as many as 150,000 people may have lost their lives. The final death toll is likely to be higher. In response to the disaster, the UN system at the country level began assessing urgent humanitarian needs in order to launch a flash appeal to the international community for urgent funding. The United Nations “Indian Ocean Tsunami/Earthquake Flash Appeal” was launched on 6th January 2005. The appeal focuses on providing emergency requirements as well as some medium term recovery needs for people in Indonesia, Maldives, Myanmar, Seychelles, Somalia, Thailand and Sri Lanka from January to the end of June 2005. In total it calls for US\$ 977 million to fund the critical work of some forty UN agencies and NGOs. Following the launch of the Flash Appeal the focus of the United Nations (UN) and the International Financing Institutions (IFI) has shifted towards promoting an effective transition towards recovery and reconstruction of the Maldives. In order to support the reconstruction of the Maldives, the United Nations, World Bank and Asian Development Bank jointly undertook a Needs Assessment during 11-14 January to form the basis for the recovery and reconstruction budget for the Maldives until 2008. The Needs Assessments were based on data gathered during field visits and on interaction with Maldivian stakeholders. Each of the sectors have produced a sectoral report highlighting their priorities and budgetary requirements for the immediate post-tsunami period (0- 6 months), as well as indicative priorities for the remaining period of 2005 until 2008, taking into account the humanitarian/reconstruction needs of the Maldives as well as the absorptive capacity within the government and economy. UNEP has been the focal point for developing an environmental needs assessment as well as for integrating environmental actions along with budgetary requirements into each sector.

#### ***1.2. Scope and Approach for the Environmental Needs Assessment***

Immediately following the disaster, the Joint UNEP-OCHA Environment Unit sent an environmental expert to the Maldives as part of the United Nations Disaster Assessment Team (UNDAC). The UNEP expert was tasked to assess the nature and scale of the environmental emergency. In consultation with the UNDAC team and the Ministry of Environment and Construction (MEC), site assessment missions were undertaken to three representative inhabited islands that were severely impacted by the tsunami: Guraidhoo Island (Kaafu Atoll), Vilifushi and Guraidhoo Islands (Thaa Atoll) and, two sites of specific environmental interest were also visited: Male Harbour and the main landfill on Thilafushi Island. Following a request from the Maldivian Government, the UNEP Asian Tsunami Task Force sent a waste management expert to the Maldives. The UNEP experts were tasked to collect information on environmental impacts and needs, meet with key Maldivian environmental stakeholders including Ministries, Research Institutes, international agencies, and NGO's, as well as to work with available sector task managers on integrating environmental issues within recovery and reconstruction plans. Consultative meetings were held with the Environmental Assessment Section of the Ministry of Environment and Construction (MEC) during the period 11-14 January 2005. This environmental needs assessment report is based on the information collected by the UNEP experts in this initial period. It represents the first preliminary assessment of the main categories of environmental impacts caused by the disaster in order to inform the immediate relief needs, as well as the medium-term rehabilitation and reconstruction needs. Given the rapid implementation of this

assessment, detailed impact assessments are still required in order to understand the full magnitude and scope of the disaster.

## 2 Environmental Context

### 2.1. Physical Environment

Even more than most island nations, the Maldives are highly dependent on the fragile ecosystem of their coral reef islands. Facing rising sea levels and climate change, the tsunami has proven once again the extreme vulnerability of small island states. It was reported that 35% of the country's 199 inhabited islands had been subject to high or very high impact by the tsunami with major physical damage to buildings, infrastructure, crops and natural vegetation.

### 2.2. Environmental Impacts and Issues

Based on the preliminary assessment work, the following main environmental issues have been identified:

#### A. Tsunami-Related Environmental Damage

- **Disaster waste:** vegetation, re-distributed domestic and hazardous waste, drums, large amounts of demolition waste have been spread over the impacted islands.
- **Groundwater contamination:** shallow freshwater aquifers impacted by infiltrated flood water, oil spillage from generator stores and leaks from septic tanks.
- **Coral reef damage:** potential damage caused by direct wave impact as well as secondary damage from sedimentation and excessive amounts of debris.
- **Coastal damage:** extensive beach erosion and damage to coastal protection measures
- **Beach, soil, vegetation and crop damage:** extensive washing-off of soils, stress and dieback noted in certain species from direct impacts as well as possible salt contamination

#### B. Chronic Degradation of the Environment

- **Sea-Level rise:** linked to global warming, threatens to impact the low lying islands
- **Sewage:** lack of sewage collection and treatment systems
- **Solid Waste:** inappropriate disposal systems especially for hazardous and clinical wastes
- **Coastal water:** pollution by disposal of raw sewage and industrial effluent
- **Natural resource depletion:** including coral sand mining and exploitation of reef resources (over-fishing)
- **Chemical management:** Unregulated use of asbestos, PCBs, anti-fouling agents and pesticides

