Integrating environmental safeguards into Disaster Management: a field manual

Volume 3: Tools, techniques and relevant resources

Compiled by Sriyanie Miththapala

Ecosystems and Livelihoods Group, Asia, IUCN

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Foreword

The devastation caused by the 2004 Asian tsunami and the subsequent world response were unprecedented. IUCN acted promptly and undertook many initiatives to combat the destruction of local ecosystems. IUCN Asia led this process and many of its country offices and programmes played their due role. Since then, the Ecosystems and Livelihoods Group of IUCN Asia, based in Colombo, has continued to play an important role in the post-tsunami scenario. The interventions have now evolved from emergency response and rapid environmental assessments to disaster risk reduction programming. Disaster risk reduction for most organisations is a relatively new area, though mainstream aid and humanitarian organisations are adept at disaster response. While most of us are working at different levels of the DRR spectrum, the objective remains a common one: ensuring human well being.

IUCN Asia is working in the DRR sector with a two-pronged approach: to infuse environmental safeguards into the mainstream disaster risk reduction programme; and to integrate disaster risk reduction into conservation and sustainable development programming.

Over the years, varied methodologies, frameworks and approaches have been used towards this end. We have had many successes and also failures in this process and keep learning and modifying our strategies. Here, the key is to continue sharing our lessons learned and helping each other in incorporating these in our respective strategies.

We are happy to share that in the course of the above process, IUCN has developed a manual, 'Incorporating environmental safeguards into disaster risk management' through the financial support of OAPN, Ministry of Environment, Spain. This manual comprises three-volumes detailing ecosystem linkage with human well-being; presenting approaches to integrate environmental considerations into mainstream disaster management programmes; and providing tools, including worksheets, for planning and implementation of environmentally-infused disaster risk management initiatives.

In addition, we are exploring the possibilities of developing hazard-specific modules to help incorporate environmental safeguards into community-based disaster management initiatives aiming at enhancing community resilience for disaster management.

We are grateful to Dr. Sriyanie Miththapala whose dedicated research, commitment and determined efforts made it possible to produce this three-volume manual.

The manual is a working document, your comments and feedback will be received gratefully. We intend to keep working to make this as relevant, practical and user-friendly as possible. We do hope that this manual will contribute positively towards achieving the main objective of all the organisations and agencies involved in this sector which is sustainable human well being.

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Executive summary

The first two volumes of this field manual focused on providing background reference material and detailing steps that should be taken during the disaster management cycle in order to integrate environmental safeguards into disaster management. In the second volume, the importance of carrying out integrated assessments was described.

In this volume, a worksheet is presented in a way that it can be copied and used in the field. Initially, a list of needs for carrying out integrated assessments is itemised. Technical documents that describe assessment techniques for each of the sections of integrated assessments - *viz* biodiversity and ecosystem services, environmental impact assessments, livelihoods and economic valuation - follow as resource material.

Simple methods for analysing data obtained from integrated assessments are presented.

Also presented in this volume is the methodology for Rapid Environmental Impact Assessments and a summary about Strategic Environmental Assessments. Another tool for use - the CRISTAL tool for community-based risk assessment - is also described briefly.

Reproduced in this volume is a series of best practice guidelines prepared after the Indian Ocean tsunami by the International Union for the Conservation of Nature (IUCN, Sri Lanka Office) to make post tsunami restoration work environmentally sound and sustainable. The guidelines present the issues, impacts, the needs, guiding principles and key steps to follow for a series of 14 topics: 1) Where to build; 2) Invasive alien species; 3) Materials for reconstruction; 4) Beach clean ups; 5) Solid waste management; 6) Recovery of marine ecosystems; 7) Restoring tourism; 8) Preparing for natural disasters; 9) Environmental laws; 10) Restoring terrestrial ecosystems; 11) Water pollution; 12) Restoring wetlands; 13) Restoring home gardens and 14) Safeguarding marine protected areas. These guidelines can be adapted easily to fit a specific situation at a specific locale.

Briefs about the Cairo Principles, the Hyogo Framework of Action and Sphere Humanitarian Charter and Minimum Standards in Disaster Response are also presented. Background information on the Emergency Personnel Network (EPN) and the Disaster Environment Working Group for Asia (DEWGA) is also given. The UNHCR handbook for emergencies is also summarised. Finally, guidelines for gender sensitive disaster management are also reproduced as reference material.

Volume 1 of this manual presented background reference material about terminology related to disaster management as well as information about hazards and ecosystems. Volume 2 examined the disaster management cycle, described integrated assessments and used the Millennium Ecosystem Assessment as a framework to present steps that must be followed at each stage of the disaster management cycle.

Recognising that field practitioners – such as protected area and coastal managers – may not always have ready access to the Internet for reference, Volume 3 of this manual presents summarised resource material that is useful for such practitioners.

This material covers a range of subjects - from technical papers on biodiversity and economic valuation, to the description of tools such as Rapid Environmental Impact Assessments (REA) and CRISTAL (for community-based risk assessment) - as well as international principles and frameworks, such as the Cairo Principles and the Hyogo Framework of Action, as well as various guidelines.

Therefore, it is hoped, that, for example, protected area managers who may already know about REAs have easy access to a summary of the UNHCR guidelines for emergencies; or, in contrast, field officers engaged in humanitarian work will have, at hand, information about REAs and biodiversity techniques.

It is hoped that the breadth of these topics in Volume 3 will reiterate the importance of a holistic approach to disaster management.

Needs for integrated assessments

Prior to carrying out any assessment, it is necessary that some ground work is laid to ensure good rapport with communities in the area.

Step 1: Obtain relevant permission.

If you are working in a protected area or an ecologically sensitive area, obtain permission from relevant government conservation authorities (i.e., Department of Wildlife Conservation, Forest Department, Coast Conservation Department, etc.). It would be best to submit a proposal of work, indicating objectives of the survey and presenting a work plan, prior to any discussion.

Step 2: Introduce yourself.

Introduce yourself to local administrators (i.e., village administrators, police, etc.), and submit a copy of the letter of approval obtained in Step 1.

Step 3: Familiarise yourself with local communities.

This is important to gain the trust of communities.

- Introduce the assessment team.
- Introduce the assessment and assessment objectives.
- Try to find a suitable local person who is familiar with the survey area, who can assist in field work. This is important as it will allow you to be aware of dangerous locations (for example, conflict and mined areas, areas where trap guns are set for animals).

Step 4: Do not offend communities nor affect the habitats of flora and/or the habitats and behaviour of fauna.

- Ensure that the survey does not disrupt community activities nor offend individuals.
- Ensure privacy when collecting data.
- Ensure that the survey does not contribute to the decline of species, through unnecessary collection of specimens in the field. When surveying animals, identification of species is possible through the use of field guides or good digital photographs that can be used later for identification. When live-trapping methods are used, ensure that traps are visited frequently, so that animals can be identified and released before they become hypo/ hyperthermic or exhausted.

Step 5: Draw a map of the area.

- Use community knowledge to draw a map of the area;
- Add GPS coordinates to the above map;
- Verify the map against published maps.

