



UNEP Post-Tsunami Recovery Activities 2004-2007

United Nations Environment Programme

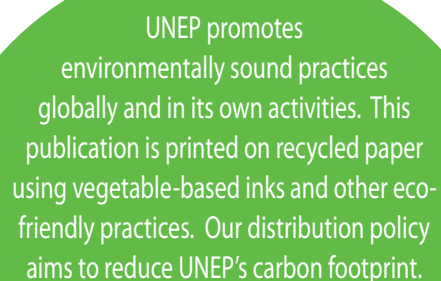
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Introduction

*Cleaning debris from a stall in Galle, Sri Lanka.
© Paul Jeffrey/ACT International*



The South Asian earthquake and tsunami of 26 December 2004, and the events that followed, are among the worst catastrophes in human history. The facts, as well known as they are, defy the imagination. First came the earthquake: at 9.3 on the Richter Scale and lasting ten minutes, the second largest and the longest ever recorded. The earthquake caused the entire earth to vibrate as much as one centimeter and triggered earthquakes as far away as Alaska. It began when a 1,200 km north-south edge of the Indo-Australian tectonic plate abruptly broke and slid beneath the Eurasian plate, rupturing the sea bottom at approximately 10,000 km/hour from off the northwest coast of Sumatra and towards the Andaman and Nicobar islands. The resulting earthquake quickly displaced billions of tonnes of seawater that surged across the Indian Ocean at up to 800 km/hour.

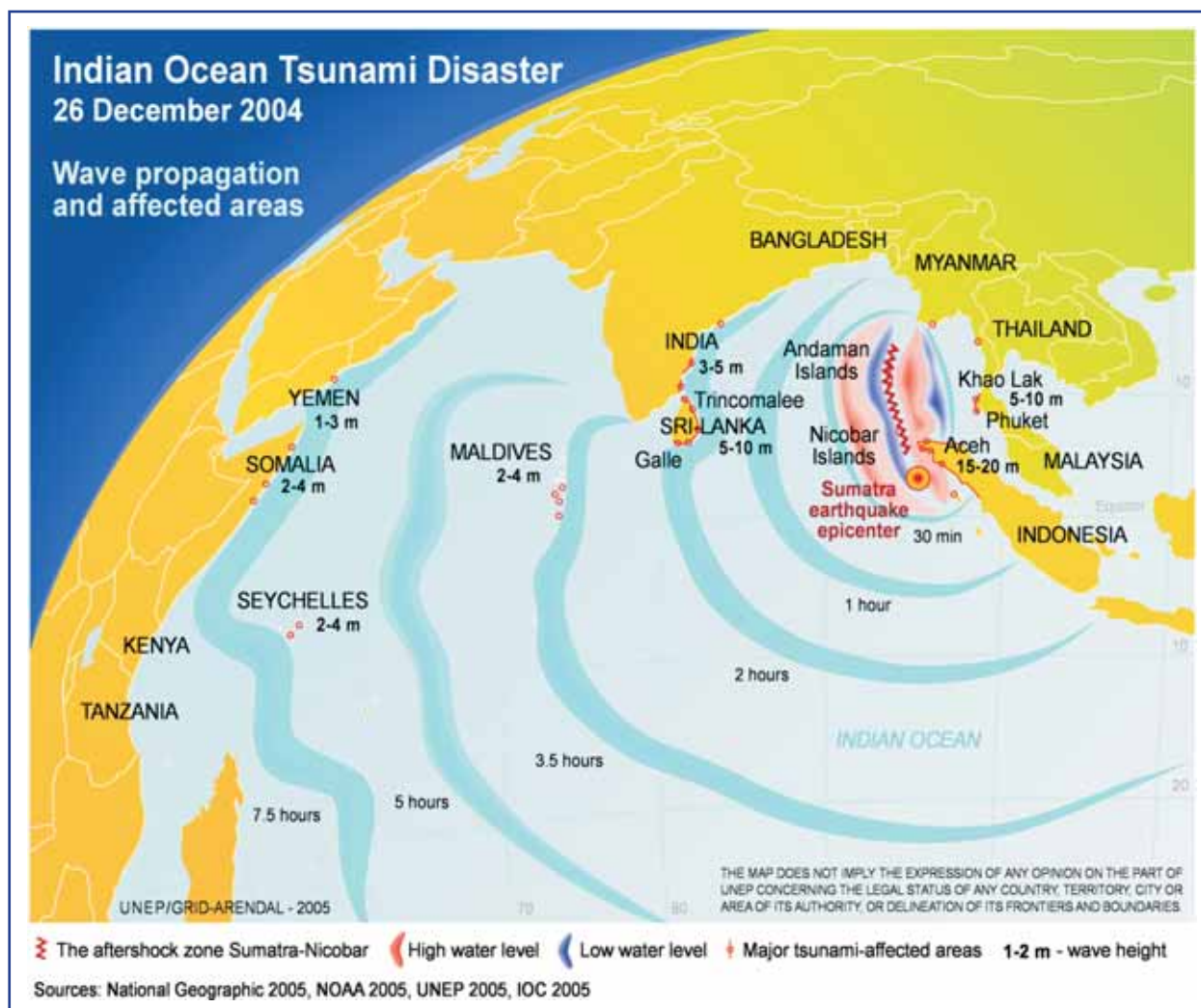
As the tsunami radiated out from Sumatra to tourist resorts in the south of Thailand, fishing villages in Sri Lanka, and the distant shores of Maldives, Seychelles and Africa, it swept away

lives, homes, livelihoods and entire communities, leaving heartbreak and disruption in its wake. Approximately 230,000 lost their lives – over half of these in Indonesia – and tens of thousands were injured. Countless more suffered untold devastation and personal loss, including the destruction of whole communities, institutions, infrastructure and livelihoods. Along a 170 km western coastal stretch of Indonesia's Aceh Province, for example, virtually every town, village, road and bridge within 10 miles of the ocean was destroyed. Altogether, approximately 1.5 million were displaced. Economic losses to the region were estimated at USD 10 billion, with 75 percent of the total attributed to damaged buildings and infrastructure in Indonesia, Thailand, Sri Lanka and India. Indonesia alone suffered USD 4.5 billion in economic loss, virtually the entire gross domestic product of Aceh.

In the immediate aftermath of the tsunami, the people and governments of the impacted countries demonstrated extraordinary strength and



Clean-up of hazardous waste from beaches, Sri Lanka.



resolve as they took the steps necessary to restore equilibrium in their communities and societies. Cooperation quickly developed among communities, government and non-governmental agencies and even between parties to historic conflicts. An unprecedented outpouring of international concern and assistance joined these efforts. Governments, corporations and private citizens from around the world contributed to relief and recovery processes that spanned more than a half dozen countries and thousands of kilometers.

In response to requests from tsunami-impacted governments, the United Nations system, under the leadership of then former Secretary-General Kofi Annan and then Under-Secretary-General for Humanitarian Affairs, Jan Egeland, swiftly mobilized emergency humanitarian assistance.

Emergency housing, health care, education, transportation, water and sanitation services were rapidly deployed to the region, as the UN worked closely with public and private relief agencies to address the tsunami victims' urgent needs.

The United Nations Environment Programme (UNEP) participated in this humanitarian relief process. The tsunami was an unprecedented natural disaster with far-reaching consequences for the region's environment. In disaster management situations, however, environmental considerations and their consequences for human health and livelihoods are often at risk of being overlooked or subordinated in the interest of less sustainable short-term solutions. On 28 December 2004, Klaus Töpfer, UNEP's former Executive Director, created the Asian Tsunami



The Aceh area of Sumatra, Indonesia, was severely affected. The images show the impact of the tsunami on a low-lying delta area in Banda Aceh, with fish ponds and mangrove cover destroyed, sandy beaches removed and large volumes of silt and soil carried out to sea.

Disaster Task Force (ATDTF). The Task Force was charged with responsibility for coordinating UNEP's post-tsunami efforts to help governments understand and respond to the tsunami's environmental impacts.

In response to requests from governments, UNEP immediately deployed dozens of experts to Indonesia, Sri Lanka, Thailand and the Maldives, and later to the Seychelles, Somalia and Yemen. ATDTF staff began working with national counterparts in these countries to assess and address the environmental consequences of the disaster. In

particular, UNEP focused on four main areas of activity: providing technical assistance; identifying environmental impacts and risks; participating in needs assessments; and mobilizing funding.

UNEP's presence in the field helped tsunami-affected countries to assess conditions and integrate environmental considerations into post-tsunami recovery programmes. UNEP's principal partners were the national and regional government agencies responsible for environment and natural resources and, less directly, those with lead responsibility for planning and reconstruction activities.

At the same time, UNEP worked closely with national and local non-governmental and community organizations.

UNEP was and is integrated into UN post-disaster recovery planning through the Inter-Agency Standing Committee (IASC) Cluster Working Group on Early Recovery, the UN Development Group, the International Recovery Platform, the UN International Strategy for Disaster Reduction (ISDR) and the United Nations Office for the Coordination of Humanitarian Affairs (OCHA). UNEP also participated in needs assessments conducted by international financial institutions (IFIs), including the World Bank and Asian Development Bank.

On the country level, UNEP experts were focal points for environmental matters within UN Country Teams, working side by side with colleagues from the United Nations Development Programme (UNDP), United Nations Children's

Fund (UNICEF), the World Food Programme (WFP), World Health Organization (WHO), Food and Agriculture Organization of the United Nations (FAO), and United Nations Population Fund (FPA). Through these formal mechanisms, UNEP worked to mobilize resources and to ensure that environmental concerns would be considered as UN recovery plans developed.

In February 2005, during the 23rd meeting of the UNEP Governing Council, UNEP issued *After the Tsunami: Rapid Environmental Assessment*, a rapid assessment of the tsunami's environmental impacts across the region. The Governing Council thereafter issued decisions relating to UNEP's post-tsunami work. Decision 23/7 called for 'strengthening environmental emergency response, developing disaster prevention, preparedness, mitigation and early-warning systems in the aftermath of the Indian Ocean tsunami disaster'. The decision requested UNEP's continued action in the affected countries in support of 'short and



A staff member of Wetlands International, one of UNEP's project partners, consults with community leaders in Banda Aceh.

long-term environmental restoration and management, in particular as they relate to human vulnerability and well-being, taking into account the role of integrated coastal-zone management, land-use planning and management of eco-systems'. A second significant decision, Decision 23/1, called for implementation of the *Bali Strategic Plan for Technology Support and Capacity-building* (the Bali Plan), which encourages the strengthening of government capacities to achieve environmental goals and targets in ways that reflect transparency, accountability, participation and full national ownership.

From its earliest days, the ATDTF worked closely with UNEP to coordinate recovery activities. In particular, the Task Force worked closely with the Joint UNEP/OCHA Environment Unit¹ (JEU), which deployed experts to tsunami-affected areas within 24 hours to make rapid assessments, UNEP's Regional Office for Asia and the Pacific (ROAP), UNEP's Division of Technology, Industry and Economics (DTIE), UNEP's Division of Early Warning and Assessment (DEWA) and UNEP/GRID-Arendal.

To share information and maximize coordination internationally, the Joint UNEP/OCHA Environment Unit, the World Conservation Union (IUCN) and WWF International participated in the Task Force. Close links were also established with the International Federation of the Red Cross (IFRC).

During 2005, the ATDTF was integrated into UNEP's Disaster Management Branch (DMB). In January 2007, the DMB merged with UNEP's Post-Conflict Assessment Branch to form the Post-Conflict and Disaster Management Branch (PCDMB). Under the auspices of the then DMB and the PCDMB, the ATDTF's project work and

the regional work of UNEP ROAP was incorporated into a unified Post-Tsunami Environmental Recovery Programme (ERP).

In November 2005, the ERP set a number of objectives that reflected the transition from post-tsunami relief to the recovery phase:

- Integrating environmental considerations into reconstruction agendas and mechanisms for coordination, funding and implementation.
- Strengthening environmental institutions in affected countries and helping them to guide national reconstruction aims and procedures.
- Mitigating environmental and health threats from the waste management sector.
- Strengthening national disaster risk reduction and early warning platforms, and advising on environmental disaster risk reduction measures.
- Improving capacities for integrated coastal zone management.
- Promoting environmentally sound reconstruction technologies.

UNEP teams remained in the field until the end of 2007, helping to coordinate multi-faceted environmental recovery programmes in partnership with national authorities, UN agencies and the international community.

Very little of UNEP's environmental reconstruction work would have been possible without the generous support of donor nations. Between 2005-2007, UNEP received approximately USD 8 million for its post-tsunami work, the vast

¹ *Through the Joint UNEP/OCHA Environment Unit, UNEP integrates environmental concerns into response operations. The JEU facilitates international response to environmental emergencies by mobilizing and coordinating international assistance to affected countries (at their request); undertakes missions for independent assessments and post-disaster analysis to assist countries in the immediate response phase; acts as broker between affected and donor countries; provides a clearing house for information, and maintains a 24 hours notification and alert system issuing regular situation reports that are disseminated worldwide.*



Mangrove seedlings are prepared for planting in nearby lagoons, Ampara District, Sri Lanka.

majority of which came from the governments of China, Finland, Norway, Spain, Sweden and the United Kingdom, either directly or via the OCHA Flash Appeal.