### 2.3. Institutional Structures for Environmental Governance

In the Republic of Maldives, the Ministry of Environment and Construction (MEC) has the main institutional responsibility for the environment. Within the Ministry, the Environment Division employs 23 staff over 4 main divisions (Assessment and Management, Law and Policy, Planning and Coordination, and, Administration and Information). The Environment Research Centre fulfils the function of providing decision makers with required research and data. The technical capacity of the Ministry to carry out its mandate is limited due to financial and human resource constraints. In addition, it is clear that the current environmental needs exceed the existing financial resources of the Ministry, despite increasing budget allocations in the recent years. The main environmental legislation is the Environment Protection and Preservation Act of Maldives (Law number 4 of 1993). This Enabling Act is concise and lays down the basic responsibilities and duties with regard to the environment but requires many by-laws or regulations to fully implement the legislation. In addition, the monitoring, inspection and enforcement capacities of the Ministry are weak and in some cases even non-existent. The environmental responsibilities of the sectoral ministries are poorly defined and

the co-ordination mechanisms are not present. Against this institutional background, international assistance will be required to address the environmental impacts created by the tsunami disaster.

### 3 Environmental Needs

#### 3.1 Immediate Priorities

**Disaster Waste Management:** The tsunami caused the widespread deposition of vegetation, coral sand, municipal waste from dumps sites, healthcare waste and human excreta from damaged septic tanks, hazardous substances (oils, asbestos, batteries, etc.) and demolition waste (concrete, coral fragments, timber, etc.) from destroyed buildings waste across impacted islands. This waste represents a risk to human health and may impact soils and groundwater. A survey of the impacted islands should be undertaken to determine the nature and scale of the disaster waste management problem. Following the survey remedial action plans (including training in health and safety and appropriate clean-up and disposal techniques) are required. The remedial options include waste segregation by hand or powered shovel (Bobcat-type), with demolition waste being stockpiled, hazardous waste removed (including drums and barrels, asbestos-containing materials, batteries, etc.), metal scrap (reinforcing bar, gas canisters) and plastics. The remaining organic matter would either be shredded and re-placed, to form a compost-layer on the soil, removed to suitable temporary landfills or the three main landfills in the Maldives. The demolition waste could either be re-used in the reconstruction process (sub-base material for foundations) or formed into elevated platforms that could be used as refuges in times of flood, storm surge or tsunami. The cost given here is in addition to those in Annex 4. *Estimated cost: \$1.5 million.*

**Assessment of Environmental Threats to Human Health:** The impact of the tsunami on groundwater salinity, flooding of generator fuel depots, indiscriminate dumping of municipal and hazardous waste especially in remote island communities, the use of pesticides and fertilizers on some resorts and agricultural islands, poor sanitation (septic tank failure) has a potential to impact human health. An immediate groundwater assessment is needed to identify the location of the contaminated sites and to provide recommendations for risk reduction and remediation. *Estimated cost: \$750,000.*

**Coral Reef Impact Assessment Programme:** The impacts of the tsunami on the coral reefs, including the secondary effects on the fishery and tourism sectors, are still to be properly assessed. The scale of the disaster combined with the size of the reef system (7<sup>th</sup> largest in the world) has resulted in a lack of data and information on physical, biophysical and ecological information on status of coral reefs system. In addition, impacts from tourism, land reclamation, harbour development and maintenance, and reef blasting for access channels have all been poorly identified. It is proposed that a comprehensive reef impact assessment programme is initiated. *Estimated cost: \$1.25 million*

**Biodiversity Survey and Recovery Plans:** The tsunami resulted in saltwater intrusion into fresh water lenses on almost all of the country's 1,200 islands. The immediate impacts on vegetation of browning and dieback were visible within days of the disaster. Agricultural land, back yard farming, wetlands, as well as mangrove and other coastal vegetation have all been affected. The impacts of saltwater in the swamps and wetlands can have further impacts on the flora and fauna, including bats and crows. It is recommended that a biodiversity survey (botanical and faunal) be conducted to establish damage to biodiversity and existing habitats and to improve the existing baseline data on biodiversity. Specific attention should be paid to the recently established Hithadhoo Protected Area and the to be established protected areas on GA. Hithaadhoo and ADh. Hurasdhoo. In addition, Management and Recovery Plans for immediate impacts on local biodiversity should be developed. *Estimated cost: \$900,000.*

**Strategic environmental assessment of overall rehabilitation and reconstruction program:** All plans and projects for rehabilitation and reconstruction must be strategically assessed to understand their individual as well as cumulative environmental impact in order to take decision on mitigation. To achieve this goal, urgent capacity building support and technical assistance on rapid project environmental screening procedures is required by the MEC and the Ministry of Planning and