Step 6: Carry out semi-structured interviews[1] to obtain required biodiversity and ecosystem service information such as:

- Local habitat/ecosystem classifications and their significance based on local knowledge (use local names);
- Dependence of local communities on their surrounding landcapes/ resource use, livelihoods in the area;
- Resource use;
- Services (water purification, waste recycling, etc.) of local ecosystems;
- Direct drivers of biodiversity loss (pollution, invasive alien species, habitat loss and degradation etc.);
- Indirect drivers of biodiversity loss (population, urbanisation, etc.);
- Constraints, issues, pressures related to resource use (for example, legislation, permits, etc.);
- Land ownership/tenure;
- Indigenous knowledge and practices;
- Human wildlife conflicts/pest and disease outbreaks and trends;

Use the worksheet in the following section for all of the above.

Step 7: For at least ten households per village, carry out a questionnaire survey[2] to obtain required economic and livelihood information such as:

- Household size and composition;
- Length of residence in respective village, and place of origin;
- Education level of family members;
- Demography;
- Equipment owned by households (tools, transport, boats, gear, etc.)
- Monthly cash income and seasonal variation;
- Livestock ownership;
- Land area (total, farmed and own/leased);
- Major livelihoods (for example, farming, fisheries, livestock, business, government/ private sector employment);
- Annual production, cost of extraction/and processing, proportion sold and used for subsistence and trends;

Necessary human resources

Experts
- A biodiversity expert with taxonomic and identification knowledge of major faunal and flora groups;
- An environmental economist; and
- A livelihoods expert.

Community
It should be ensured that community participation involves a mixed group of people and should include
- All ethnic groups;
- All religions;
- Women;
- Different age groups;
- Representatives from all sectors (for example, fishermen/carpenters/ farmers/livestock keepers/ NTFP collectors/hunters, etc.)
- Tribal communities/ marginalised groups;
- Representatives from all clubs and societies, etc.;
- Local community members who are knowledgeable about their surrounds;
- Elderly people who know about the history and natural history of the village/ community and how it has changed over time;
- Village religious leaders (who should at least be informed about the activity);
- Village level government officers (who should at least be informed about the activity).

[1] A semi-structured interview is an interview with an individual or individuals that follows a pre-defined set of question parameters, but still allows for a degree of freedom in exploring a range of issues.

[2] A questionnaire survey is a survey where a questionnnaire is filled in.

- Form of product/s marketed (raw material/secondary products/value added or not);
- Marketing mechanism;
- Relative importance different ecosystems for different livelihoods (livelihood value); and
- Monitory value of direct uses (food, fuel wood, timber, etc.) and value of indirect uses (cost of water purification, cost of waste recycling, etc.).
  Use the worksheet in the following section for the above.

Necessary equipment

For community-based biodiversity assessments
- Field note book/pen or pencil;
- Map/aerial image of the village if available;
- Compass;
- Transect cord (cut and wrapped to the length of the desired transect);
- Binoculars;
- Hand held GPS;
- Field identification guides for major taxonomic groups;
- Butterfly net for capture and release of species that can not be identified in flight;
- Fish net for capture and release of fish;
- Large clear plastic bottles with wide mouths for capturing fauna to take digital photographs for later identification;
- Digital camera with macro lens; and
- Prepared assessment sheets.

For socioeconomic/ livelihoods assessment
- Bristol boards/flipcharts;
- Beads/pebbles;
- Coloured felt pens; and
- Prepared questionnaire sheets.

Step 7: Find out other relevant information such as:

- Other development organisations and NGOs working in village and their aims and objectives;
- Businesses operating in the village.

Step 8: Carry out a transect walk.

- Using the village map, and in consultation with community participants, define a transect covering all habitat types such as primary forests, fallow land, crop land, slash and burn cultivation, sacred/spirit forests, rivers etc.
- Try to cross the highest possible number of boundaries between such types.
- In order to ensure that you do not return along the same route, define a circular transect.
- The team should walk through the transect, ensuring that measures are taken to make the transect walk safe (for example, from trap guns, land mines, animal attacks etc.).
- Record geo-reference points where necessary (at least at 100m intervals), record habitat/ecosystem/ landscape type (stream, marsh, grassland, forest, pasture etc.) and take photographs referring the recorded geo-reference.
- Record the following while walking: (This is called opportunistic observation.)
  - Plant species (local name/uses/abundance/life form/habitat etc.);
    Animals (local name of the animal, sighted/heard/signs/faeces/foot prints/ nests/feathers etc.);
  - Invasive alien species (local name/impact/uses etc.);
  - Pollution (point sources/grey water/noises/smells etc.);
  - Degraded lands, harmful practices to environment etc. This should include oil and chemical storage tanks (both above ground and underground), garbage and sewage disposal/treatment facilities/ underground sewers, areas with unexploded ordinances - i.e., former military training areas and storage facilities.
  - Any other issues/opportunities as listed in the worksheet;
  - Any NTFP collected (part (seed/bark/leaves) season/amount/purpose/ history of use and extraction etc.);
  - Communal resources (water/mineral resources/grazing lands etc.);
  - Wildlife related damages (animal/type of damage and gross estimate of damage).
- When it is not possible to identify species, take reference digital photographs with an included scale, for subsequent identification.

Step 9: Carry out focal group discussions.

- Meet representatives of each sector to elicit relevant information (for example, of fish species caught and relative abundance, crops etc.).
- Ask about specific use of habitats, landscapes.
- Ask about specific threats to each of their sectors.

(Adapted from Bambaradeniya, unpublished report).

Worksheet for integrated assessments

Worksheet for integrated assessments

This can be adapted to suit any habitat. What is shown below is for a wetland.

Name and location:		
Date:	Coordinates:	
Type of ecosystem (habitat)		Description
For example, Lagoon/Estuary/Mangrove/Saltmarsh/Tank/Pond		
Approximate area:		
Management and jurisdiction		
Responsible government institution:		
Is it a protected area?	Yes	No
BIODIVERSITY ASSESSMENT		
Species Diversity (Fauna)		Number
Birds	Number of species	
	Abundance	
	Breeding colonies	Yes/No
Other vertebrate fauna (Define group)	Number of species	
	Abundance	
Fish (Subsistence catch)	Number of species	
	Abundance	
Fish (Commercial catch)	Number of species	
	Abundance	
Macro-invertebrates (crabs, shrimps, molluscs, butterflies, dragonflies)	Number of species	
	Abundance	
Species Diversity (Flora)		Number
Emerging flora or weeds/herbs	Number of species	
	Abundance	
Submerged flora or seedlings/saplings	Number of species	
	Abundance	
Floating flora or Trees/Shrubs	Number of species	
	Abundance	
ECOSYSTEM SERVICE ASSESSMENT		
Service type	Indicator	Details (qualitative/quantitative data)
Provisioning services		
Food	Fruits, vegetables, fish	Types and numbers
Fuelwood		Quantity extracted
Medicines		Types, quantity extracted
Drinking water		Quantity extracted
Other		
Supporting services		
Biodiversity	Species richness from section above	
Nutrient cycling		
Primary production	Green foliage	Quantity of vegetation
Regulating services		
Protection from hazards	Vegetation stands	Extent
Flood control	Wetlands/catchment forests	Extent
Carbon sequestration	Canopy cover	Extent
Pollution control	Tree cover	Extent