This report summarizes UNEP's work in the aftermath of the tsunami and offers observations based on that experience. The next chapter reviews UNEP's work thematically, describing efforts in the areas of environmental assessment; institutional strengthening and integrating environment

into the recovery process; coastal zone restoration and management; waste management; disaster risk reduction; and sustainable reconstruction. Subsequent chapters focus on UNEP's work on a country-by-country basis, in Indonesia, Sri Lanka, Maldives, Thailand, Seychelles, Somalia and Yemen. The report concludes with reflections on lessons UNEP has learned and carried forward as it continues to promote and catalyze environmental recovery and disaster risk reduction efforts around the world.

Building back better – UNEP's post-tsunami work

*Harvesting mussels, Pulot, Banda Aceh.
Mangroves are helping to increase biodiversity
in the lagoon ecosystem.*



UNEP's post-tsunami work took a number of forms, depending on the particular conditions and needs identified by national counterparts and UNEP experts. In general, however, UNEP focused on assessing environmental impacts and risks; providing technical and institutional support; promoting environmental restoration and management; and mobilizing resources for environmental recovery.

Collectively, UNEP's efforts helped to guide the tsunami-affected countries along a path to environmentally sound recovery and more sustainable futures. Below is an overview of the major areas of UNEP's post-tsunami work.

Environmental assessments

A cornerstone of UNEP's work has been its assistance to governments in identifying priority environmental issues and mobilizing support. This mandate took on urgency in the days and

weeks following the tsunami. Immediately after the tsunami, the Joint UNEP/OCHA Environment Unit deployed experts to make preliminary evaluations of the tsunami's environmental impacts, so that first appeals for assistance could be developed. UNEP experts on site also provided inputs to needs assessments that were rapidly developed by IFIs and the UN Disaster Assessment and Coordination (UNDAC) in the early days following the tsunami.

In the following weeks, UNEP supported national counterparts and stakeholders in their efforts to conduct rapid assessments of the tsunami's environmental impacts. During the February 2005 meeting of UNEP's Governing Council, UNEP published *After the Tsunami – Rapid Environmental Assessment*. The report provided important primary evidence of the tsunami's environmental destruction in seven affected countries and helped to attract international attention to the region's environmental recovery needs.



UNEP rapid assessment team in the Maldives.



The large amount of debris generated by the tsunami was found to contain significant amounts of hazardous waste, including asbestos containing materials. UNEP trained local workers to clear, transport and safely store hazardous waste at two demonstration sites in Sri Lanka.

In the following months, more detailed field assessments were carried out in the Maldives, Sri Lanka, Indonesia and the Seychelles, and a desk study was undertaken on the environmental situation in Somalia. The detailed assessments, though varying in their methodologies according to local priorities and capacities, had in common extensive national technical participation and the use of local, site-specific data reflecting physical parameters. The detailed assessments also took stock of national, regional and local environmental protection capacities. UNEP assisted with the coordination and finalization of these assessments and in a number of cases supplied external technical expertise to the assessment teams. In the case of Indonesia, a two-year follow-up assessment also examined the progress made by the recovery

process, and some of the environmental risks that the process entailed.

The value of the UNEP-supported assessments to local decision-making processes was evident. Early assessments carried out during the emergency phase brought environmental issues to greater prominence in the disaster relief process. In the Maldives, for example, following a first, nationally driven rapid assessment, environmental protection quickly emerged as a priority area in the Government's National Recovery and Reconstruction Plan. In Sri Lanka a far-reaching assessment process involving a broad array of stakeholders and national experts similarly established environment as a pillar in the government's recovery decision-making.

The field assessment process yielded a number of additional benefits. Assessments often included a number of representative site visits, interviews with local officials and community members, and the collection of water and soil samples. By establishing partnerships between international and national experts, knowledge and experience was exchanged. Government debriefings fed information quickly into key decision-making processes. And final, detailed reports containing recommendations for mitigation and longer-term recovery measures to help governments ‘build back better’ often had direct impacts. In the Maldives, for example, an assessment recommendation calling for the creation of a ministry of environment led within weeks to the creation of the Ministry of Energy, Environment and Water. Most importantly, UNEP assessments

helped to integrate environmental considerations into recovery planning by establishing credible, independent baseline environmental information on which donors and policy makers could rely.

References to UNEP post-tsunami assessments can be found in Annex 1.

Technical and institutional support

Immediately following the tsunami, UNEP deployed environmental experts to the region. A number of important benefits follow from having field staff on site in the aftermath of a natural disaster, especially one for which most countries were not prepared. UNEP’s assistance helped tsunami-affected countries in their efforts



Destroyed stall in Galle, Sri Lanka. © Paul Jeffrey/ACT International



Forestry officials inspect a proposed site for mangrove plantation, Kunugala Lagoon, Sri Lanka.

to make sustainable reconstruction choices and to respond to immediate environmental threats to human health, in particular from waste and contaminated water supplies.

Working side by side with national and regional environmental authorities, UNEP experts provided advice on the issues at hand, assisted in the development of environmental recovery plans, and, when possible, mobilized external resources. UNEP also supported environmental authorities as they participated in government reconstruction planning processes. This intense daily collaboration resulted in the sharing of technical information, as well as best environmental and business practices. It also created professional bonds of enduring value, drawing on the best traditions of international cooperation.

Over the past three years, UNEP cooperation with national and regional authorities continued at the request of the affected countries. This cooperation led to the development of environmental

mitigation and risk reduction activities, as well as longer-term environmental management capacity building projects in such areas as waste management, planning, monitoring, environmental impact assessment and coastal restoration. In the Maldives, Indonesia and Sri Lanka, in particular, UNEP helped to improve the capacity of environmental authorities to guide the reconstruction process and to monitor environmental conditions. UNEP also supported affected countries' efforts to screen the environmental impacts of reconstruction activities and to carry out strategic environmental assessments of proposed plans and programmes.

Although UNEP is a non-resident agency without a permanent field presence, UNEP field teams participated to the extent possible in the UN Country Teams in a number of tsunami-affected countries. As such, UNEP coordinated its activities with UN counterpart organizations, and supported and advised UN country operations with environmental expertise.



Mangrove seedlings are planted on Huraa Island in the Maldives, as part of a UNEP-supported ecosystem restoration and education project.

Cross-sectoral information sharing yielded results. For example, when UNEP convened an *ad hoc* inter-agency group to focus on water and soil contamination in the Maldives, WHO, FAO, UNICEF and UNEP were able to share data that strengthened UN efforts to restore agricultural livelihoods. In the Maldives, UNEP was also able to develop a set of sustainable reconstruction principles that were adopted by the UN Country Team and helped to guide reconstruction efforts toward more environment-friendly outcomes.

UNEP's work enabled essential environmental recovery funding to be delivered to the tsunami-affected countries, particularly through the UN Flash Appeal. Urgent environmental assessment and risk reduction projects were recognised in the first Flash Appeal in January 2005. Significantly increased inputs were subsequently included in the February 2005 revised Flash Appeal. In addi-

tion, environmental coordination meetings took place in Indonesia, Sri Lanka and the Maldives to help mobilize resources for the environment, as well as to improve coordination. In the ensuing months, UNEP's active participation in the IASC, UN Development Group and other coordination mechanisms helped to mobilize additional resources for environmental assistance.

Overall, UNEP succeeded in helping governments and the UN system to recognize environmental protection and the sustainable use of natural resources as important elements of reconstruction planning and implementation. The technical assistance that UNEP provided during the three years following the tsunami helped to mitigate risks and to set post-tsunami reconstruction on a more sustainable path, while also strengthening the capacities of many of the national and regional environmental authorities involved.

Waste management

The tsunami overwhelmed waste management systems across the region, spreading massive quantities of waste, some of it hazardous, across a vast territory. Left unattended, the waste threatened public health through contamination of water supplies and exposure to smoke from burning waste.

In the immediate aftermath of the tsunami, UNEP offered to assist national authorities and UN agencies in mitigating risks from waste. At the same time, UNEP facilitated and supported the development of waste management strategies and guidance materials designed to meet medium and longer-term needs.

In February 2005, UNEP organised a technical meeting on debris and waste management. The meeting was attended by a broad array of international stakeholders. Based on findings and



Young mangroves in a UNEP-supported reforestation project, Banda Aceh.

perspectives presented during the meeting, UNEP DMB and DTIE developed the UN Post-Asian Tsunami Waste Management Plan, which set forth best waste management processes and practices. The Plan was developed with the support of UNICEF, WHO, UN-HABITAT, and UNDP. UNEP launched the Plan in the Maldives in May 2005 and in Banda Aceh in June 2005. The Plan formed the basis for waste management capacity building activities and workshops that UNEP subsequently implemented in both countries.

In 2005-2006, UNEP implemented waste collection, recycling and disposal projects in the Maldives and Indonesia, the details of which are described more fully below. These projects strengthened local waste management capacities and greatly reduced imminent risks to public health and ecosystems from the many tons of accumulated tsunami waste and debris.

Coastal zone restoration and management

The tsunami devastated many coastal zones in the region. To focus attention on coastal zone reconstruction, the Regional Organisation for the Conservation of the Environment of the Red Sea and Gulf of Aden hosted a meeting on *Coastal Zone Rehabilitation Management for the Tsunami Affected Region*. The meeting was held in Cairo, Egypt in February 2005 in conjunction with the UNEP ATDTF and the UNEP Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA). Government representatives gathered with international coastal zone management experts and supporting institutions to discuss coastal reconstruction and rehabilitation within the broader framework of integrated coastal zone management. The meeting also provided a venue for knowledge to be exchanged on policy tools and mechanisms for reducing the impacts of possible future disasters. By the meeting's conclusion, the participants endorsed 12 guiding principles for environmentally sound coastal rehabilitation and reconstruction, known as the Cairo Principles.

Guiding Principles for Post-Tsunami Rehabilitation and Reconstruction

THE CAIRO PRINCIPLES

Having participated in the 17 February 2005 UNEP meeting on Coastal Zone Rehabilitation and Management in Regions Affected by Tsunamis and Other Natural Disasters, we endorse the following Guiding Principles for affected nations and supporting international institutions for post-tsunami rehabilitation and reconstruction.

Overarching Principle 1. Reduce the vulnerability of coastal communities to natural hazards by establishing a regional early warning system, and applying construction setbacks, greenbelts and other no-build areas in each nation, founded on a science-based mapped "reference line".

Using concepts of Integrated Coastal Management, including public engagement in local decision-making, employ a rapid assessment and zoning and planning process to:

Principle 2. Promote early resettlement with provision for safe housing; debris clearance; potable water, sanitation and drainage services, and access to sustainable livelihood options.

Principle 3. Enhance the ability of the natural system to act as a Bioshield to protect people and their livelihoods by conserving, managing and restoring wetlands, mangroves, spawning areas, seagrass beds and coral reefs; and by seeking alternative sustainable sources of building materials, with the aim of keeping coastal sand, coral, mangroves and rock in place.

Principle 4. Promote design that is cost-effective, appropriate and consistent with best practice and placement of infrastructure away from hazard and resource areas, favoring innovative and soft engineering solutions to coastal erosion control and employing standardized service systems for potable water, wastewater and drainage.

Principle 5. Respect traditional public access and uses of the shoreline, and protect religious and cultural sites.

Principle 6. Adopt ecosystem-based management measures and promote sustainable fishery management in overfished areas, and encourage low impact aquaculture.

Principle 7. Promote sustainable tourism that respects setback lines and carrying capacity, benefits local communities and applies adequate management practices.

Process Measures: How things are done is often as important as what is done. Local knowledge and insights are important to successful planning and decision-making, and local citizens must be engaged in the planning and decision making process at each stage. National governments must be able to measure progress and disseminate results.

Principle 8. Secure commitments from governments and international organizations to abide by these Principles and build on and strengthen existing institutional arrangements where possible.

Principle 9. Ensure public participation through capacity building and the effective utilisation of all means of communication to achieve outcomes that meet the needs and realities of each situation.

Principle 10. Make full use of tools such as Strategic Environmental Assessment, spatial planning and Environmental Impact Assessment, to identify trade-offs and options for a sustainable future.

Principle 11. Develop mechanisms and tools to monitor and periodically communicate the outcomes of the reconstruction through indicators that reflect socio-economic change and ecosystem health.

Principle 12. Widely disseminate good practices and lessons learned as they emerge.

BUILDING BACK BETTER – UNEP’S POST-TSUNAMI WORK

In February 2005, UNEP also issued *After the Tsunami – Rapid Environmental Assessment*. Among other findings, the assessment confirmed that healthy mangroves and coastal ecosystems moderate the impact of waves in coastal zones and consequently, are important barriers against coastal erosion and storm damage. After the tsunami, however, mangrove cover in the twelve countries most affected by the tsunami was less than half its pre-tsunami extent. Maintaining the safety of coastal populations requires the restoration of coastal ecosystems such as mangroves, beach forests and coral reefs. There is also a close connection between coastal ecosystem health and human well-being. Services derived from coastal and marine resources, e.g. fisheries, tourism, mining and shipping play crucial roles in the economies and societies of the tsunami-affected countries.

After the tsunami, UNEP engaged in a number of partnership-based activities to strengthen environmental education and build community involvement with coastal ecosystem restoration in Indonesia, Sri Lanka and the Maldives.

In Indonesia, UNEP funded a project implemented by Wetlands International – Indonesia Programme (WI-IP), which managed capacity development, planting and environmental education at a variety of sites in Aceh. UNEP and WI-IP also conducted a knowledge exchange process between communities in Aceh and other communities in Java where large-scale mangrove planting was done to rehabilitate aquaculture landscapes.

In Sri Lanka, UNEP supported capacity development and planting efforts by the Ministry of Environment’s Forestry Department and environmental education initiatives conducted by IUCN – Sri Lanka.