National Development to jointly review all reconstruction plans and projects, assess impacts and identify options for mitigation. The strategic assessment should be initiated within weeks, and the project environmental screening interim guidelines should be developed urgently. *Estimated cost: \$300,000.*

**Strengthening Environmental Governance at the National, Atoll and Island Levels:** The Environmental Division of MEC represents an important mechanism for monitoring and controlling impacts to the environment and integrating the environment into other ministerial sectors. However, it is clear that investment is required to enhance the capacity and skills of the environmental administration by training them in environmental best practices and providing them with sufficient equipment, operating budgets and guidelines to initiate environmental monitoring, enforcement, clean up and conduct proactive environmental assessment and management. *Estimated cost: \$1.15 million*

### **3.2. Medium-Term Priorities**

**Development of a Sustainable Waste Management System:** The current waste management practices including the open burning of waste, stockpiling of hazardous wastes, dumping of waste on islands, beaches and the open sea are poor. A new sustainable waste management system should be developed based on the construction of simple composting, recycling and waste incinerators at island level combined with centralised integrated waste management facilities (waste processing unit, to separate hazardous waste, metals, organics, combustibles, plastics and glass, a composting unit, low technology incinerator and lined landfill to accept ash residues). Hazardous wastes should be collected and treated/stored. Waste oil should be used for energy utilization. Construction and demolition waste should be crushed and recycled for use as aggregate or used for infilling material for land reclamation projects and for 'selected fill' to profile and cover new landfills. In addition, the Maldives should develop a national waste management policy/system, develop a regulatory framework (permits, inspection and enforcement), adopt appropriate waste reduction strategies and cost-recovery mechanisms and promote private sector involvement and recycling. A number of landfills including the main Thilafushi site require urgent remediation (municipal waste deposited directly into the sea, uncontrolled burning, poor hazardous waste storage) and re-engineering to modern design standards. *For further discussion and costs, see also Water and Sanitation Sector Report.*

**Sewage and Wastewater Management System:** Apart from a few resort islands, no sewage is treated in the Maldives. Anecdotal evidence indicates that faecal material is frequently visible on the shores of Male Island and that the groundwater at Male is impacted by leaking sewers. In addition, it was reported that few septic tanks on the islands were de-sludged and that a large number were damaged by the tsunami. It is recommended that a comprehensive and detailed review of sewage treatment and related improvement measures be undertaken combined with the adoption of bathing water standards. For further discussion and costs, see also Water and Sanitation Sector Report.

**Climate Change Programme:** Climate change and predicted sea level rise is of grave importance to the Maldives. The estimated predicted sea level rise of 0.09m to 0.88m in the period 1990 to 2100, combined with increased extreme weather occurrences, makes the Maldives one of the most vulnerable countries to climate change and sea level rise. The small sizes of the islands forces human settlements and vital infrastructure to be located near the coast and thus at high risk. There is an urgent need to include climate change predictions in the reconstruction phase and future land use planning. The recommended projects include undertaking a vulnerability assessment and establish a network of monitoring sites for sea level rise and coastal erosion, climate change awareness raising workshops for policy-makers, media, educators and the general public and the development of guidelines to integrate climate change issues into land reclamation projects. For further discussion and costs, see Disaster Management and Vulnerability Reduction Sector Report.

**Coastal Zone Management:** The extent of damage to the coastal environment caused by the tsunami has not been established. Damage to coastal infrastructure, such as quay walls, breakwaters and causeways, as well as extensive beach erosion, has been reported. In order to provide critical

information for the design of coastal engineering and disaster management structures it is recommended that the hydrodynamics around reef top islands are studied including capacity building in the field of coastal engineering and undertaking studies into appropriate erosion management techniques and the development of technical guidelines for shore protection methods and procedures. These studies and guidelines would be prepared by a newly created Coastal Zone Engineering Unit. *Estimated cost: \$ 1.5 million.*

**Disposal Facilities for Clinical Wastes:** There is no proper system for collection and disposal of clinical wastes at present in the Maldives. It is a matter of urgency that equipment (incinerators) is procured and guidelines are prepared for separate collection and safe disposal of clinical wastes in all hospitals and clinics. *For further discussion and costs, see Health Sector Report.*

**Hazardous Substances Control Programme:** There are no regulations for the use, procurement and disposal of hazardous substances in the Maldives including asbestos, polychlorinated biphenyls (PCBs), anti-fouling paints (tributyl tin) and pesticides. A control programme should be initiated. *Estimated cost: \$450,000.*