Service type	Indicator	Details (qualitative/ quantitative data)
Cultural services		
Recreation/aesthetic value	Extent of tourism	Tourist facilities/number of tourists
Education	Educational facilities	Number/number of students
Traditional knowledge	Traditional practices	Type/number engaged in practice
Other		
ECONOMIC ASSESSMENT		
Type of value	Indicator	Valuation method and data requirements
Direct use value	Economic value of provisioning services harvested (e.g. food, NTFPs, freshwater, wood and fibre, fodder, fuel and medicines)	For products which are traded. *Market Price Method*: Local price X quantity of products harvested over a given time period. For products which are not traded, but consumed within the household or exchanged without cash payments. If the product is traded locally, even if it is not traded by the user himself: *Market price method*: Local price X quantity of products harvested over a given time period. If the product is not traded, but has a close substitute (e.g. kerosene for firewood, purchased foods for wild foods, roofing tiles for thatch): *Substitute Price/Replacement Cost Method:* Equivalent quantity of substitute used over a given time period X local market price of substitute. If the product is not traded, and has no close substitutes which are traded: it may not be possible to get an economic value.
Indirect use value	Economic value of regulating, supporting and cultural services is utilised.	First of all it is necessary to determine what quantity or magnitude of service the ecosystem provides (see ecosystem service assessment findings). *Note: it is always better to use several methods to calculate the value, and present a range of possible values.* If the service contributes clearly towards a specified output or production process as a raw material or input (e.g. year-round water for irrigation, soil nutrients for agriculture, nursery habitat and productivity for fisheries): *Effect on Production Method:* Establish the relationship between changes in a given ecosystem service and changes in production over a given time period, value this contribution to production in terms of market prices of the output.

ECONOMIC ASSESSMENT CONTD.		
Type of value	Indicator	Valuation method and data requirements
Indirect use value contd.	Economic value of regulating, supporting and cultural services is utilised.	If the service can be at least partially provided through artificial means (e.g. through built shoreline protection, sediment trapping, water purification, erosion control measures): *Replacement Cost Method*: Establish the works required to replicate the ecosystem service over a given time period, and calculate the physical costs (capital and recurrent) of building the infrastructure to provide an equivalent type and level of services. If the loss of the service will give rise to effects which would require mitigation[3] or avertive[4] action (e.g. building a reservoir to ensure year round water supplies, purchasing clean water, providing emergency food supplies): *Mitigative[3]/Avertive[4] Cost Method*: Establish the measures required to mitigate or avert the effects of the loss of an ecosystem service for a given area or population over a given time period, and calculate how much these measures would cost to implement. If the loss of the services will give rise to clear damages to infrastructure, production, etc. (e.g. flood damage to roads and bridges, drought damage to agriculture, damages from rising sea level): *Damage Costs Avoided Method*: establish the level of damages and affected area/population resulting from the loss of an ecosystem service over a given time period, and calculate the economic costs or losses associated with these damages. If calculating the recreational value of an ecosystem: *Travel Cost Method*: \collect data from visitors on the costs incurred in visiting and using the site including both direct expenses (such as fuel and fares, food, equipment, accommodation) and time spent on the trip, carry out a statistical regression to test the relationship between visitation rates and other explanatory factors, construct a demand curve relating number of visits to travel cost, model visitation rates at different prices, and calculate visitor consumer surplus. *Note: this is a complex method which requires extensive data collection, detailed data analysis, and a high level of training in environmental economics.*

[3] To act to lessen severity or intensity

[4] An action that avoids the loss of service.

ECONOMIC ASSESSMENT CONTD.		
Type of value	Indicator	Valuation method and data requirements
Option value	Economic value of provisioning, regulating, supporting and cultural services kept for future use.	*Contingent Valuation Method*: How much would people be willing to pay to ensure that the ecosystem is conserved for possible use in the future or how much compensation would people be willing to accept for the loss of the ecosystem and the consequent loss of possible use in the future. *Note: this is a complex method which requires extensive data collection, detailed data analysis, and a high level of training in environmental economics.*
Non use value (Existence and bequest value)	Economic value of provisioning, regulating, supporting and cultural services appreciated for their existence but never intended to be used.	*Contingent Valuation Method*: How much would people be willing to pay to ensure that the ecosystem is conserved or how much compensation would people be willing to accept for the loss of the ecosystem *Note: this is a complex method which requires extensive data collection, detailed data analysis, and a high level of training in environmental economics.*
LIVELIHOODS ASSESSMENT		
Basic materials for life	Indicator	Details (qualitative/quantitative data)
Adequate livelihoods		
	Total income/month/household	Higher than national average/lower than national average/below poverty line
	Total income/month/person	Higher than national average/lower than national average/below poverty line
	Sources of total income	Dependent on natural or other resources.
	Subsistence and non marketed income	From fruit/vegetables/agriculture/fish/ livestock/fuelwood/fodder/medicinal plants/ nuts (Non-timber forest products, NTFPs)
	Percentage of total income derived from fisheries	
	Percentage of households that are employed in fishing	
	Percentage of households that are employed in coastal tourism and tourism-related activities	
	Total number of households (in a village) directly dependent on fishing for their livelihoods	
	Total number of households (in a village) indirectly dependent on fishing for their livelihoods (net making etc.)	
	Total assets	Cultivable land/other land/cart/boat/plough/ thresher/water pump/livestock/poultry
	Percentage of households that own boats	

For detailed descriptions of methods described in this section, please refer to the chapter on economic valuation methodology starting on page 36.

LIVELIHOODS ASSESSMENT CONTD.		
Basic materials for life	Indicator	Details (qualitative/quantitative data)
Sufficient nutritious food/water		
Food per 24hr consumption	Frequency of meals	1/2/3
Balanced diet	Type of food	Protein/starch/fat/minerals
Sources of food	Quantity of monthly household consumption that is derived from fisheries	
	Quantity of daily protein intake that is derived from fisheries	
Water per capita	Access to safe drinking water	Personal piped water/community piped water/spring/personal well/community well/delivered/purchased water/other
	Distance to water source	
	Duration to water source	Days/hours/minutes
	Cost	Weekly spending if bought
Shelter		
Housing	Permanency	Permanent/semi-permanent
	Ownership	Owned/rented/shared/other
	Personal space	Number of people/m^2
Access to housing goods	Percentage of households that use timber/thatch from surrounding ecosystems	
	Frequency of use of timbe/thatch from surrounding ecosystems	
	Quantity of timber/thatch use per house household per year	
Fuel	Type	Gas/wood/other
	Weekly requirement	
	Source	Gas pipeline/gas stove/wood from forest
	Cost	Weekly spending if bought
Access to fuel	Total number of households dependent on fuelwood from the surrounding ecosystem	
	Quantity of fuelwood collected by average household per month	
	Distance and time to collect fuelwood	
Health & Sanitation		
Feeling well	Prevalence of diarrhoea	Number of cases per day/per month.
	Prevalence of infectious hepatitis	Number of cases/day/month
	Prevalence of acute respiratory infections (ARI)	Number of cases/day/month
	Prevalence of chronic respiratory infections (CRI)	Number of cases/day/month
	Maternal mortality rate (to be collected at community level)	Number of deaths/year
	Infant mortality rate (to be collected at community level)	Number of deaths/year
	Under 5 mortality rate (to be collected at community level)	Number of deaths/year
	Access to family health services	Easy/Fair/Difficult