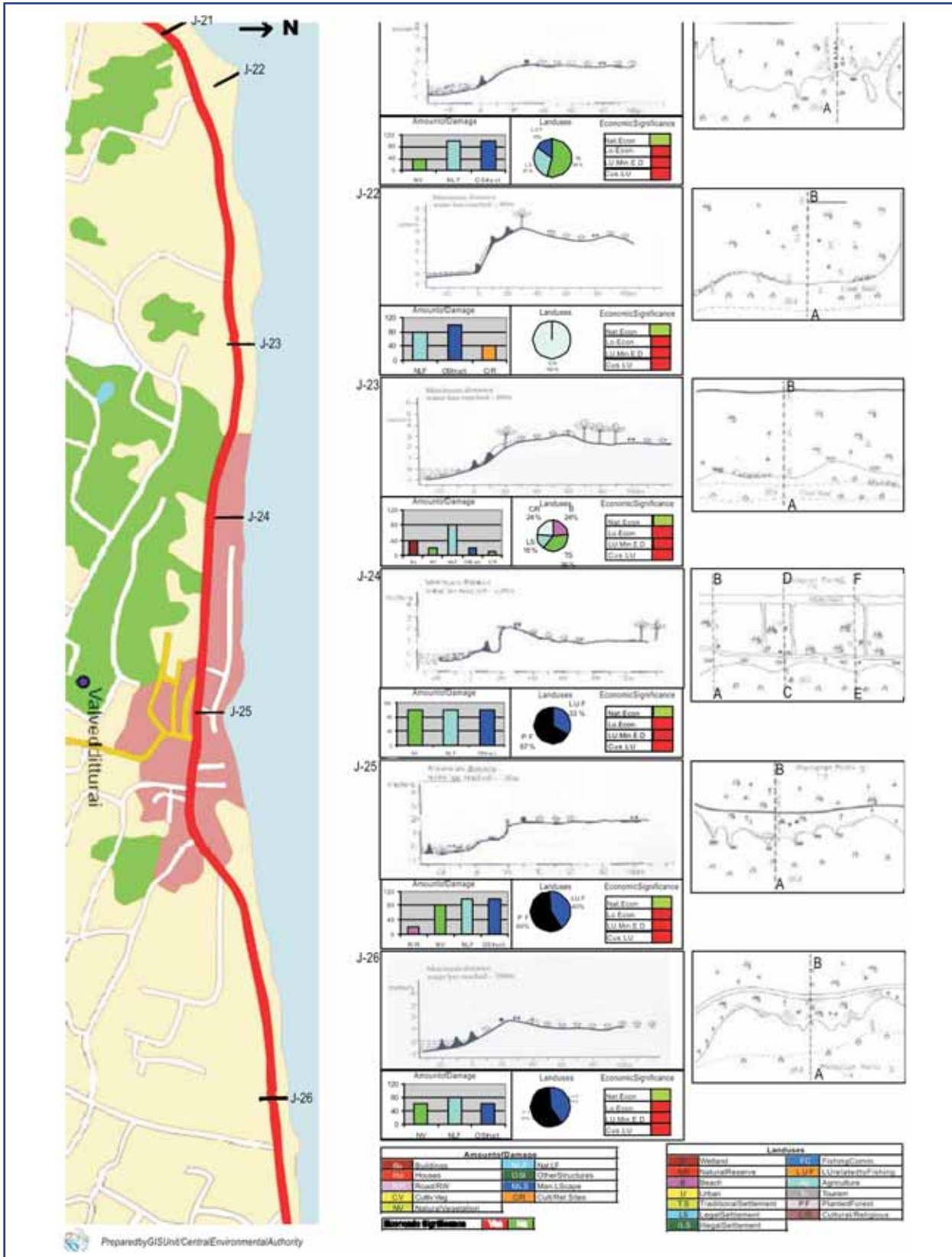
In the Maldives, UNEP worked closely with the IUCN Ecosystems and Livelihoods Group to analyze the economic value of coastal ecosystems. UNEP also supported a project implemented by

the Ministry of Energy, Environment and Water (MEEW) and Wetlands International to restore a protected lagoon-mangrove ecosystem and use the site for environmental education.

In October 2006, a study commissioned by UNEP and undertaken by the Indonesia Programme of Wetlands International, in cooperation with the UN Recovery Coordinator in Aceh found that 50 percent of some 30 million mangrove seedlings planted since the tsunami by various relief agencies had been lost through inadequate planning and planting. The study catalogued a variety of important lessons learned about mangrove reforestation. Key priorities identified included stakeholder coordination; full community participation in all stages of the process and its planning; awareness of the proper techniques and species for mangrove planting, and the ability to distinguish good sites from bad ones. The study emphasized that educational and awareness-raising activities are crucial to success.

UNEP also supported the development of the broad, multi-stakeholder Mangroves for the Future initiative (MFF), a project developed by UNDP and IUCN. MFF was designed to restore and manage mangrove and other high-value coastal ecosystems in Indonesia, Sri Lanka and the Maldives as a means of conserving biodiversity and promoting environmental and livelihood security. Pilot locations were selected to maximise the opportunity for stakeholders to develop experience with best practices. UNEP provided technical guidance during the project’s strategic planning and inception phase. UNEP also built on its experience with coastal ecosystem restoration in Indonesia, Sri Lanka and the Maldives by supporting and supervising ongoing coastal restoration activities and partnerships in those countries.

All these activities strengthened local capacities to manage and restore coastal ecosystems, while promoting a greater understanding of how and why to undertake such activities. By collaborating with like-minded institutions and processes,



UNEP assisted the Sri Lanka Ministry of Environment and Natural Resources to execute detailed “green” and “brown” environmental assessments of tsunami-related environmental damage. The resulting *Atlas of Tsunami Damage in Sri Lanka* includes field-level data regarding vulnerability, physical, social and ecological damage, land use and the pattern of tsunami inundation (*MENR, 2005a, Volume 2*).



More than 800 people died when tsunami waves capsized a train traveling on this coastal railway track between Colombo and Galle. The tsunami caused serious concern about the proximity of coastal development to the shoreline. This was reflected in the Cairo Principles, which call for the enforcement of construction setbacks, greenbelts and other no-build areas.

such as Wetlands International, IUCN and the MFF initiative, UNEP leveraged its resources, expanded the use of best practices and maximised project impacts. These activities also benefited livelihoods and poverty alleviation. In Indonesia, for example, mangrove-based silvofishery systems were found to have enhanced the production of marine organisms, which encouraged the development of new livelihood options, such as crab, shrimp, fish and seaweed farming.

Disaster risk reduction

In January 2005, delegates from more than 160 UN member states gathered at the World Conference on Disaster Reduction in Kobe, Japan to adopt the *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters* (the ‘Hyogo Framework’). In the immediate aftermath of the tsunami, UNEP was one of the agencies that worked with ISDR

towards the adoption of the Hyogo Framework. The Framework set an international agenda aimed at the substantial reduction of loss of life and loss of the social, economic and environmental assets of countries and communities due to disasters. The Framework’s Priorities for Action identified the need to encourage the sustainable use and management of ecosystems and to implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction.

Following the tsunami, UNEP worked closely with the UN International Strategy for Disaster Reduction (ISDR) to integrate environmental management into disaster risk reduction policies and programmes in the tsunami-affected countries. In particular, UNEP cooperated with the ISDR project *Strengthening Tsunami Early Warning Systems*, which was supported by the Governments of Finland, Germany, Japan, Netherlands,

Norway, Sweden and the European Commission Humanitarian Aid Office (ECHO).

On the policy level, UNEP worked to advance technical knowledge of environmental aspects of disaster risk reduction. With the support of the ISDR Secretariat, UNEP led the UN/ISDR Environment and Disaster Working Group (EDWG). The EDWG provided a working forum for identifying and communicating the strategic aspects of addressing the environmental dimensions of disaster risk reduction. In addition to convening advocacy events in technical policy forums, the EDWG published a working paper, *Environment and Disaster Risk Reduction*, to help ISDR members to address environmental concerns more effectively.

On the country level, UNEP worked to build the capacities of national environmental authorities in Indonesia, Sri Lanka and the Maldives to identify and manage environmental factors contributing to risk in coastal areas vulnerable to tsunamis. In Sri Lanka, UNEP facilitated technical training and promoted integrating disaster risk concerns into Strategic Environmental Assessments (SEAs). In addition to providing hands-on experience through field-based exercises, this activity led to the creation of an inter-ministerial task force on SEAs and support for SEAs in the Sri Lankan Parliament. In the Maldives, UNEP, in cooperation with UNDP, supported the Ministry of Environment, Energy and Water's (MEEW) efforts to use environmental information to identify vulnerable sites at the island level. This activity strengthened cooperation between the MEEW and the Ministry of Planning and other ministries and agencies that are investigating the concept of 'safe islands'. UNEP's work in the Maldives also contributed to having Environment and Disaster Risk Reduction identified as one of three pillars in the country's UN Development Assistance Framework (UNDAF).

UNEP also worked to identify best environmental management practices that would reduce risks in coastal communities. In 2005, UNEP and the World Conservation Monitoring Centre published *After the Wave*, a report that examined the role that coastal mangroves and coral reefs play in buffering against the impacts of natural hazards. UNEP's International Environmental Technology Centre initiated an innovative project in Indonesia on the use of environmentally sound technologies in forestry waste management for disaster prevention in Indonesia. UNEP's ongoing initiative, Awareness and Preparedness for Emergencies at the Local Level (APELL)², led to a new effort in Sri Lanka to develop the capacity to assess and understand local risks and to strengthen preparedness for effective response.

As a result of these various initiatives, enhanced assessment instruments were adapted for use in coastal communities throughout the region. National authorities became more fully engaged with disaster managers in advancing early warning systems and other disaster reduction measures. And awareness was raised among policy makers, disaster risk managers and development partners of the opportunities for reducing risk through environmental management.

Better buildings

In the aftermath of the tsunami, millions of homeless or displaced survivors found shelter in temporary barracks and tents. The need to create adequate permanent housing was urgent. In Aceh alone it was estimated that 92,000 new houses had to be built and 151,000 damaged houses repaired. Numerous relief agencies took on the task, but project managers were often overwhelmed by the challenge of rapidly producing conceptually sound, practical building solutions with minimal environmental impacts.

² APELL is a strategy developed by UNEP in conjunction with governments and industry to minimise the harmful effects of disasters. For more information, see Box 2 below or <http://www.unep.org/pcl/apell/>



UNEP produced practical guidelines for project managers on sustainable building techniques, including demolition, housing and settlement design.

In response, UNEP promoted the concept of sustainable building, an integrated approach to reconstruction that takes into account environmental, technical, economic, social, and institutional concerns at each stage of reconstruction. The goal of sustainable building is to enhance and improve approaches to housing design, construction, use and demolition, and to design of settlements that includes green spaces and sustainable infrastructure such as water supply and sanitation systems. The approach takes into account energy use, biodiversity and quality of life, thereby offering a variety of environmental, economic and social benefits.

UNEP advanced the idea of sustainable reconstruction on an informal basis during meetings with UN Country Team members and national planning and environmental authorities. UNEP’s ROAP also conducted a series of green building workshops in tsunami-affected countries.

In addition, UNEP published *After the Tsunami – sustainable building guidelines for Southeast Asia*, a manual designed to provide project managers with guidance in the area of ‘sustainable reconstruction’. *After the Tsunami* explains in detail how the choice of appropriate design and construction methods and sustainable materials and technologies during the planning, implementation and maintenance phases of reconstruction can protect natural resources and reduce energy consumption and pollution. The manual was designed for international donors, development agencies, NGOs, UN agencies, government institutions and local authorities as a means of helping to ensure that reconstruction activities yield net positive environmental or social impacts to local communities – in other words, that they truly ‘build back better.’

Building back better, country by county

*A grim reminder of the events of December 2004,
Ampara District, Sri Lanka.*



2004.12.26

Just as each country affected by the tsunami was distinct from the next culturally, economically, politically, geographically and environmentally, so did the tsunami affect each country very differently. A common denominator linking the tsunami-affected countries, however, was the complex nature of the environmental problems caused or exacerbated by the tsunami and the difficulties governments throughout the region faced in responding to the tsunami's impacts. On the country level, UNEP worked closely with national counterparts and UN Country Team partners to assess the unique dynamics, environmental conditions and needs of each affected country. In all countries, UNEP's overarching goal was to support environmental authorities in their efforts to ensure that the reconstruction process took environmental considerations into account. Strategic decisions were made early on, therefore, to avoid a one-size-fits-all approach and, instead, to adapt UNEP's assistance and activities

to locally identified, site-specific priorities. The following chapter provides an overview of these priority activities.

Indonesia

Country context

Indonesia suffered more damage and loss of life from the Asian Ocean earthquake and tsunami than any other country. The first tsunami waves reached the island of Simeule, 40 km from the earthquake's epicentre, and then travelled along the western and northern coasts of Sumatra, causing massive destruction along the coastlines of Aceh and North Sumatra provinces and nearby islands. The waves then proceeded around to the northeastern shores of Sumatra, causing further devastation. On the eastern coast, the waves reached inland an average of 500 m, while along the western coast they travelled overland 2 km, in some places surging as far as 6 km upriver.



Construction in a UNEP eco-housing demonstration project, Labuye, Banda Aceh.



Remnant of the tsunami in a residential area, Banda Aceh.