**Development of Ambient Air Pollution Control Regime:** The capital city of Male has a high population density, high vehicle number and intense construction activity. All of these factors contribute to local air pollution (SO<sub>x</sub>, NO<sub>x</sub> and particulates including unburnt fuels). Although air quality issues are primarily restricted to Male, other centres of population may also be impacted by the uncontrolled burning of wood, waste and dust generated from unpaved roads. There is a need for the development of an ambient air pollution control regime including the following: ambient air standards, monitoring (mobile and fixed), emission limits, inspection, regulation and enforcement action. *Estimated cost: \$750,000.*

**Development of Integrated Transport System:** The marine transport system is based on the ad-hoc use of small vessels which use large volumes of poor-grade marine fuels resulting in elevated emissions of CO<sub>2</sub>, SO<sub>x</sub>, NO<sub>x</sub> and particulates. A scheduled marine transport system should be developed that includes the procurement of larger, more-fuel efficient ferries, the development of harbours and feeder services. Although land-based transport is primarily restricted to the congested city of Male, other islands are constructing roads and allowing vehicles to be imported. A land-based transport system should be developed based on the promotion of public transport, the use of unleaded fuel, replacement of petroleum driven vehicles with liquefied petroleum gas (LPG) or electric vehicles and regular vehicle maintenance and inspections. The import and use of vehicles on small islands should be restricted. *For further discussion and costs, see Transport and Maritime Infrastructure Sector Report.*

**Environmental Land-Use Planning:** The Maldives has limited land-use planning policies and strategies. Procedures should be developed for identifying and controlling development in areas vulnerable to flooding, storm surge and nature reserves (forests or endangered species habitats). *For further discussion and costs, see Housing Sector Report.*

**Sustainable Construction Design and Building Codes:** The current construction and building codes are limited to government buildings. New codes should include sustainable development criteria, such as the potential for reusing construction and demolition (C&D) waste (crushed concrete, etc.), energy efficient materials (solar heating, lighting, thermal insulation, etc.) and the use of CFC-free refrigerants in air conditioning units. In addition, the building codes should include design standards to minimize structural damage during flood events. *For further discussion and costs, see Housing Sector Report.*

**National Environmental Contingency Plan:** The Maldivian islands are vulnerable to natural disasters, such as flooding, storm surge and tsunamis. The Maldives imports all of its fuels (approximately 346,552 tonnes per annum), creating a potential risk of oil spills. It is important that a national environmental contingency plan be developed to enable swift reactions to natural disasters and oil spills and to ensure that environmental impacts are properly managed. *Estimated cost range for*

*design and implementation of national oil spill response plan: \$450,000. For further discussion and costs, see the Disaster Management and Vulnerability Reduction Sector Report.*

**Environmental Management of Diesel Generators:** All of the inhabited islands of the Maldives are supplied by diesel generators. There are no regulations to ensure the safe storage and handling of diesel fuel and diesel engine oil, as well as safe disposal of used diesel engine oil. Key objectives of this program are to prevent leaks and spills of diesel fuel and disposal of used diesel engine oil in open land fields, both of which cause contamination of soil, surface water, and/or groundwater resources. In addition, an incentive programme (subsidies) should be initiated for the procurement of energy-efficient, low-noise generators fitted with spill avoidance equipment. Spill control kits and a spill reporting mechanism should also be developed. *For further discussion and costs, see the Power Sector Report.*

**Energy Conservation and Promotion of Renewable Energy:** The government should promote the use of energy efficient appliances and renewable energy sources through suitable mandatory and voluntary programmes accompanied by national awareness campaigns. *Estimated cost: \$450,000.*

**Environmental Awareness Building:** Environmental awareness building is integral to ensuring sustainable improvements in environmental quality and in preventing immediate danger to populations from exposure to risks from hazardous materials and toxic contamination of air, soil and water resources. During 2005, awareness raising should be conducted through the use of television and media campaigns, followed by efforts to integrate environmental issues into educational curriculum at the national and local levels. *Estimated cost: \$350,000.*

### **3.3. Budget Cost Estimate (millions \$USD)**

<b>Project Proposal</b>	<b>IMMEDIATE (0-6 months)</b>	<b>MEDIUM-TERM (7-36 months)</b>	<b>Total</b>
Disaster Waste Management	1.5		1.5
Assessment of environmental threats to health	0.75		0.75
Coral Reef Impact Assessment	0.5	0.75	1.25
Biodiversity Survey and recovery plans	0.3	0.6	0.9
Environmental Assessment of reconstruction Programme	0.2	0.1	0.3
Strengthening environmental governance	0.45	0.7	1.15
Coastal Zone Management		1.5	1.5
Hazardous Substances Control Programme		0.45	0.45
Air Pollution Control System		0.75	0.75
National Oil Spill Response Plan		0.45	0.45
Energy Conservation and Promotion of Renewable Energy		0.45	0.45
Environmental Awareness Building		0.35	0.35
<b>Total</b>	<b>3.7</b>	<b>6.1</b>	<b>9.8 million</b>