LIVELIHOODS ASSESSMENT CONTD.		
Basic materials for life	Indicator	Details (qualitative/quantitative data)
	Access health clinic services	Easy/Fair/Difficult
	Access to hospital services	Easy/Fair/Difficult
	Type of allopathic health services available	Mobile/clinic/door to door nurse/maternity clinic/midwife/hospital.
	Distance to above services	Hours/days/km etc.
	Type of traditional health services available	Practitioner/clinic/hospital.
	Distance to above services	Hours/days/km etc.
	Proportion acutely malnourished	Proportion of children stunted for age
	Proportion chronically malnourished	Proportion of children underweight for age
	Incidence of diseases in children	Number, water related and others
	Proportion of income spent on health per month	
	Access to sanitation	Exclusive to the HH/shared with other HHs/community toilet/no toilet
	Type of sanitation	Water seal/pit type/temporary covering/ other
Security		
Personal security	See under Hazard assessment	
Resource access	See under Provisioning services	
Security from disasters	See below	
Alternate livelihood strategy in case of disasters		Yes/No
Good social relations		
Social cohesion	Frequency of verbal exchanges	Greetings only/conversation/visits/ attendance at family functions such as marriages.
Mutual respect		
Ability to help others	Existence of a community-based organisation (CBO) to manage ecosystem use	Yes/No
	Membership in the CBO from different income groups	Yes/No
	Frequency of CBO meeting	Weekly/fortnightly/monthly/quarterly
	CBO plan includes disaster risk reduction	Yes/No
Education		
	Years of formal education on average	
	Primary education	
	Secondary education	
	Tertiary education	

ASSESSING DRIVERS OF CHANGE		
Direct drivers of change	*Prevalence*	*Magnitude*
Over-exploitation		
Harmful fishing practices/dynamiting/small mesh nets	Yes/No	High/Moderate/Low
Other (specify)	Yes/No	High/Moderate/Low
Spread of IAS		
IAS flora	Yes/No	High/Moderate/Low
IAS fauna	Yes/No	High/Moderate/Low
Habitat destruction		
Clear felling of habitats	Yes/No	High/Moderate/Low
Filling of wetlands	Yes/No	High/Moderate/Low
Land reclamation	Yes/No	High/Moderate/Low
Development – roads, infrastructure	Yes/No	High/Moderate/Low
Pollution		
Solid waste (garbage)	Yes/No	High/Moderate/Low
Solid waste (sewage treatment facilities/ underground sewers)	Yes/No	High/Moderate/Low
Former military training areas/facilities	Yes/No	High/Moderate/Low
Water pollution	Yes/No	High/Moderate/Low
Diminished water quality	Foul smell	Yes/No
	Foaming	Yes/No
	Silting	Yes/No
Indirect drivers of change		
External drivers	*Prevalence*	*Magnitude*
Prawn farming	Yes/No	High/Moderate/Low
Agricultural fields	Yes/No	High/Moderate/Low
Industrial areas	Yes/No	High/Moderate/Low
Human habitations and population density	Yes/No	High/Moderate/Low
Vulnerability to natural hazards	Yes/No	High/Moderate/Low
Other (specify)		
HAZARD ASSESSMENT INFORMATION		
		Magnitude
Kind of hazard		High/Moderate/Low
Frequency		High/Moderate/Low
Location of hazard		
When does it occur		Rarely/often/very often
Which sector of the community is most affected		
How many deaths?		
How many displacements?		
What used natural resource is affected most?	i.e., fish, fuelwood	

Analysing data

For Biodiversity Assessments:

- Calculate the total number of faunal species seen.
- Calculate the total number of flora species seen.
- For each taxonomic group of fauna, calculate the percentage in relation to the total species seen. For example, if you saw 100 species of fauna, and 20 species of birds, the percentage of birds seen will be 20%.
- Repeat this for abundance.
- The above will reveal which species is most common, which is most abundant, as well as which taxonomic group.
- Bar graphs can be used to display effectively the results obtained.
- Repeat for subsistence and commercial fish catches.
- For flora, calculate the percentage for trees, saplings, seedlings, shrubs, forbs, grasses, for a terrestrial habitat and emergents, submerged plants, floating plants for an aquatic habitat.
- The above will indicate which floral life forms are most dominant.

For Ecosystem Service Assessments:

For all services, rank the service per habitat and total the score as shown in a single example below.
5= very high; 4=high; 3=average; 2= poor; 1=none. An example is given below.

Service component	Habitat			
Provisioning services	Forest	Fallowland	Farmland	River
Fruits	4	-	4	-
Vegetables	3	-	5	1
Fish	-	-	-	5
Fuelwood	5	-	2	-
Medicinal species	5	-	3	1
Drinking water	-	-	5	5
Total				

Assessing drivers of change:

- Identify the most severe threat from the direct drivers listed.
- Identify the most severe threat from the indirect drivers listed.

Ranking assets:

As described in page 14 of Volume 2, rank the ecological assets using three general criteria a) uses and economic value, b) uniqueness, and c) pre-existing threats.

Identify, from the analyses carried out,

1. Which species/ecosystem has the most number of uses;
2. Which species/ecosystem is the most economically valuable;
3. Which species/ecosystem is the most over-exploited;
4. Which is the greatest threat to ecosystem services;
5. Which is the ecosystem service that impacts the most number of people; and
6. Which sector of the community is most affected by the above.

For more detailed biodiversity and ecosystem assessments that require a higher level of technical expertise, please refer to the next section of this volume, which details biodiversity assessment techniques.

Economic Valuation:

This section of the assessment requires a higher technical knowledge than is possible with community participation. For detailed methodology, please refer to the relevant chapter in this volume.

Livelihoods Assessment:

Assessing livelihoods:

- Calculate the percentage of households in the community that have higher/lower than national average and below poverty line incomes.
- Calculate the percentage of persons in the community that have higher/lower than national average and below poverty line incomes.
- Bar graphs can be used to display effectively the results obtained.
- Identify the most common source of income in the community.
- Identify subsistence and non market income in the community.
- Display, using bar graphs, the percentages of households engaged in fisheries, tourism and other natural resource-based livelihoods.
- Display, using bar graphs, the percentages of the community directly and indirectly involved in fisheries.
- Display, using bar graphs, the percentages of the community directly and indirectly involved in tourism.
- Display, using bar graphs, the assets in the community.
- Display, using a pie chart, the percentage of the community owning boats.