Settlements and infrastructure were largely destroyed wherever the tsunami hit. The human cost was unfathomable. In Nanggroe Aceh Darussalam (NAD, or Aceh), over 167,000 were reported dead or missing. Some 127,000 houses were destroyed with a similar number damaged, leaving inhabitants homeless or displaced. Especially hard hit were the districts of Aceh Besar, Aceh Jaya and Nagan Raya. On the island of Nias, in the province of North Sumatra, 850 were killed and 83,900 houses destroyed or damaged. Altogether, an estimated 500,000 lost their homes and livelihoods.

In addition to this human tragedy, the earthquake and tsunami caused tremendous social, economic and environmental devastation. Most of Aceh's coastal areas, public infrastructure and social facilities such as schools, health centres, and government buildings were destroyed. Livelihoods were severely impacted through damage to agricultural areas, disrupted fishing activities, loss of

land title, impaired water quality, the breakdown of sanitation and sewage facilities, and pollution from solid and liquid waste.

Environmental impacts included substantial amounts of mixed solid waste, damage to coral reefs, loss of fertile soil, salt intrusion, damaged vegetation (e.g. beach forests and mangroves), and overexploitation of natural resources resulting from the relocation of displaced populations.

The international community responded to the tsunami with a massive outpouring of assistance. Hundreds of national and international aid agencies from more than 130 countries contributed to a massive emergency aid programme.

Within months, emergency relief operations evolved into a rehabilitation and reconstruction agenda. In April 2005, the Government of Indonesia issued a 'Master Plan' to guide the rehabilitation and reconstruction of communities

in Aceh and Nias. At the same time, the President of Indonesia established the Agency for the Rehabilitation and Reconstruction of Aceh and Nias (BRR), to coordinate the rehabilitation and reconstruction process. The process aimed to meet basic humanitarian needs while creating a framework for the region's economic and social regeneration.

UNEP's response

At the request of the Government of Indonesia, UNEP experts arrived in Aceh on 1 January 2005. UNEP immediately began working closely with the UN Country Team to identify the tsunami's environmental impacts, to help to mainstream environmental concerns into early relief and recovery planning, and to ensure that environmental needs were reflected in OCHA's January 2005 Flash Appeal.

UNEP subsequently provided various forms of environmental relief and recovery assistance.

Mainstreaming environment: UNEP recruited an environmental policy expert to advise the Aceh-based UN Office of the Recovery Coordinator and to help ensure that environmental issues were integrated into UN recovery operations to the extent possible. At the same time, UNEP worked closely with the Ministry of Environment (MoE) to assist with setting the MoE's reconstruction agenda, and to create intergovernmental linkages essential to establishing a sustainable environmental recovery.

Rapid assessments: UNEP was the environment sector focal point for the damage assessment conducted by the National Development Planning Agency (BAPPENAS) and coordinated by the World Bank. UNEP calculated USD 155 million in damages to environmental assets and a USD 515 million total loss of environmental services. In February 2005, UNEP published *After the Tsunami – Rapid Environmental Assessment (REA)*. The REA provided an overview of the tsunami's extensive environmental impacts on the region.

The report included a chapter on Indonesia that set forth initial findings of extensive damage to virtually every aspect of the tsunami-affected natural and human environment. The UNEP REA provided the MoE with much-needed data and analysis for reconstruction decision-making.

Environmental policy & management: In response to the MoE's need for improved environmental management, and to identify gaps in knowledge and establish baseline information for the future, UNEP developed a two-part project to assess environmental conditions in Aceh and Nias and create a strategic environmental framework for Aceh:

Environmental assessment: UNEP worked closely with BRR, the MoE and relevant expert institutions to develop an assessment of the environmental impacts of the tsunami and reconstruction activities. The project included data acquisition by a team of environmental researchers, data review and gap analysis by a team of international experts, and focused environmental investigations and reporting. The assessment, entitled *Environment and Reconstruction in Aceh – Two years after the tsunami*, provided a detailed overview of post-tsunami environmental conditions in Aceh and Nias, observations on the environmental challenges that pre-existed the tsunami, the impact of reconstruction activities, and practical recommendations for sustainable reconstruction and resource management.

Strategic Environmental Framework: UNEP in cooperation with the BRR, MoE and other expert institutions, developed a policy and management tool to assist the BRR's Environment Unit in its efforts to promote sound environmental practices during reconstruction. The *Strategic Environmental Framework for a More Environmentally Sound Reconstruction of Aceh Province (SEF)* was designed to strengthen environmental governance at both provincial and district levels. In accordance with the SEF, policy guidance would be developed through



A scene from Banda Aceh (November 2007) showing natural mangrove regeneration in the foreground.

a Joint Environmental Committee. Tools would be developed for application on the district level to integrate best practices early in project cycles, monitor activities, measure and mitigate environmental impacts and promote compliance and advancement toward the Millennium Development Goals. The SEF was formally approved by the BRR in May 2007 and recommended by the Governor of the province in June 2007.

Waste management

UN Post-Asian Tsunami Waste Management Plan: In June 2005, UNEP launched the UN Post-Asian Tsunami Waste Management Plan

in Indonesia at a workshop in Banda Aceh. Over 100 local, national and international delegates attended the workshop. Following the workshop, Bapedalda (the local environmental management authority) created a Waste Management Forum that met on a weekly basis to coordinate donor, UN agency and national responses to the tsunami waste challenge.

Technical assistance: UNEP provided extensive waste management advice to Bapedalda and donors on appropriate waste-related activities. For example, UNEP assisted the Canadian Government in developing a project concept for dealing with inert waste. UNEP also

prepared a proposal for recycling demolition debris using portable crushing and screening equipment.

Asbestos-containing materials: In September 2005, after UNEP confirmed that building materials containing asbestos were present in Aceh's tsunami-damaged homes, UNEP conducted detailed monitoring in affected districts and urged all UN agencies to take account of the risks of uncontrolled exposure to asbestos and to avoid using asbestos-containing materials in reconstruction projects.

Pharmaceutical waste: UNEP worked with the WHO and local health authorities to develop a plan for addressing the large volume of expired and potentially hazardous drugs that were imported by international NGOs at the time of the disaster.

Coastal ecosystem restoration

Coastal restoration project: UNEP funded a programme implemented by Wetlands International – Indonesia Programme (WI-IP) to restore mangrove ecosystems and other coastal vegetation in Aceh Besar, and Simelue and Sabang islands. At one project site in Labuye, over 30,000 mangrove seedlings were planted, with planting also taking place at a further site in Desa Pulot. The project rehabilitated coastal zones damaged or destroyed by the tsunami, and promoted the recovery of habitats, biodiversity and livelihoods. Replanting yielded a number of benefits, including improved soil stability, revitalized biodiversity, such as increased crab, shrimp and wading bird populations, and renewed incomes for community members. Thanks to strong buy-in and involvement by community members, the project also had a strong capacity building and environmental education component. Local residents were trained to design and implement local rehabilitation projects. UNEP and WI-IP facilitated a knowledge exchange process between communities in

Aceh and communities in Java, where large-scale mangrove planting had been done to rehabilitate aquaculture landscapes. A variety of additional outreach and awareness activities stimulated community involvement while increasing local knowledge of the coastal zone environment and its proper management.

Mangrove/coastal ecosystem restoration report: In August 2007, UNEP published a report that it had commissioned from Wetlands International-Indonesia on lessons learned from post-tsunami mangrove and coastal ecosystem restoration efforts. Among the study's major findings was that, due to inadequate planning and planting, there had been a very high rate of avoidable loss among the 30 million mangrove seedlings planted by relief agencies after the tsunami. The study catalogued a variety of additional important lessons learned regarding mangrove reforestation.

Mangroves for the Future: Based on UNEP's experience and technical expertise in coastal restoration, the organisation joined the partnership of UNDP and IUCN, which is leading Mangroves for the Future, a broad-scaled, multi-partner initiative to conserve and restore mangrove ecosystems in India, Indonesia, the Maldives, Seychelles, Sri Lanka and Thailand.

Environmental planning capacity building: In 2005 and 2007 UNEP sponsored training courses for 30 district officers at the Bandung Institute of Technology. The training focused on geographical information systems (GIS), remote sensing, spatial analysis, field assessment work and case study development. UNEP provided computers, digital cameras and GPS equipment. Participant presentations on spatial planning case studies included: road reconstruction projects, eco-city designs and integrated coastal zone management.

Sustainable construction guidance: As detailed in the previous chapter, UNEP in collaboration with UN Habitat, prepared a sustainable construction



This lagoon in Pulot, Banda Aceh, used to be a river and was formed by sand deposits from the tsunami. UNEP worked with local project partners to encourage the generation of mangroves in the lagoon, thereby increasing biodiversity and helping to secure the livelihood of the local community.

guidance manual for use by development agencies, donors, NGOs and UN agencies. The manual provides non-technical information on sustainable construction techniques and materials (e.g. recycled materials), energy efficiency and conservation, alternative water supply and sanitation systems, waste recycling, composting and environmental management (e.g. secondary containment of fuel tanks, minimization of dust and noise emissions). Launched in Indonesia in September 2006, *After the Tsunami – sustainable building guidelines for Southeast Asia* has become a significant tool for government reconstruction planners.

Construction screening: UNEP helped Aceh's environmental and planning authorities develop and implement an interim environmental screening tool with which to evaluate proposed reconstruction projects in order to minimize their potential environmental impacts. The Project

Environmental Review tool was used while the Government undertook a revision of its environmental impact assessment (EIA) regulations. At the request of the Government's National Project Office, UNEP supported the recruitment of two experts to assist in the environmental screening of post-tsunami projects. The team reviewed project proposals for infrastructure, housing, economic development, classified the proposals into three broad categories (require an EIA / require an environmental report / no further reports required), placed data into a spreadsheet and translated the proposals into Bahasa Indonesian.

EIA database: To improve coordination of the EIA process and EIA-related information (e.g. proponent, type of project, location, environmental review / report) UNEP supported spatial planning training and the development of an online EIA document repository for the provincial environmental agency (Bapedalda). The database

was designed to support the Government's implementation of new fast-track EIA legislation by improving information sharing capacity.

Green Aceh: UNEP co-sponsored a Green Aceh Conference that was held in Banda Aceh from 21-23 June 2005. The conference gathered a wide range of provincial, national and international stakeholders to promote the mainstreaming of good environmental practices in tsunami reconstruction efforts. The conference emphasized the crosscutting issues of participation, transparency, accountability and gender equity. UNEP sponsored a follow-up Green Aceh Conference in July 2007.

Eco-housing: UNEP ROAP undertook a regional initiative to promote eco-friendly housing and village development options. In May 2005, UNEP held an eco-housing workshop for Indonesian environmental authorities in Jakarta. Thereafter UNEP, in collaboration with the BRR, MoE and the Indonesian Ministry of Public Works' Institute of Human Settlements, developed a project to promote the construction of sustainable housing units in Aceh. During the projects' first phase, Chulalongkum University in Bangkok developed a comprehensive master plan for a village in Labuye. The master plan included: housing, utilities, a mosque, school, office, roads, public areas, etc. In the project's second phase, BRR oversaw the design and construction of demonstration homes that used alternative construction techniques, materials and environmental technologies (e.g., solar power, solar distillation, reed beds, dry toilets, composting, recycling, etc).

Sri Lanka

Country context

At 6:59 a.m. local time, approximately 90 minutes after disaster had struck Indonesia, the tsunami's waves reached the shores of Sri Lanka. With waves up to nine metres high and backed by the momentum of deep, surging waters, the tsunami smashed Sri Lanka's eastern coastline before

sweeping along the country's southern and south-western shores. Wave penetration ranged from a few tens of metres to up to three km inland. The median depth of penetration was approximately 300 m in eastern districts, 100 m in the south, and 50 m in the far north. Approximately 40,000 were killed, 15,000 were injured and tens of thousands were displaced as the water destroyed some 100,000 houses, fishing boats, vehicles and infrastructure.

The country lost approximately USD 900 million in assets. Another USD 331 million in losses occurred as the result of damage to assets and disrupted economic activity. Fisheries, tourism, trade, agriculture and artisanal or cottage industries provided most of the livelihoods in the affected areas. All were severely impacted. Of the country's 29,700 fishing boats, about two-thirds were destroyed or badly damaged, often affecting entire fishing communities. Altogether, an estimated 150,000-200,000 people lost their jobs, including approximately 100,000 in fisheries, 27,000 in tourism and related activities, and scores more in informal sector activities.

The tsunami's major environmental impacts were caused by debris and waste. Sri Lanka's already underdeveloped solid waste management system was completely overwhelmed by the quantity of debris produced by the tsunami. The problem was compounded when emergency relief and clean-up operations transferred debris to inappropriate locations (e.g. wetlands, beaches and stream channels). In addition, agricultural lands and drinking water sources were inundated and contaminated by seawater and marine sediment. The resettlement of displaced persons added to environmental pressures, when forests, sometimes even in protected areas, were cleared to create shelter.

Immediately after the tsunami, the Government of Sri Lanka declared a state of emergency in all 12 affected coastal districts and rapidly deployed national emergency and security services to the areas. The President appointed three national task

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Salvaging items from the debris, Sri Lanka. © Paul Jeffrey/ACT International

forces to lead and coordinate the response. In the north and east, the Liberation Tigers of Tamil Eelam (LTTE) also played an active role.

The international donor community and national charities mobilized in unprecedented force. Aid agencies delivered educational, health, housing and other forms of assistance to help meet the basic needs of affected communities.

UNEP's response

On 28 December 2004, the Government of Sri Lanka, through its Ministry of Environment and Natural Resources (MENR), requested urgent assistance from UNEP to help assess the environmental damage caused by the tsunami. UNEP deployed staff, including a resident programme officer, and various environmental experts who participated in the UN Country Team and worked in collaboration with the MENR, Central Environment Authority (CEA) and the Reconstruction and Development Agency (RADA) (formerly the Task Force for Rebuilding the Nation) to

integrate environmental considerations into the post-tsunami recovery and reconstruction programme and to assist the Government's efforts to remediate damaged ecosystems and environmental features. The following summarizes UNEP's work in Sri Lanka:

Environmental assessments

Rapid assessments: On 26 December 2004 UN Disaster Assistance and Coordination (UNDAC) sent a mission to Sri Lanka that included an environmental expert from the Joint UNEP/OCHA Environment Unit. The team conducted a rapid environmental assessment to identify environmental problems posing imminent threats to human health and welfare. The findings of this assessment were incorporated into the national environmental assessment process. UNEP also worked with the UN Country Team to ensure that further environmental assessment activities were included in OCHA's January Flash Appeal. In

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February 2005, UNEP published *After the Tsunami – Rapid Environmental Assessment* (REA). The REA contained extensive inputs from Sri Lankan environmental authorities and drew attention to the range of damage the tsunami had caused to the country's natural and human environment.

Post-tsunami environment assessment: UNEP closely supported the Sri Lankan Ministry of Environment and Natural Resources (MENR) and the Central Environmental Agency (CEA) in the development of a detailed assessment of the environmental impacts and lessons learned from the tsunami. Published in October 2005, *Post-Tsunami Environmental Assessment for Sri Lanka* drew on previously published studies and the work of a range of national experts led by four Sri Lankan universities. The assessment analysed the tsunami's impacts on the 'green' environment

(ecosystems, biodiversity, protected areas and farmlands) and the 'brown' environment (pollution, debris and impacts on human settlements and infrastructure). 'Green' assessment teams collected data on vulnerability, physical, ecological and social damage, land use, and the pattern of tsunami inundation. 'Brown' assessment teams studied the contamination of over 750 sites where risks existed from potentially hazardous materials. Key issues highlighted included: debris and waste management; sustainable sourcing of drinking water; land drainage; deforestation; and disaster preparedness. The assessment was the government's official analysis of tsunami-related environmental impacts. Its recommendations provided a roadmap for environmental recovery activities and informed government, UN and donor recovery and reconstruction strategies, as well as UNEP's Environmental Recovery Programme for Sri Lanka.



The nursery for mangrove seedlings in the Ampara District, Sri Lanka, is managed by a community-based organization of fishermen whose livelihoods were affected by the tsunami. This family's yard is used as the nursery site.



Local teams were trained on the clearing and storage of hazardous waste, including asbestos containing materials, as pictured below.

Strategic environmental assessments: UNEP worked with various Sri Lankan governmental, community and non-governmental actors to promote SEAs as a tool for integrating environmental concerns into national reconstruction decisions. These initiatives were strongly supported by national authorities and strengthened environmental decision-making by the UNCT.

Capacity building and implementation: UNEP supported national efforts to develop the capacity to provide technical support for SEAs. UNEP, in collaboration with the Netherlands Commission on Environmental Impact Assessment (NCEIA), provided SEA training workshops for CEA staff. The workshops focused on guiding urban planning for approximately 50 townships in tsunami-affected areas. UNEP's provision of disaster preparedness and assessment methods



was an essential component of the training package.

Policy development: Introduction of the SEA methodology, which harnesses public participation and multi-stakeholder dialogue, had a number of significant consequences on the environmental policy level. The Government's Cabinet of Ministers endorsed the SEA concept and required all government agencies to undertake SEAs for their national planning and programmes.

Pilot projects: The Government required that a number of pilot SEA studies be completed before taking up the question of requiring SEAs under national law. To guide this programme the MENR and CEA formed the SEA Task Force. UNEP supported the Task Force with project preparation advice, training and equipment. Three completed pilot SEA projects succeeded in bringing together stakeholders from different sectors. One of the projects, in Trincomalee Bay, was particularly effective in highlighting ecosystem sensitivities and influencing development planning.

Ampara project: UNEP provided technical and policy inputs to a € 50 million EU-funded project administered by the UN Office of Project Support (UNOPS) in the Ampara District of Eastern Sri Lanka. The project entails road construction and rehabilitation; solid waste management; and environmental remediation, including roadside and homestead planting, quarry remediation and mangrove reforestation. Amongst other things, UNEP provided documentation and guidance on best practices, provided inputs regarding legal and policy aspects of the project's planned solid waste management and environmental rehabilitation components.

Environmental screening of housing: UNEP, UNDP, NCEIA and the University of Muratura conducted environmental screening of 480 donor-driven housing sites in Hambantota. MENR

used mitigation recommendations developed by UNEP to negotiate mitigation plans with developers on a site-by-site basis, and MENR monitored compliance with these plans.

Coastal zone planning and ecosystem restoration: More than half of Sri Lanka's 1,600 km coastline was badly damaged by the tsunami, destroying settlements, marine-related livelihoods and ecosystems. The tsunami's destruction compounded underlying coastal zone problems from coral mining, blast fishing, coral bleaching events, clearance of mangroves and mining of sand dunes, all of which had reduced the coastline's absorptive capacity. Coastal zone planning and restoration is therefore a top Government priority since the tsunami.

Cairo Principles training: In September 2005, UNEP GPA organized a training workshop in Sri Lanka based on the Cairo Principles (see page 19-20) for post-tsunami rehabilitation and reconstruction.

Mangrove and coastal ecosystem restoration: UNEP provided various forms of technical support to MENR to enable coastal ecosystem restoration and mangrove reforestation. With UNEP support, MENR's Forest Department and IUCN implemented a project to restore tsunami-impacted mangrove and other coastal ecosystems at two sites in the Ampara District of Eastern Sri Lanka. The project, which was initially delayed due to security issues in the region, enabled community-based organizations to create and manage ecologically appropriate nurseries and local communities to replant mangroves. MENR and IUCN created environmental education and outreach activities, including the dissemination of UNEP policy guidelines, which have also been used by the UNDP-IUCN-UNEP 'Mangroves for the Future Programme', a broad regional initiative.

Disaster risk management: Recognizing the need to strengthen its capacity to reduce

Awareness and Preparedness for Emergencies at a Local Level

APELL is a 10-step management process that helps local communities develop the information and decision-making structures needed to address hazards. Stakeholders participate in a process of structured dialogue and coordination that leads to the development of a unified emergency response plan for the entire community. The APELL process consists of the following steps:

1. Identify the emergency response participants and establish their roles, resources and concerns.
2. Evaluate the hazards and risks that may result in emergency situations in the community.
3. Have participants review their own emergency response plans to ensure a coordinated response.
4. Identify the required response tasks not covered by existing plans.
5. Match these tasks to the resources of the identified participants.
6. Make the changes necessary to improve existing plans, integrate them into an overall community plan and gain agreement.
7. Commit the integrated community plan to writing and obtain approval from local governments.
8. Educate participating groups about the integrated plan and ensure that all emergency responders are trained.
9. Establish procedures for periodic testing, review, and updating of the plan.
10. Educate the community about the integrated plan.

disaster risk, Sri Lanka launched *Towards a Safer Sri Lanka: A Road Map for Disaster Risk Management* in December 2005. The Road Map project included initiatives ranging from policy development to community-based disaster risk management. UNEP worked with the NCEIA to strengthen national capacities for integrated assessments of development plans, policies and programmes. Disaster risk criteria were introduced into the guidelines for SEAs. The guidelines were developed through disaster risk reduction training for environmental authorities, which included a pilot exercise in Panadura Township. UNEP also worked to strengthen the engagement of environmental authorities in the development of a national action plan for multi-hazard early warning systems.

UNEP also worked in close cooperation with MENR and the CEA to initiate the Awareness and Preparedness for Emergencies at a Local Level (APELL) process at two key tsunami-affected sites. The project strengthened local awareness and preparedness for natural and human-caused emergencies. Activities included a workshop and site demonstrations of the APELL process.

Information dissemination: With support from UNEP, the MENR, in collaboration with the CEA, established environmental 'help desks' in Colombo and the country's 14 affected districts. The help desks provided guidance and local support to address on-the-ground problems in the project implementation process.

Waste/debris management: Approximately 900,000 tonnes of debris were generated by the tsunami, including waste from damaged houses, household goods and furnishings, vehicles, boats and other items. In May 2006, UNEP, in cooperation with UNOPS and the CEA, commenced a project to clean hazardous waste and asbestos-containing materials (ACM) from two demonstration sites on Sri Lanka's East and South Coasts and to create a site in Thambiluvil for storage of ACM. In addition to cleaning up beaches where hazardous waste and ACM was posing an imminent threat to public and ecosystem health, the project trained local workers in the proper handling, transport and safe storage of hazardous materials, provided personal protective equipment and resulted in strengthening of the national hazardous waste inventory. The project also led to creation of national hazardous waste guidelines, as well as hazardous waste labels, logbooks and associated materials. UNEP's waste management work in Ampara District served as demonstration projects for the inception phase of the EU Ampara project.

Maldives

Country context

The Indian Ocean tsunami reached the Republic of Maldives at 9:20 a.m. local time, approximately three hours after tremors were felt. Tidal waves ranging between one and five meters high were reported in all parts of the country. The force of the waves caused widespread infrastructure devastation in the atolls, 80 percent of which are less than one metre above sea level.

On a per capita basis, Maldives was one of the worst affected countries. The tsunami's impact was national in scope. Sixty-nine of the country's 199 low-lying inhabited islands were damaged, 53 of them severely. Twenty were largely devastated, and 14 had to be evacuated. According to the Government of Maldives, some 30,000 residents were displaced by the tsunami. In all, nearly a third of the country's 290,000 residents suffered from loss or damage of homes, livelihoods and local infrastructure.



Mangrove roots exposed by the low tide, Huraa Island, the Maldives.

The tsunami had an enormous impact on the national economy, which depends largely on nature-based tourism, fishing and agriculture. Indeed, tourism generates approximately one-third of GDP. According to the World Bank-Asian Development Bank-UN System Joint Needs Assessment (“Joint Needs Assessment”), total asset losses were estimated to be USD 472 million, equaling 62% of the country’s GDP. Flooding wiped out electricity supplies on many islands, destroying communication links with most atolls. Twenty-five percent of the islands experienced major damage to essential infrastructure such as jetties and harbours, which provide crucial links between the islands and the outside world. Water supplies were disrupted on approximately 15% of the islands.

UNEP’s response

Within hours after the tsunami struck, the former Ministry of Environment and Construction (MEC) joined a Ministerial Committee and Task Force organised by President Maumoon Gayoom to address the national emergency. The Ministry quickly surveyed the affected islands and requested support from UNEP on behalf of the Government. On 27 December 2004, the Joint UNEP/OCHA Environment Unit deployed an expert to the Maldives to assist the MEC. The following is a summary of UNEP’s activities in Maldives since then.

Rapid Assessments: The UNEP/OCHA expert undertook a rapid environmental assessment that identified environmental problems posing imminent threats to public health and welfare. UNEP also ensured that the Maldives’ most urgent environmental needs were reflected in OCHA’s January Flash Appeal. On 10 January 2005, at the MEC’s request, UNEP deployed two staff members to the Maldives, including a waste management expert, to support and provide technical assistance to the MEC. During these first weeks, UNEP provided environmental inputs to the Joint Needs Assessment and helped the MEC organize an intergovernmental environmental task



Soil sampling during the Maldives post-tsunami environmental assessment.

force that contributed to a chapter on the Maldives in UNEP’s February 2005 publication, *After the Tsunami – Rapid Environmental Assessment*.