Assessing nutrition and water availability:

- Display, using bar graphs, the percentages of the community eating 1/2/3 meals a day.
- Display, using bar graphs, the percentages of the community eating a balanced diet.
- Display, using a pie chart, the per capita use of water: personal piped water/community piped water/spring water/personal well/community well/delivered water/purchased water, etc.
- Calculate the percentages of the community travelling far/average/close distances to collect water.

Assessing shelter:

- Display, using a pie chart, the percentages of the community living in permanent/non-permanent shelter.
- Display, using bar graphs, the percentages of the community living in owned/rented/shared housing.
- Display, using bar graphs, the percentages of the community that use timber, thatch etc. from nearby ecosystems.
- Display, using bar graphs, the frequency of the above use.
- Display, using bar graphs, the quantity of the above use.
- Display, using a pie chart, the types of fuel used in the community and percentage of use.
- Display, using a pie chart, the source of use of the above.
- Display, using a pie chart, the percentage of community dependent on fuelwood from the surrounding ecosystem.
- Calculate, using average household use, and the above, the total fuelwood requirement of the community.
- Calculate the percentages of the community travelling far/average/close distances to collect fuelwood.

Assessing health and sanitation:

- Calculate the percentages of the community that have diarrhoea per month.
- Calculate the percentages of the community that have infectious hepatitis per month.
- Calculate the percentages of the community that have acute respiratory infections per month.
- Calculate the percentages of the community that have chronic respiratory infectious per month.
- Display using bar graphs, the above data against national averages to identify whether the values are higher/on par with/lower than normal.
- Display using bar graphs, maternal mortality, infant and under 5 mortality rates, against national averages to identify whether the values are higher/on par with/ lower than normal.
- Display using bar graphs, proportion of children acutely and chronically malnourished, against national averages to identify whether the values are higher/on par with/lower than normal.
- Calculate the percentages of the community having easy/fair/difficult access to family health services.

- Calculate the percentages of the community having easy/fair/difficult access to health clinic services.
- Calculate the percentages of the community having easy/fair/difficult access to hospital services.
- Display, using a pie chart, the proportion of each type of health service used in the community.
- Display, using a pie chart, the proportion of each type of sanitation used in the community.
- Display, using a pie chart, the proportion of access to sanitation in the community.

These simple analyses will answer clearly the questions posed in page 13 of volume 2.

Initially,

- They will assess household benefits from ecosystem services and identify those services;
- Identify livelihood dependence on provisioning services; and
- Assess the impacts from ecosystem loss on human well-being: i.e., food and water security, health and sanitation, social relations, etc.

Hazard assessment:

The hazard assessment data will show which resource and which sector of the community is affected most by a specific hazard.

Through the data obtained from the integrated assessment, it is possible to build a complete picture of the status of the ecosystem and community, as well as about hazards that affect the given area. When this snapshot of ecosystem and human well-being is taken before a disaster - i.e., during the Prevention phase of disaster management, then it feeds technically sound information for decisions taken during the Mitigation and Preparedness phases, as well as actions taken during post disaster phases.

Biodiversity Assessment Techniques (for coastal ecosystems)[5]

Note that this is a technical annexe that requires advanced knowledge of field biology.

Inventorying and monitoring biodiversity – an overview

Why undertake a biological inventory?
Carrying out a biological inventory, like any other inventory, allows for the assessment of what biological entities are there in a given area. It establishes the composition and structure of the ecosystem, its status and health provides baseline information for informed decision making for disaster management, as well as sustainable development. Biological assessments also allows for the recognition of priority conservation areas. The analyses of data gathered from biological assessments facilitates sustainable harvesting of species. These assessments also serve to provide information for promoting nature-based tourism and increasing awareness about the environment. The ecosystem service assessment focuses on identifying the services being provided by the ecosystem, as well as the expected impacts on the provision of these services from changes in biodiversity composition and structure.

Measuring (Inventorying) versus Monitoring:
There is an important difference between measuring biodiversity and monitoring changes in biodiversity. Measuring/ inventorying biodiversity provides a snapshot of biodiversity (for example, yields a number of plant and animal species) at the time of measurement. It is useful for spatial comparisons of biodiversity. In contrast, monitoring involves measuring trends and changes over time, which would allow the researcher to determine the impacts of anthropogenic or natural factors on biodiversity. Monitoring also assesses whether management interventions are achieving the desired conservation goals and allows for adaptation of management. An inventory provides the necessary baseline data for monitoring the effects of anthropogenic disturbance or natural phenomena such as climate change on the biota.

Given below is a summary of biodiversity assessment techniques:

Rapid assessments:

Rapid field surveys:
These may be carried out by two or more observers, where opportunistic observations on plants and animals may be made through transect walks in and around a particular ecosystem. The morpho-species concept (categorising species according to morphological features) may be adopted for invertebrate groups (for example, crabs, molluscs, dragonflies) that do not have sufficient information for field identification.

Secondary information:
Information on the biodiversity of a particular site can be compiled through the review of secondary information such as published papers and articles, unpublished reports, as well as field notes maintained by protected area managers/rangers. Information on species could also be gathered through interviews with local communities (key informants).

Detailed assessments:

Pure inventory:
This involves a one-off activity to record the presence of plants and animals in a particular area, through systematic assessment techniques for different taxa (see following sections for details on specific sampling techniques for different taxa).

Dynamic inventory:
This involves the repetition of the pure inventory techniques at frequent and uniform intervals (for example, every month, every quarter, and every year) to document temporal changes in biodiversity in a particular area.

[5] Citation: Bambaradeniya, C. N. B (2007). Biodiversity Assessment Techniques (For Coastal Ecosystems) Colombo: Ecosystems and Livelihoods Group, Asia, IUCN. pp viii + 49. Unpublished document.

General methodology for a biodiversity survey:

a. Selection of suitable personnel:
- Naturalists, para-taxonomists[6];
- Botanists;
- Ecologists; and
- Suitable members from the local community (for example, NTFP collectors, hunters).

b. Gathering secondary information
- Previous work on the particular location/surrounding areas;
- Field guides on fauna and flora; and
- Spatial information (land use/vegetation maps, satellite images, aerial photographs, etc.).

c. Reconnaissance survey:
- Familiarising the team with the study area;
- Identifying major habitats and vegetation types;
- Selecting representative sampling sites;
- Verifying the practical application of pre-determined sampling techniques for fauna and flora; and
- Establishing contacts with local authorities/communities.

d. Design and confirm field sampling techniques for fauna and flora:
- Selecting taxa to be surveyed and finalise sampling techniques; and
- Designing field data templates for different taxa.

e. Finalise sampling period and frequency:
- Number of field visits/days and frequency of field visits to capture temporal changes related to seasonal events.

f. Field survey:
- Sampling of habitats, fauna and flora;
- Trying to identify vertebrates in the field itself, using field guides;
- Collecting faunal specimens sparingly (for species that needs to be verified in the laboratory);
- Collecting specimens of plants and preparing herbarium sheets for confirmation of identification;
- Sampling fauna should encompass both diurnal and nocturnal times;
- Identifying specific ecosystem services and dose-response relationships;
- Documenting conservation issues/threats to biodiversity; and
- Obtaining relevant geo-referenced information using a GPS instrument (i.e., boundaries of different habitat types, breeding sites of animal species, sites with specific threats to biodiversity, etc.).

g. Analyses of data:
- Using ecological diversity indices, univariate analyses (describing central tendency, dispersion, distribution, and multivariate analysis - for example, MANOVA, PCA, Cluster analysis);
- Evaluating ecosystem services related to biodiversity in the area, and analysing dose-response relationships;
- Identifying critical habitats for the conservation of biodiversity and ecosystem services for human well-being;
- Selecting suitable indicators for monitoring of biodiversity;
- Categorising conservation issues/threats, and identify severity using indicators; and
- Synthesise geo-referenced information for relevant spatial maps.

h. Data presentation:
- Presenting key information using visual tools (graphs, tables, charts, etc.);
- Preparing spatial maps with the aid of GIS technology (habitat/vegetation/land-use types);
- Locating threatened/endemic species; critical habitats; threat zones; rank areas according to ecosystem services etc.; and
- Obtaining a compendium of indicators to monitor biodiversity, and threats to conservation.

[6] Parataxonomists: (local assistants trained by professional biologists

Sampling techniques for coastal vegetation:

General methods to record plants:

Method	Life forms
Total counts (to assess density of large plants of low density)	Trees, shrubs
Visual estimates of cover – Braun-Blanquet Scale (% Cover of species)	Trees, shrubs, herbs and grasses, bryophytes, fungi and lichens, algae
Frame quadrats (cover, density, biomass)	Trees, shrubs, herbs and grasses, bryophytes, fungi and lichens, algae
Transects (changes of vegetation along an environmental gradient or through different habitats)	Trees, shrubs, herbs and grasses

Documentation of plant diversity in coastal ecosystems using total counts:

Category	Size	Plot size
Tall trees	Above 10cm dbh[7]	10m x 10m
Treelets, shrubs, palms lianas, herbs, etc.	dbh < 10cm, Height > 2m	5m x 5m
Grasses, herbs, saplings, etc.	Height < 2m	1m x 1m

The following calculations may be made with the information obtained from total counts:

For trees above 10cm dbh:

Radius (r) = Diameter/2; Basal area = πr^2 = Acm^2; 1ha = $10,000m^2$

Basal area (m^2ha^{-1}) = A/400

Density (ha^{-1}):

Total individuals of species. A = X (in 20 x 20m)

Density of species A (ha^{-1}) = 25X

Relative Basal Area (%):

Basal area of species A = Z (m^2ha^{-1}); Total basal area of all species = X

Relative basal area of species A = Z/X x 100%

Relative density (%):

Density of species A = Z(ha^{-1}); Total density of all species = X(ha^{-1})

Relative density of species A = Z/X x 100%

Taxonomic richness:

Number of species/genera and families per ha

Important Value Index (IVI):

For woody plant species, the Important Value Index (IVI) can be calculated to indicate the abundance of species. IVI for a particular woody species = %Basal cover + %Density + % Frequency

For others (dbh < 10cm)

Taxonomic richness:

Number of species/genera and families per m^2

Richness of life floral forms

Number of trees/palms/lianas/shrubs/herbs/grasses per m^2

[7] dbh - Diameter at breast height is measured 1.2m above ground level, using a special diameter tape that is used for plant censuses.

The Braun-Blanquet scales for visual estimates of plant cover:

The plot sizes used to document the percentage cover of plants can vary depending on habitat, vegetation types, etc. The scale can be applied to determine the cover of plants in strip quadrats (i.e., 20m x 5m) or in quadrats (i.e., 5m x 5m).

Value	Cover
+	<1% cover
1	1-5% cover
2	6-25% cover
3	26-50% cover
4	51-75% cover
5	76-100% cover

Sampling techniques for coastal fauna:

(A) *Direct methods* – Visual encounter of live or dead animals.
(B) *Indirect methods* – Calls, footprints, faeces, prey hair/bone remains in carnivore scat samples, nests of birds, feeding signs.
(C) *Reliable information from local people* – Pictorial guides and photos of species could be shown to local communities to verify the presence of different faunal taxa.

Fish:

Method	Habitat
Fish catch surveys (commercial/subsistence)	Lagoons, estuaries, ponds.
Bank side counts	Shallow pools, slow-flowing shallow streams.
Snorkelling	Clear shallow pools, slow-flowing shallow streams, coral reefs.
Seine netting	Tanks, reservoirs, slow-flowing rivers, lagoons/estuaries.
Scoop netting	Shallow pools, slow-flowing shallow streams, marshes.
Cast netting	Tanks, reservoirs, slow-flowing rivers, lagoons/estuaries.
Gill netting	Tanks, reservoirs, slow-flowing rivers, lagoons/estuaries.

Herpetofauna (Amphibians and Reptiles):

Method	Habitat
Visual Encounter Surveys (VES) and hand-capturing A) Transect sampling; B) Quadrat sampling	Mangroves, saline marshes, grassland, scrubland.
Pitfall and fence trapping	Mangroves, saline marshes, grassland, scrubland.
Netting	Ponds, tanks.
Nocturnal road cunts	Roads that adjoin/cut across mangroves, coastal scrubland, lagoons and estuaries.

Avifauna:

Method	Habitat
Timed point counts (for example, 15 minute radial point counts)	Estuaries, lagoons, tanks, saline marshes, beach, mangroves.
Line transects	Mangroves, saline marshes, maritime grasslands.
Mist netting	Mangroves.

Mammals:

Method	Habitat
Belt transects	Mangroves, saline marshes, maritime grasslands.
Nocturnal road counts	Roads that adjoin/cut across mangroves, coastal scrubland, lagoons and estuaries.
Cage trapping	Mangroves, saline marshes, maritime grasslands.
Camera trapping	Mangroves, saline marshes, maritime grasslands.

Selected coastal invertebrates:

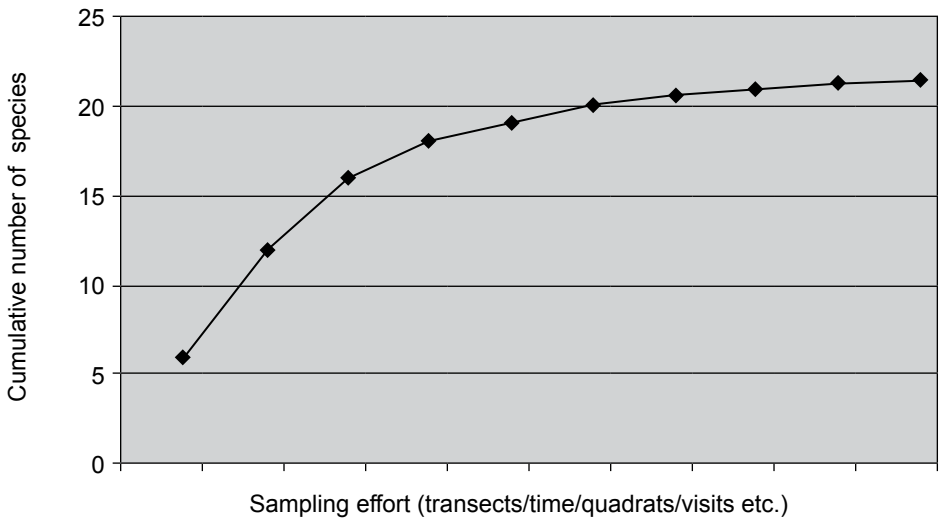
Group	Method	Habitat
Corals	Line transects (50m)	Coral reefs
Butterflies, dragonflies and damselflies	Line transects/sweep netting	Coastal scrubland, mangroves, coastal ponds
Crabs	Bucket traps (1litre)	Ponds, mangroves
Molluscs	Quadrat sampling	Mangroves, lagoons, mudflats

Data analysis:

Species Recruitment Curves:

A graph is plotted using sampling effort and cumulative species recorded. The curve will reach an upper asymptote (plateau), when all species in a given area are documented adequately.