Mainstreaming environment: In the months following the tsunami, UNEP worked to integrate environment into recovery and reconstruction decision processes. Working closely with the MEC, UNEP met regularly with key Government decision-makers to emphasize the value of sustainable reconstruction. In March 2005, the Government issued the National Recovery and Reconstruction Plan, its core reconstruction-planning document. Senior MEC officials credited UNEP for the Government’s decision to include environmental protection as one of five key recovery themes. UNEP also cooperated with UNDP and UN Volunteers to respond to a MEC request for planning assistance. In April 2005, a senior environmental planner from Australia arrived in the Maldives under the auspices of UN Volunteers, and at the request of UNEP and the Maldives government, to begin a six-month post

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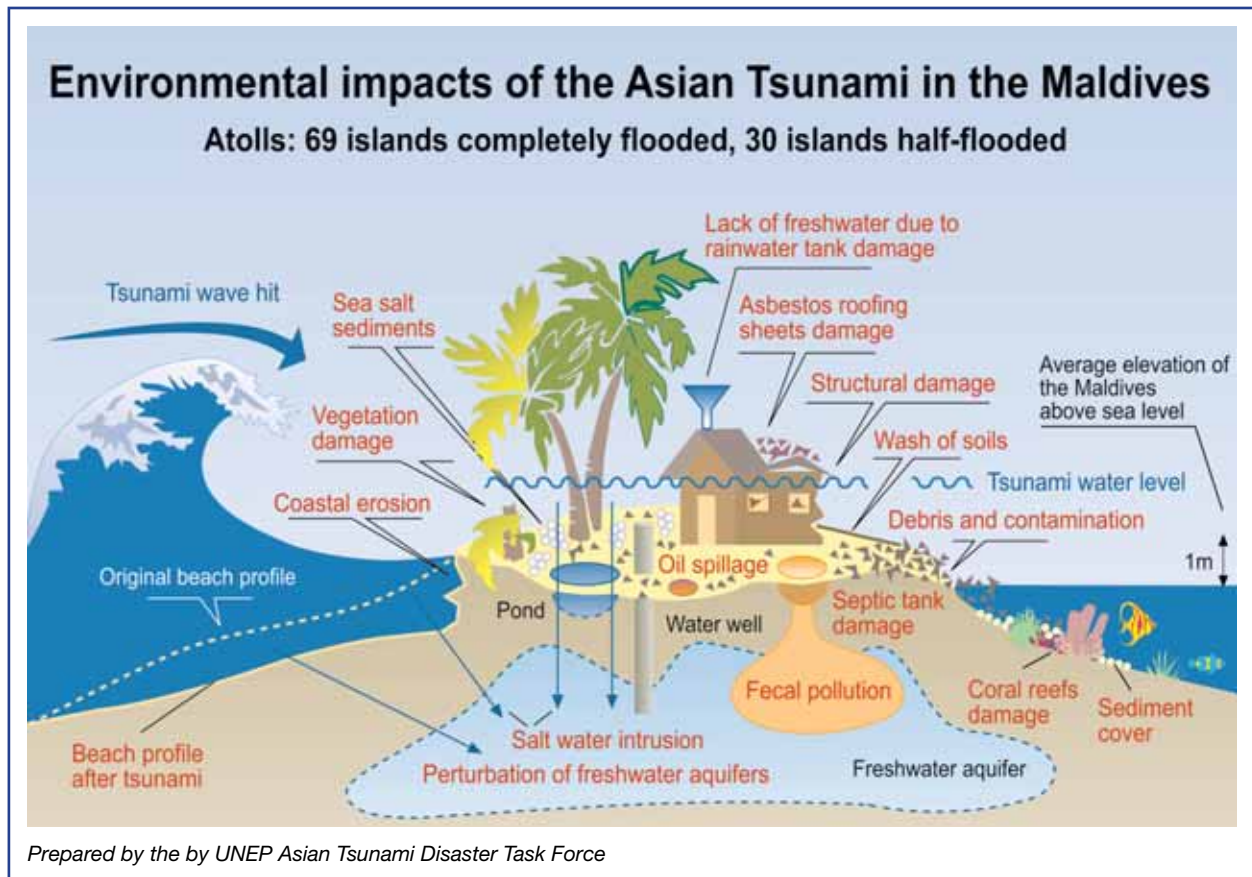
as in-house planner/adviser to the MEC. UNEP's promotion of environment in reconstruction also led the UNCT to designate environmental protection and disaster risk reduction as one of three core principles in the UN's recovery strategy for the country.

Detailed environmental assessment: In 2005 UNEP, in coordination with the MEC, conducted a field mission to the Maldives. The field mission combined 9 international experts (including 14 national experts) and visited 15 islands in 7 atolls (in addition to 10 islands investigated by UNEP prior to the mission). The resulting report, *Maldives Post-Tsunami Environmental Assessment*, was issued on World Environment Day in June 2005. The report presents a broad assessment of the tsunami's environmental impacts with recommendations for immediate and longer-term

action. Among other things, the assessment findings indicated that the tsunami created a number of environmental problems, including physical destruction of habitats; the creation of large volumes of tsunami debris; significant amounts of hazardous waste (including asbestos); contamination of soils and groundwater with high levels of salinity, faecal coliforms and nitrates; damage to coastal zones by soil erosion; damaged vegetation, especially home gardens and agricultural crops; and a lack of technical capacity and experience that limited the MEC's ability to participate meaningfully in reconstruction planning. The assessment also identified chronic environmental problems predating the tsunami, including poor waste management and sanitation systems. In July 2005, the Government implemented one of UNEP's key recommendations when it created the Ministry of Environment, Energy and Water



Tsunami debris in the Maldives, 2005.



(MEEW). UNEP’s report remains one of the most comprehensive environmental assessments ever undertaken in the country, and its recommendations are still being used.

Waste management was quickly identified as a priority environmental concern, a challenge that the Maldives had encountered prior to the tsunami. UNEP provided the MEC/MEEW with extensive technical support on waste management challenges in the aftermath of the tsunami. A UNEP waste expert worked side by side with MEC/MEEW’s waste management staff, providing daily training and advice, travelling to assess impacted islands and assisting with urgent day-to-day waste management decisions facing the Ministry.

Emergency waste clean-up: A three-phased UNEP project cleaned up hazardous waste posing potential threats to public health. More than 17 tonnes of hazardous waste was collected from 89 impacted islands. Included

were asbestos cement roof sheets (which alone accounted for approximately 12 tonnes or 70 percent of the waste collected); 800 litres of waste oils; 700 kg of batteries containing acid; solvents; pesticides; and clinical waste. Additionally, UNEP equipped and trained 60 Maldivian workers in the identification, handling, storing and labelling of hazardous waste. All the work was conducted under supervision of UNEP and MEEW. The project also resulted in the development of guidance for clean-up teams, work plans for emergency hazardous waste clean-up, preparation of a hazardous waste database and draft technical standards for landfill sites.

Waste management planning: In May 2005, UNEP organised a post-tsunami waste management workshop in Male. During the workshop, UNEP presented the UN’s Post-Asian Tsunami Waste Management Plan. Thirty participants attended the two-day



Ground water sampling, the Maldives.

workshop, including senior officials from government, UN, aid agencies and donors. Government, UN agencies and other participants subsequently used the Plan as a framework for guiding post-tsunami waste clean-up and disposal projects. Following the workshop, the Ministry developed a Maldives Waste Management Plan and established a Tsunami Waste Management Forum, which met regularly to coordinate activities in the waste sector. UNEP also assisted the International Federation of Red Cross and Red Crescent Societies (IFRC) in developing a national waste management project implemented by Canadian Red Cross and Australia Red Cross. Within the UNCT, UNEP secured a commitment by UN agencies to ensure that relief assistance vendors would remove and properly dispose of packaging materials used in the delivery of recovery supplies. In September 2006, UNEP conducted a site investigation of oil spills on two islands to determine the risk to human health and groundwater.

Coastal zone restoration: UNEP supported the rehabilitation of mangrove and other coastal ecosystems in the Maldives, working in partnership with IUCN, Wetlands International and the Ministry's Environmental Research Centre. UNEP worked closely with IUCN's Ecosystems and Livelihoods Group to analyze the economic value of coastal ecosystems. UNEP also supported a project on Huraa Island to restore a protected lagoon-mangrove ecosystem and use the site for environmental education. IUCN, Wetlands International and the MEEW's Environmental Research Centre implemented the Huraa Island project in 2007. The project directly supported the MEEW's Conservation Management Plan for the island's legally protected ecosystems. The local community was deeply engaged in the project and the local women's association played a strong role in managing the mangrove reforestation project.



The leader of Huraa Island's Women's Association with a batch of newly arrived mangrove seedlings, 2007.

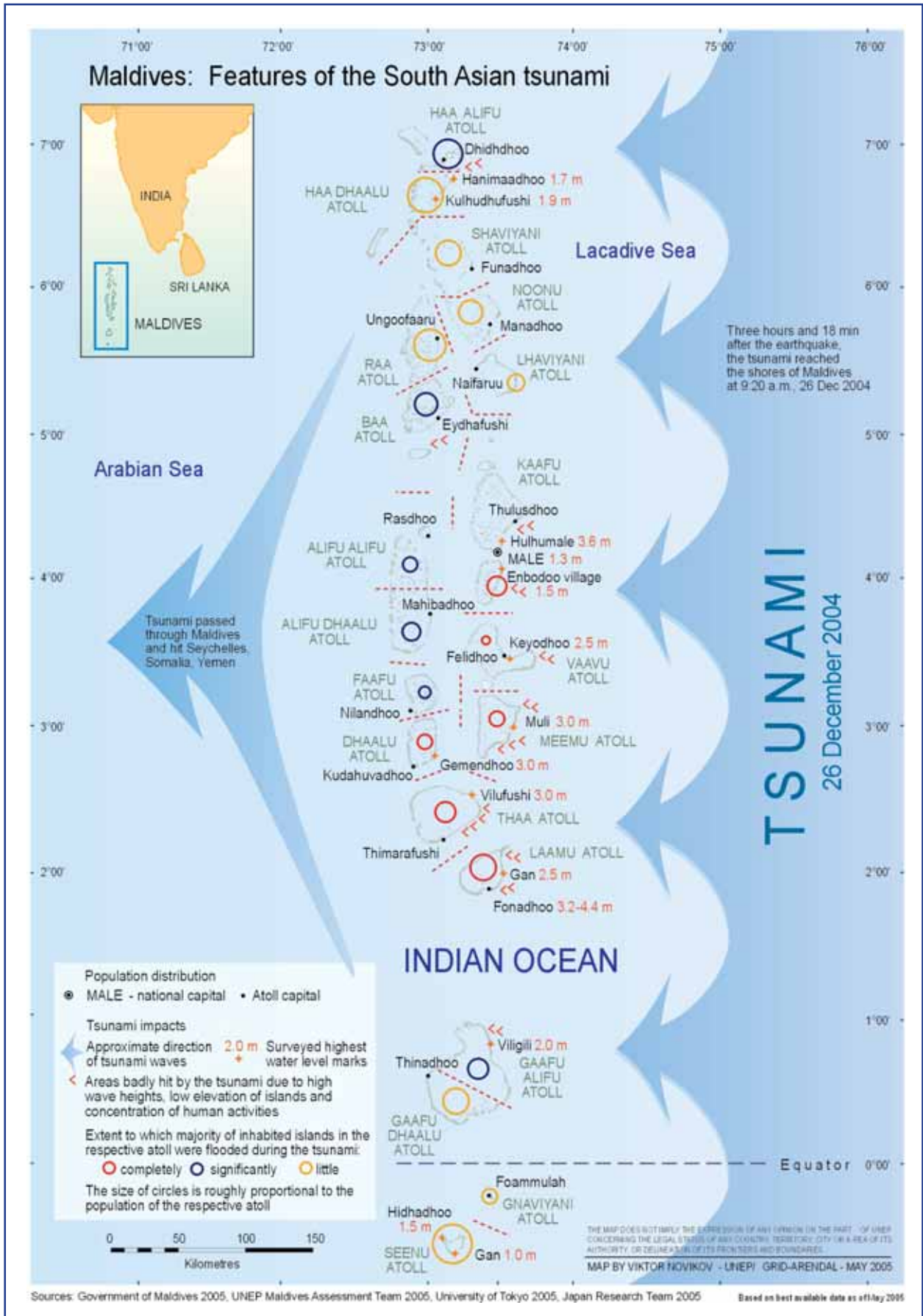
Institutional strengthening of the MEEW: Following creation of the MEEW in July 2005, UNEP, working with MEEW and the Ministry of Planning and Development, developed institutional activities for the MEEW. To assist with coordination, UNEP, in close collaboration with MEEW, established an Informal Environmental Coordination Group that served as an umbrella organisation for tsunami-related environmental activities in the Maldives. In 2006, UNEP conducted a five-day EIA workshop that trained a combination of senior and junior government officers. MEEW officials subsequently enrolled in distance learning courses offered by the UN Institute for Training and Research, including ones providing training in environmental law and policy.

Disaster risk reduction: The Maldives' economy is largely dependent on its environmental assets. At the same time, the country's small, low-lying islands make its environment and people exceptionally vulnerable to climate change and natural hazards. In order to reduce the social,

economic and environmental vulnerability of the country's widely dispersed population, the Government of the Maldives developed a 'Safer Islands' programme aimed at providing incentives for voluntary migration to larger islands. The programme was initiated in 2002 with the objective of reducing the number of inhabited islands and consolidating the population in smaller groups of settlements across an identified number of islands. UNEP assisted the Government by providing environmental expertise and financial support to carry out a Detailed Island Risk Assessment in the Maldives (DIRAM) focused on 13 potentially safe islands. The environmental analyses formed the foundation of subsequent socio-economic analyses that continue to be reviewed by government partners and stakeholders. In May 2007 an unusually powerful series of waves, 3-5 metres high, washed over dozens of inhabited islands in Maldives, bringing a disturbing reminder of this vulnerability. In October 2007, UNEP prepared a detailed environmental assessment of the waves' impacts.



Environmental education material for the Huraa Island mangrove restoration project.



Sustainable construction: UNEP led the development of voluntary *Tsunami Reconstruction Design Principles*, which the Maldives UNCT adopted as part of a ‘building back greener’ approach. The principles advocated the use of sustainable approaches to various aspects of reconstruction design, including planning, coastal engineering, vegetation retention/planning; building design, construction materials, energy efficiency; water provision and management; sewage and wastewater management; and waste. UNEP also promoted the use of a project environmental impact screening tool in reconstruction activities and subsequently introduced the guidance manual, *After the Tsunami – sustainable building guidelines for Southeast Asia*. In addition, UNEP ROAP conducted a ‘green building’ workshop for government officials in 2005.

Thailand

Country context

The tsunami struck Thailand’s Andaman Coast starting at approximately 9.40 a.m. local time. Although a first series of waves passed almost unnoticed four to ten kilometres offshore, a second series up to ten metres high severely impacted six coastal provinces along the Andaman Sea. The level of devastation in the six provinces varied significantly depending on a number of natural parameters and man-made features. The most affected area was the Khao Lak district of Phang Nga province. Phuket and Krabi provinces were also severely impacted. In some of the worst affected coastal areas, the tsunami flood spread up to two to three kilometres inland. Islands in Ranong, Trang and Satun provinces sustained severe damage, but lesser impacts were recorded on the mainland. As of June 2005, the Royal Thai Government estimated that 5,393 had died with 8,457 injured and 2,817 missing.

The tsunami disaster heavily affected the infrastructure of the tourism, fishing and agriculture industries, the main economic sectors of the Andaman Coast. The losses in these three sectors

were estimated at USD 321 million, USD 43 million and USD 0.65 million respectively. Several hundred hotels, resorts, restaurants and tourist boats, and thousands of shops were destroyed. The fishing industry sustained massive losses of vessels, gear, culture ponds, cages, and shrimp hatcheries as well as the use of eight severely damaged harbors. Over 1,500 hectares of agricultural lands were inundated with seawater, making soils



Large mangrove forests in the north and south of Phang Na province (the most severely affected in Thailand) mitigated the impact of the tsunami. They suffered damage on their seaside fringe, but reduced the wave energy, providing protection to the inland population.



A coastal area in Phang Na province, which was not protected by mangrove forests and suffered severe damage.

saline. In total, the livelihoods of an estimated 50,000 people were affected.

The Royal Thai Government immediately organized response operations to address urgent humanitarian needs, including the provision of food, clean water and shelter. An emergency fund was created to help support relief operations, which were carried out by government agencies with the support of the private sector and individual volunteers. A number of Government agencies very quickly initiated rapid assessments of the tsunami's impacts on natural resources in the affected provinces. The Department of Marine and Coastal Resources of the Ministry of Natural Resources and Environment (MONRE) worked together with Thai universities and the private sector to assess impacts on coral reefs, sea grass and mangroves. MONRE's Department of National Parks, Wildlife and Plant Conservation investigated impacts on infrastructure and facilities in

protected areas. The Department of Mineral Resources assessed land subsidence, coastal erosion and surface water quality. The Ministry of Public Health's Department of Health assessed groundwater quality, and the Department of Fisheries of the Ministry of Agriculture and Cooperatives examined impacts on fishing vessels and aquaculture infrastructure.

To help coordinate international support, the Government established a subcommittee on environmental and livelihoods rehabilitation and task forces on coral reef and coastal habitats, geo-hazards and community livelihoods. MONRE was the lead agency on environmental rehabilitation and geo-hazards. The Government did not seek external financial assistance but requested technical expertise, equipment and capacity building, specifically in the areas of environmental rehabilitation and community livelihood recovery. Short-term priorities included the clean-up of

affected coastal ecosystems, in particular coral reefs and beaches.

UNEP's response

On behalf of the Government, the MONRE requested UNEP expertise and support to assess the tsunami's impact on the environment and to prepare response plans and projects, including the development of an early warning system. UNEP assisted the MONRE via its Bangkok-based UNEP office (ROAP), which was supplemented by additional staff in the days and weeks following the tsunami. The following is a summary of UNEP's post-tsunami activities in Thailand, many of which were implemented in cooperation with regional partners such as the Asian Institute for Technology, WWF-Thailand and IUCN:

Institutional strengthening/mainstreaming environment: UNEP provided ongoing technical support to MONRE and worked closely with Government partners to identify assessment and rehabilitation needs and to ensure that environment was factored into the development of recovery and reconstruction activities. UNEP supported a MONRE analysis of the economic costs of tsunami-related damage at four representative sites, a project that supported the integration of environment into reconstruction and rehabilitation planning. UNEP also participated in a series of sub-regional dialogues on rehabilitation and recovery activities that were organized to reassess community priorities and ensure the effectiveness of implementation mechanisms.

Rapid environmental assessments: On 28 December an UNDAC team assessed emergency needs, including imminent threats to public health and welfare. In early January, a joint interagency mission made a broader assessment of shelter and resettlement, employment, environment, migrant workers and indigenous communities and knowledge. UNEP led the environmental sector portion of this assessment. UNEP also supported and provided inputs to a joint UNDP-World Bank-FAO mission that assessed medium

and long-term impacts and possible partnerships in the areas of livelihood recovery and environmental rehabilitation. Based on these preliminary assessments, OCHA's January 2005 Flash Appeal included an inter-agency project proposal aimed at improving environmental restoration, increasing awareness of the role of natural resource management in natural hazard vulnerability, and protecting fishing and tourism resources. UNEP also assisted MONRE and other government agencies in the development of the *Post-Tsunami National Rapid Environmental Damage Assessment*, which became Thailand's input into the February 2005 UNEP publication, *After The Tsunami – Rapid Environmental Assessment (REA)*. This publication contained detailed early findings regarding the tsunami's environmental impacts and created a benchmark for future environmental recovery activities. Key issues highlighted in the REA included significant impacts to coral reefs, marine parks and turtle conservation projects; contaminated surface waters, well waters and coastal aquifers; inundated soils and agricultural land; and extensive quantities of tsunami debris on land and in the marine environment.

Coastal restoration: Thailand hosted two UNEP-supported workshops on implementing the *Cairo Agreement's Guiding Principles for Tsunami Reconstruction* in coastal zones. UNEP also provided expertise for local projects to clean up coral reefs and helped to develop digital maps to show the status of mangrove forests. The digital maps were useful in planning the rehabilitation of damaged mangroves and creating mangrove plantations. UNEP ROAP staff has worked closely with UNDP and IUCN in the Mangroves for the Future initiative to encourage the use of best practices and lessons learned through UNEP's experiences with mangrove planting in Indonesia, Sri Lanka and Maldives.

Marine database: UNEP supported Thailand's development of a unified GIS-based database at the National Coastal and Marine Information Centre. The database included information about key components of marine and coastal resources

in six of the country's tsunami-affected provinces. UNEP also supported the implementation of a pilot project in Had Thuai Muang Marine National Park to engage local communities and the private sector in restoring and managing the park's natural resources.

Seychelles, Somalia & Yemen

SEYCHELLES

Country context

The tsunami struck the islands of the Republic of Seychelles on 26 December 2004 after having travelled approximately 5,000 km from the earthquake zone's epicentre off the coast of Sumatra. The waves that reached the Seychelles' lacked the destructive energy of those that had struck in the eastern Indian Ocean but were nonetheless from 2.5 m to 4 m high. Powerful surges flooded low-lying areas of Mahé, Praslin and La

Digue, causing widespread damage to houses, roads, bridges, beaches and coastal vegetation. The flooding lasted about six hours, claimed two lives, and destroyed the property and livelihoods of hundreds of families. Exceptionally heavy rainfall on 29 December caused flooding and landslides that compounded the tsunami's effects.

The Seychelles' rich marine and terrestrial ecosystems support the island's main economic activities, tourism and fishing. There was concern that in addition to its direct impacts on human communities, the tsunami may have caused damage to the islands' environmental values, thereby indirectly affecting livelihoods.

In January 2005, the Government of Seychelles estimated that the cost of repairing the damage caused by tsunami was USD 30 million. The Department of Environment of the Seychelles Ministry of Environment and Natural Resources made a preliminary estimate of damage to the



An eroded turtle nesting beach, Anse Kerlan, Seychelles. © Mark Collins/UNEP



Victoria suffered the most extensive damage in the Seychelles, particularly to infrastructure such as bridges, roads, port facilities and sewage systems.

environment, including damage to shorelines, vegetation and ‘environmental infrastructure’ such as municipal parks. The Department concluded that an estimated USD 1.3 million would be needed for environmental recovery.

UNEP’s response

On 21 January 2005, following discussions at the Mauritius meeting of Small Island Developing States (SIDS), UNEP’s Executive Director, Klaus Töpfer received a request from President James Michel for technical and financial assistance to enable a rapid assessment of the tsunami’s environmental impacts. In response, UNEP organized a fact-finding mission to the Seychelles consisting of experts from UNEP, IUCN and the Netherlands Ministry of Water and Transport. The UNEP mission coordinated with a parallel UNDP mission focused on post-tsunami humanitarian and infrastructure needs. UNEP’s assessment also took into account Government findings on impacts on marine protected area ecosystems, coral reefs and sea-grass beds.

The UNEP team examined the tsunami’s environmental impacts, and the need for reconstruction and capacity building, focusing in particular on such topics as the long-term effects of the tsunami on the productivity of marine ecosystems, the rehabilitation of services for the Marine Parks Authority, the stability of the coastline as a result of the wave surges, institutional capacity to protect the environment and disaster preparedness, including early-warning systems. The mission team conducted site visits and met key stakeholders involved in management of the islands’ environment and natural resources.

The team concluded that the principal environmental impacts had largely been confined to the granitic inner islands, which include the country’s main population centres on Mahé, Praslin and La Digue. The outer islands apparently escaped more severe harm due to the physical shelter provided by the Seychelles reef bank. The main impacts identified were severe damage to beaches, granitic island coral reefs, coastal vegetation and, to a lesser extent, seagrasses and some marine and coastal

BUILDING BACK BETTER COUNTRY BY COUNTRY



The Seychelles – Shoreline vulnerability and tsunami impacts.

ecosystems. Additional impacts were found to have occurred from debris and sewage discharges. The report drew attention to the importance of building environmental and early warning capacities, and to the value of mangrove ecosystems and coastal vegetation as a means of strengthening coastal zone resilience to natural disasters.

The Government's estimated cost of USD 1.3 million for environmental rehabilitation was found to understate the full cost of stabilizing and protecting coastal ecosystems. Taking into account anticipated damage from future rises in sea levels and surface temperatures, intensified rainfall, drought and storm waves, UNEP estimated that a short to medium-term programme might cost approximately USD 3.9 million. The team estimated that a long-term programme providing for monitoring, early-warning systems, erosion control, ecosystem and biodiversity conservation, legal work and capacity building could cost USD 26–52 million.

SOMALIA

Country context

In Somalia, most of the damage caused by the tsunami occurred in the country's northeastern region, along a 650 km coastline stretching from the Bari region to the Mudug region. The tsunami took an estimated 150 lives, displaced 5,000 and affected 44,000 others. Houses, water sources, infrastructure and the livelihoods of tens of thousands of Somalis residing in coastal towns and villages were destroyed, particularly in the northern regions. Wells were submerged and contaminated by seawater and debris and food items were washed away. It is estimated that in total, approximately 18,000 households were directly affected and in need of urgent humanitarian assistance. The tsunami came at a time when many parts of the country's already vulnerable population were beginning to recover from four consecutive years of drought,



Aerial view of the aftermath of the tsunami, Harun, Somalia. © AFP/Getty Images

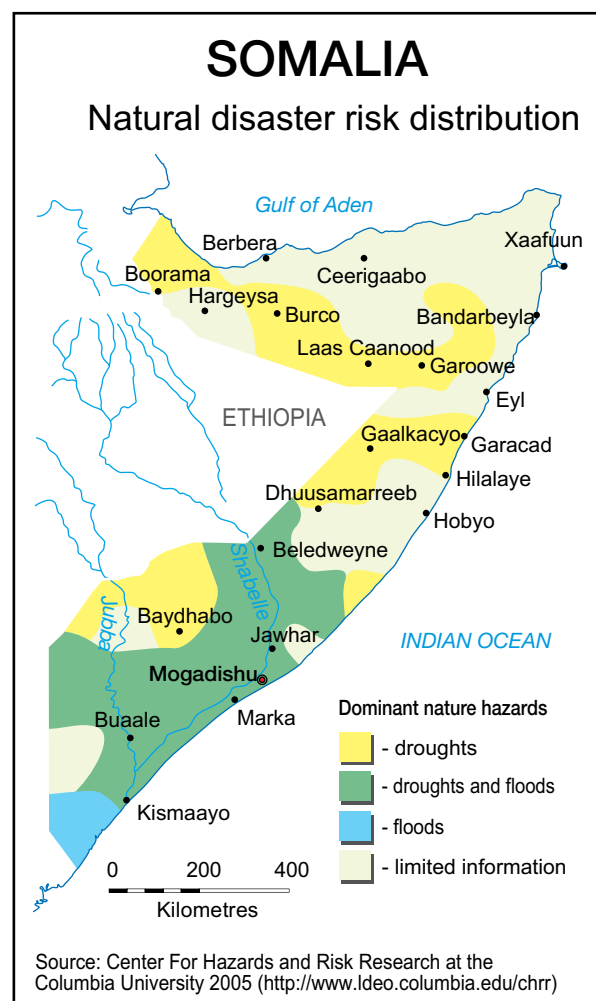
periodic flooding and chronic insecurity. UN agencies and relevant organizations immediately responded by providing those affected with emergency humanitarian assistance, including food, drinking water, shelter, medicine and emergency relief kits.

UNEP's response

On 17 January 2005, UNEP received an urgent request for assistance from the Ministry of Fisheries, Ports and Marine Transport of the regional Government of Puntland. The Ministry requested that UNEP assess environmental damage to Puntland including habitat destruction, pollution and soil erosion in the affected coastal areas, as well as on Hafun Island. The Ministry also sought UNEP's assistance in ensuring that environmental considerations are integrated within the recovery and reconstruction process.

In response to the request for assistance from Puntland, UNEP held discussions with the Minister of Environment and Disaster Management of the Transitional Federal Government of Somalia (Somalia TFG). During the discussions, it was agreed that UNEP should send a fact-finding mission to investigate tsunami impacts that might have been posing a threat to public health and livelihoods. The mission that UNEP planned was ultimately cancelled for security reasons, and a preliminary desk study of Somalia's tsunami-affected areas was undertaken instead.