Figure 1: Species recruitment curve



Ecological diversity indices:

Diversity measurement	Index	Equation	Definition of terms
Species richness	Margalef (D_{Mg})	$D_{Mg} = (S-1) / \ln N$	S = Total species N = Total individuals
Species diversity	Shannon (H')	$H' = p_i \ln p$	p_i = Proportion of individuals in *i*th species $p_i = n_i/N$

Statistical methods:

- Univariate methods (for example, ANOVA)
- Multivariate methods (for example, Cluster Analysis)

Assessment of the threats to coastal biodiversity:

Major threat	Contributory factors	Indicators to assess severity
Habitat deterioration/degradation	Reclamation/transformation	Area reclaimed (ha/acres/km^2).
	Clearing of vegetation (mangrove and scrubland)	Area cleared (ha/acres/km^2).
Pollution	Organic pollution	Levels of DO, BOD5, COD. Oil spills/leakages (amount leaked/ spilled, areas affected, animals (fish, birds, etc.) affected.
	Chemical effluents	NO_3 and PO_4 levels, algal blooms. Levels of heavy metals, biocide residues, indicator biota (i.e., odonates, molluscs, annelids, surface insects, micro-crustaceans etc.).
	Sewage disposal	Coliform bacteria, algal blooms.
Direct loss/Exploitation	Poaching	Information gathered from forest rangers (frequency of incidences). Number of traps observed in the wild. Frequency of gunshots heard at night. Bushmeat available in surrounding areas.
	Removal of vegetation	Number of large trees cut (based on remaining stumps). Information gathered from the Department of Wildlife/Forest Department (frequency of incidences).
	Over-exploitation of live animals and plants for commercial trade/ornamental purposes/medicinal purposes/ consumption	Direct field observations of species collections. Data gathered from collectors (number of individuals collected, weight, etc.) Data gathered from government departments.
Spread of invasive alien species	Introduction and spread of invasive alien flora	Area of invasion (ha/acres/km^2)
	Introduction and spread of invasive alien fauna	Population numbers if IAS fauna. Reduction of native fauna due to predation (area).
Natural hazards	Floods	Number of dead animals.
	Storms/hurricanes	Number of dead animals, vegetation destroyed (area/number of trees).
	Drought	Number of dead animals and trees.

Criteria for selection of critical habitats for conservation:

a. *Ecological attributes:* Areas with high species richness and habitat diversity.

b. *Ecological functions and services:* Areas that provide a large number of provisioning, supporting, regulating and cultural services, as well as areas that are are feeding and breeding sites of threatened species.

c. *Naturalness*: The extent to which the area has been protected from, or has not been subject to, human-induced change.

Evaluation of ecosystem services and dose-response relationships related to coastal ecosystems:

Ecosystem services:

Ecosystem services include provisioning services, supporting services, regulating services and cultural services (see below for examples)

Provisioning services related to coastal ecosystems:

Service component	Coral reefs	Seagrass	Beach scrub	Mangrove
Lime	+	-	-	-
Food fish	+	+	-	+
Ornamental fish	+	+	-	-
Curios/ornaments	+	-	-	-
Fruits/vegetables	-	+	-	+
Timber/fuelwood	-	-	-	+
Medicines	-	-	-	+
Sand	-	-	+	-

Supporting services related to coastal ecosystems:

Service component	Coral reefs	Seagrass	Beach scrub	Mangrove
Biodiversity sustenance	+	+	+	+
Primary production	-	+	-	+
Nutrient cycling	+	+	-	+

Regulating services related to coastal ecosystems:

Service component	Coral reefs	Seagrass	Beach scrub	Mangrove
Carbon sequestration	+	+	-	+
Prevention of coastal erosion	+	+	+	+
Protection from storms and tidal surges	+	-	+	+
Flood control	-	-	-	+
Pollution control/treatment	-	-	-	+

Cultural services related to coastal ecosystems:

Service component	Coral reefs	Seagrass	Beach scrub	Mangrove
Coastal recreation and tourism	+	+	-	+
Education and research	+	+	+	+
Sustenance of traditional knowledge	+	-	-	+

Dose-response relationships related to ecosystem services:

Any changes in ecosystem services can be documented in response to human interventions or effects of natural hazards as a dose-response relationship. These changes can be documented by biodiversity monitoring surveys. These may include changes such as the following:

- Anthropogenic negative impacts on ecosystems (i.e., reclamation of wetlands, forest clearance);
- Anthropogenic positive impacts on ecosystems (i.e., reforestation, dredging of silted mangroves); and
- Natural hazard-related negative impacts (i.e., damage associated with hurricanes, drought, floods, etc.).

The responses related to specific interventions can be identified using suitable biodiversity and socio-economic indicators, as shown in the following examples:

Clearing coastal vegetation for development (negative impact):

Impact on ecological functions and services	Physical impact of change in functions and services
Reduction of timber and fuelwood	Over-exploitation of trees in remaining sites.
Reduction of mangrove fruits	Increase in damage to home garden fruit crops by bats.
Loss of refuge/breeding sites for fish and other animals (i.e., birds)	Decrease in fish catches; decrease in species richness and abundance of birds.
Increase in coastal erosion	Loss of beach area; decrease in turtle nesting.
Decrease in recreational and aesthetic value	Decrease in tourist visitation.

Dredging a mangrove/lagoon to remove excess silt/sand (positive impact):

Impact on ecological functions and services	Physical impact of change in functions and services
Increase in fish production	Increase in fish catches; increase in species richness and abundance of aquatic birds.
Increased efficiency in nutrient recycling and tidal flushing	Increase in the number of seedlings established in mangroves; increase in crustaceans.
Increase in primary productivity	Increase in above ground productivity (stock).
Increased capacity for flood control	Reduction in flashfloods.
Increase in recreational and aesthetic value	Increase in tourist visitation.

Preparation of maps:

High quality remote sensing coverage, combined with Geographic Information System (GIS) technology and ground surveys facilitated with a Global Positioning System (GPS) instrument will lead to the preparation of accurate maps. Such maps make an important contribution to biodiversity monitoring.