The preliminary desk study highlighted coastal environmental damage caused by the tsunami, including contamination of surface and ground-water supplies and disturbance of hazardous waste stores; that a more thorough assessment of the country's environmental conditions was needed; and that the country lacked the capacity to cope with future climate-related environmental threats (e.g. droughts and floods) that could be anticipated. The results of the preliminary desk study were incorporated into UNEP's February 2005 publication, entitled *After the Tsunami – Rapid Environmental Assessment*.



Following the release of these findings, the Somalia TFG requested UNEP to send a fact-finding mission to Somalia to investigate the alleged existence of tsunami-impacted hazardous waste and, in addition, to conduct a more detailed desk study of the state of Somalia's environment. In May 2005, a UN inter-agency technical fact-finding mission led by the UNDP Humanitarian/Resident Coordinator and comprising experts from UNEP, FAO and WHO visited key coastal locations in Hafun, Bandarbeyla and Eyl. The mission's objective was to establish whether there were risks to human health and the environment from any combination of hazardous waste and the tsunami. Neither the inter-agency mission nor subsequent efforts by a variety of other UN agencies, including a detailed analysis by the Joint UNEP/OCHA Environment Unit, was able to

confirm the presence of hazardous waste at any location in Somalia.

Despite the small supply of available information, UNEP's report, entitled *The State of the Environment – A Desk Study*, found that Somalia was experiencing significant environmental problems, including deforestation, overfishing, overgrazing and soil erosion. At the same time, UNEP found Somalia to be lacking the stability and political, human and financial resources needed to address these issues at even the most basic level. These problems were further compounded by cycles of drought and flooding, and resulting food shortages and starvation. UNEP recommended a number of specific interventions, strengthened environmental governance, regional and international environmental cooperation, and more detailed environmental assessment work so that priorities could be set for environmental recovery, resource management and development planning.

YEMEN

Country context

The tsunami wave and subsequent sea surges first arrived on the coast of Yemen at 11.40 a.m. on 26 December. The waves damaged Yemen's mainland and islands facing the Indian Ocean, penetrating inland as much as 400 m. Relative to the countries of Southeast Asia, damage in Yemen was much less severe, mainly because of the country's great distance from the earthquake's epicentre and the protection it receives from the Indian Peninsula and Horn of Africa. The two locations most affected were Socotra Island, south of Yemen's mainland, and the coastline of Al Maharah Governorate. Both areas are relatively remote and not heavily populated.

Most of Yemen's coastal population, particularly in Socotra, relies on a subsistence economy.



The island of Hafun was the worst hit area in Somalia. © Francesco Broli/World Food Programme/Reuters

Socotra's inhabitants are, therefore, particularly vulnerable to environmental change, decreasing productivity of the coastal ecosystem, extreme weather events and natural catastrophes such as storms, heavy rains, and tsunamis.

The tsunami's impact on local livelihoods, especially fishing, was significant. The fishery sector plays a key role in the Yemeni economy, providing food security and employment to more than 53,000 fishers and workers in related sectors. An August 2005 joint fact-finding mission by FAO and the Government of Yemen determined that 2,000 fishing families had been affected by the tsunami, with losses in the sector totaling an estimated USD 2.2 million. High waves damaged boats, engines and fishing gear, as well as infrastructure vital to the fishing sector, such as ice plants, storage sheds and jetties. In all, some 653 boats, 569 engines 1,625 nets and 16,980 fishing traps were either damaged or completely destroyed. The damage halted fishing, which in turn had an economic impact on buyers, sellers, processors and others working in fisheries-related activities.

UNEP's response

In the weeks following the disaster, Yemen's Ministry of Water and Environment requested UNEP's technical and financial assistance. The Ministry was particularly interested in assessing the tsunami's impacts on the marine environment, strengthening the capacity of its Environmental Emergency Unit, and ensuring Yemen's inclusion in any regional or global early warning system to address natural hazards. In response to this request, UNEP organized a fact-finding mission to Yemen between 5 -11 February 2005. The findings of this mission resulted in Yemen's contribution to the February 2005 UNEP regional assessment, *After the Tsunami – Rapid Environmental Assessment*.

The UNEP mission made a number of preliminary findings. Although a sub-marine investigation of marine resources was not possible, visits to the



A man stands among the rubble of Dabut market, Yemen. © Al Mahra Rural Development Project

coastal area affected by the tsunami showed what appeared to be beach erosion and possibly altered beach profiles. A number of wells on the coast had high salinity levels and could not be used, and inland groundwater reservoirs may have been affected as well, with further implications for well water supplies. Tsunami debris was strewn along the coastline, especially within the fishing centres, which also lacked proper sanitation systems. The country also did not have an integrated environmental information system that could provide timely integrated data in case of an environmental emergency. The study recommended a number of actions, including an assessment of the tsunami-affected marine ecosystems; a baseline survey of environmental resources along the Yemeni coastline; an assessment of the country's early warning capacity, assistance to help Yemen establish a national early warning system and integrate into any regional early warning system that might be developed, the development of various disaster risk management measures and strengthening of the Ministry's Environmental Emergency Unit.

Lessons learnt and conclusions

*Crab fishing among restored mangrove forests,
Banda Aceh, Indonesia.*



The Indian Ocean tsunami thrust UNEP into a level of engagement in field and project work that was, in several ways, new to the organization. The organization stretched itself, as many other organizations did, to rise to the humanitarian challenge presented by the largest natural disaster in memory. It did so by simultaneously addressing, to the best of its ability, the urgent needs of seven developing countries spanning over 5,000 miles, each with its own unique history, culture, political dynamics, environmental challenges and capacities. In so doing, UNEP took risks. It accomplished much, and, at the same time, learned important lessons as an organization.

These lessons have strengthened UNEP and better prepared it for the many disaster-related challenges that surely lie ahead. The following are some of UNEP's key observations from its experience after the Indian Ocean tsunami:

- Integrating environmental concerns into relief and recovery planning, and avoiding the creation of new or additional risks, is best served by participating in UN/IFI needs assessment processes, assessing environmental impacts and appropriate mitigation options, and engaging strategically with national counterparts at the earliest possible juncture following a disaster.
- Early post-disaster environmental assessments and the engagement of environmental expertise at the field level, as well as in the UN coordination mechanisms, helps to identify environmental risks during the recovery process and to catalyse appropriate mitigation measures.
- Experience shows that the most effective and efficient results can be achieved by establishing a sustained field presence, working closely with the UNCT under the leadership of the Resident Coordinator, building close working relationships with national counterparts and providing ongoing strategic, institutional and technical support.
- UNEP field operations require clear and transparent strategic objectives, policy platforms and coordination mechanisms within UNEP and between UNEP and its UN counterpart agencies. Successful operations require administrative arrangements that support field-level actions, including quick decision-making, deployment, contracting and procurement.
- Relationships with national authorities are most effective when commitments and expectations are clearly communicated in advance and then met. This implies early development of country plans as well as exit strategies. Particular attention should be paid to the transition from response to recovery phases and determining UNEP's role within this continuum.
- While each disaster presents site-specific challenges, the tsunami experiences show that common themes emerge, suggesting the possibility that response options could be anticipated on a strategic level.
- The goal of "building back better" encourages the use of environmentally safe technologies and management practices that contribute to sustainable recovery and development.
- Natural ecosystems and the use of 'soft engineering' solutions can play a significant role in reducing disaster vulnerability. More science is needed in order to increase understanding of coastal and critical ecosystem resilience and restoration. More capacity and awareness building is needed to inform planning decisions and to promote proper management of natural resources and critical ecosystems.
- National, regional and community engagement in project planning and implementation increases acceptance, buy-in and long-term sustainability.



Mussel collection, Pulot village lagoon, Banda Aceh.

- Environmental authorities and disaster managers can strengthen disaster management and reduce the environmental risks resulting from disasters and post-disaster relief and recovery operations by actively engaging in preparedness and prevention activities at the national, regional and local levels.

UNEP's many years of responding to environmental disasters has provided the organization with critical experience in disaster prevention, preparedness, assessment and recovery. As the world has increasingly realized that climate change and

natural disasters are very likely to play a far more prominent role in our lives, UNEP has adapted its priorities and institutional capabilities. UNEP is ready to elevate post-conflict and disaster management operations to be one of six thematic priorities for the organization. This growth not only reflects recognition of the world's burgeoning environmental challenges, but indicates UNEP's readiness to assume leadership in addressing the environmental aspects of disaster risk reduction, management and recovery so that communities can live in greater safety and more sustainably.

Appendices

Appendix I

Acknowledgements

Indonesia

Ministry of Environment
Agency for the Rehabilitation and Reconstruction of Aceh and Nias (BRR)
Provincial Environment Agency (Bapedalda NAD)
National Disaster Management Coordinating Board
National Development Planning Agency (BAPPENAS)
Bandung Institute of Technology
Australian Agency for International Development
Fauna and Flora International
Green Coast
Leuser International Foundation
Swiss Red Cross
Wetlands International – Indonesia Programme
World Conservation Union (IUCN)

Sri Lanka

Ministry of Environment and Natural Resources
Ministry of Fisheries and Oceanic Resources
Ministry of Defense
Ministry of Provincial Councils and Local Governments
Central Environment Authority
Department of Wildlife Conservation
Forestry Department
IUCN-Sri Lanka
Marine Pollution Prevention Authority
National Aquatic Resources Research and Development Agency
Urban Development Authority
University of Jayawardenapura
University of Moratuwa
Coral Reef Degradation in the Indian Ocean (CORDIO)
International Coral Reef Action Network
International Committee of the Red Cross
International Coral Reef Initiative
International Water Management Institute
Japan Bank for International Cooperation
Japan International Cooperation Agency
Netherlands Commission for Environmental Impact Assessment
South Asia Co-operative Environment Programme
Swedish International Development Agency
United Kingdom Department for International Development
United States Agency for International Development

Maldives

Ministry of Energy, Environment & Water
 Maldives Customs Authority
 Maldives Housing and Urban Development Board
 Maldives Water and Sanitation Authority
 Ministry of Atolls Development
 Ministry of Communication, Science and Technology
 Ministry of Defense and National Security
 Ministry of Finance and Treasury
 Ministry of Fisheries, Agriculture and Marine Resources
 Ministry of Health
 Ministry of Labour
 Ministry of Planning and National Development
 Ministry of Tourism
 Environment Research Centre
 National Disaster Management Centre
 Marine Research Centre
 Huraa Island Women's Association
 Australian Agency for International Development
 United States Geological Survey
 Wetlands International
 World Conservation Union (IUCN)

Thailand

Ministry of Natural Resources and Environment
 Asian Institute for Technology
 World Conservation Union (IUCN)
 WWF-Thailand

Seychelles, Somalia & Yemen

World Conservation Union (IUCN)
 Ministry of Environment and Natural Resources (Seychelles)
 Netherlands Ministry of Water and Transport (Seychelles)
 Seychelles Centre for Marine Research and Technology (Seychelles)
 Marine Parks Authority (Seychelles)
 Nature Seychelles (Seychelles)
 Ministry of Environment and Financial Management (Transitional Federal Government, Somalia)
 Ministry of Water and Environment (Yemen)

International Organizations

Asian Development Bank
International Federation of Red Cross and Red Crescent Societies
International Labour Organization
International Maritime Organization
Joint UNEP/OCHA Environment Unit
United Nations Children's Fund
United Nations Development Group
United Nations Development Programme
United Nations Disaster Assessment and Coordination
United Nations Educational Scientific and Cultural Organization
United Nations Food and Agriculture Organization
United Nations Framework Convention on Climate Change
United Nations High Commission for Refugees
United Nations Human Settlements Programme
United Nations Inter-Agency Standing Committee, Cluster Working Group on Early Recovery
United Nations International Strategy for Disaster Reduction
United Nations Office for the Coordination of Humanitarian Affairs
United Nations Office for Project Services
United Nations Population Fund
United Nations World Food Programme
United Nations Volunteers
World Bank
World Health Organization

Appendix II

Financial information

Table 1. UNEP received funding for its post-tsunami response and recovery activities from seven main sources, totalling US\$ 7,982,539. UNEP contributed core funding of US\$ 1,385,923.

Donor/source	Funds contributed (USD)
Finland	1,679,383
Norway	1,487,751
United Kingdom	721,000
Sweden	784,054
Spain	1,685,371
UN-ISDR	286,200
OCHA	1,338,780
UNEP	1,385,922
Total	9,368,461

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Further information

Further technical information may be obtained from the UNEP Post-Conflict and Disaster Management Branch website at: <http://postconflict.unep.ch> or by email: postconflict@unep.ch

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The South Asian Tsunami of December 2004 took a catastrophic human toll, with approximately 230,000 deaths, tens of thousands injuries, the displacement of 1,500,000 people and the destruction of entire communities. Apart from constituting a humanitarian disaster, the tsunami also had far-reaching impacts on the region's environment, with consequences for human health and livelihoods.

This report is a summary of UNEP's response to the event, tracing the organization's work from the immediate aftermath – through the Asian Tsunami Disaster Task Force – to its recovery phase activities under the Environmental Recovery Programme.

UNEP received funding of approximately US\$ 9.3 million through the donor Governments of Finland, Norway, Spain, Sweden and the United Kingdom, as well as through the OCHA Flash Appeal and International Strategy for Disaster Reduction. This report describes UNEP's resultant work in Indonesia, Sri Lanka, the Maldives, Thailand, the Seychelles, Somalia and Yemen between 2004 and 2007, together with lessons learnt for environmental recovery and disaster risk reduction.