Initially, a one inch map on vegetation/land-use types in a given area should be digitised and divided into equal-sized grids (i.e., 1 x 1km^2). The vegetation/land-use types in each grid should be analysed with remote sensed images and/or aerial photographs, and further verified through field visits covering representative areas.

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Rapid Environmental Impact Assessments

This annexe is extracted from the Guidelines for Rapid Environmental Impact Assessment developed by Benfield Hazard Research Centre, University College London and CARE International[8] as well as OECS (2003) Technical Manual for Post-disaster Rapid Environmental Assessments, Volume 1 & 2[9].

'A Rapid Environmental Impact Assessment (REA) is a tool to identify, define, and prioritise potential environmental impacts in disaster situations. REAs are simple, consensus-based qualitative assessment process, involving narratives and rating tables, and are used to identify and rank environmental issues and follow-up actions during a disaster. The REA is built around conducting simple analysis of information in the following areas:

- The general context of the disaster;
- Disaster related factors which may have an immediate impact on the environment;
- Possible immediate environmental impacts of disaster agents;
- Unmet basic needs of disaster survivors that could lead to adverse impact on the environment; and
- Potential negative environmental consequences of relief operations' (CARE, 2003).

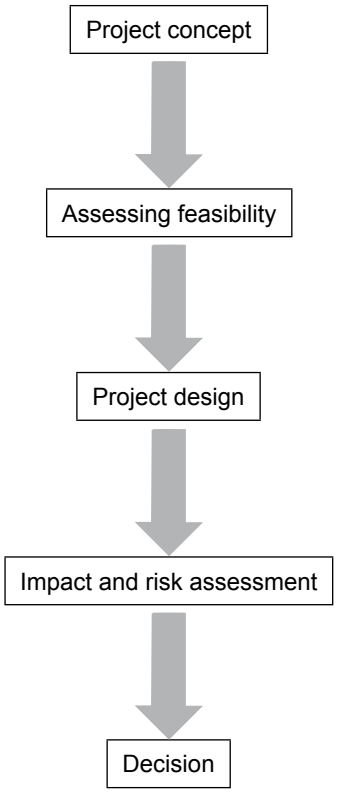
Under non-disaster conditions, a longer, more detailed process of environmental impact assessments is followed.

'An Environmental Impact Assessment (EIA) is an assessment of the possible impact - positive or negative - that a proposed project may have on the natural environment. The purpose of the assessment is to ensure that decision makers consider the ensuing environmental impacts to decide whether to proceed with the project.' (http://en.wikipedia.org/wiki/Environmental_impact_assessment).

The following matrix shows how an EIA aids in the decision making process.

Figure 2: Decision making matrix (Source: D. Weerakoon, personal comm.)

Socio-economic	Environmental
+	+
+	-
-	+
-	-



[8] Rapid Environmental Impact Assessment in Disaster Response. Copyright © 2003 Cooperative for Assistance and Relief Everywhere, Inc. (CARE). Used by Permission, summarised by Devaka Weerakoon, and

[9] OECS (2003). Technical Manual for Post-disaster Rapid Environmental Assessments, Volume 1 & 2 . http://www.caribank.org/titanweb/cdb/webcms.nsf/AllDoc/9E2B73C29C5CB1A1042573D100546360/$File/OECSManualVolume_1_Final.pdf

Listed below are some of the socio-economic queries that arise with respect to a proposed project (D. Weerakoon, personal comm.):

- Is the project likely to have a significant positive impact in the overall economy of the country?
- What are the impacts it will have on socio-economics of the community?
  - Will the project generate new jobs?
  - Will the project improve the marketability of community products?
  - Will the project improve infrastructure - such as health, education, transport?
  - Will the project relocation of people from their traditional homeland?
  - Will the project increase or decrease risk?
  - Will the project increase or decrease the risk of disasters?
  - Will the project have negative impacts on cultural heritage?

Similarly there are environment-related queries that arise with respect to a proposed project:

- What are the impacts on the physical, chemical and biological components of the environment
  - in the immediate impact area?
  - in upstream and downstream impact zones?
- What are the impacts on the main habitats and species?
  - What is the inventory of ecosystems and species?
  - What are the critical ecosystems and species?
- What are the impacts on the chemical and physical environment?
  - Is there contamination of soil, water or air?
  - Is there destabilisation of soil, changes in flow patterns etc.?
- What is the extent of the significance of these impacts - heavy/moderate/low?
  - What is the magnitude of impact, area affected, and the duration of the effect?
  - Do these impacts need mitigation and can they be mitigated?
  - If so which ones and how?

Valution of impacts:

These impacts can be valued economically.

- Some impacts can be valued directly, such as:
  - Loss of income or income generated through the project;
  - Value of products harvested from nature;
  - Value of mitigation activities required.
- Some impacts cannot be valued directly, such as:
  - Services provided by ecosystems;
  - Loss of critical habitats and species.
- There are different valuation techniques available for such valuation (See section on economic valuation methodology).

Mitigation of impacts:

Mitigation is the reduction of adverse impacts of the project. However, all adverse impacts cannot be mitigated, and mitigation of some impacts may not be cost effective. Therefore, there should be a critical analysis in order to identify the impacts that must be mitigated and a mitigation plan developed for each of the identified impacts. The mitigation plan should

- adopt an adaptive approach;
- should include a time-bound set of activities;
- should include costs for each of the activities and the mode of financing; and
- parties responsible for activities (develop Memoranda of Understanding).

Monitoring mitigation:

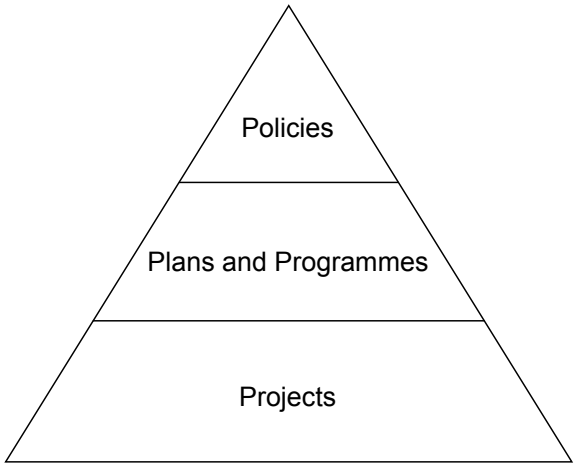
- Monitoring should take place during the construction and implementation phase to ensure that
  - the recommendations of the EIA are carried out;
  - that proposed mitigation measures are carried out as defined;
  - that best practices are followed during project implementation.
- A set of parameters to be monitored should be identified;
- Then, the parties responsible for monitoring, indicators to be monitored, monitoring frequency and method of financing should be defined clearly;
- A committee should be formed to evaluate the results of the monitoring programme and take necessary action.

Data collected from biodiversity and ecosystem service assessments facilitate the EIA process.

Strategic Environmental Impact Assessment

Strategic Environmental Assessment (SEA) is a system of incorporating environmental considerations into policies, plans and programmes. It is sometimes referred to as Strategic Environmental Impact Assessment (http://en.wikipedia.org/wiki/Strategic_Environmental_Assessment). SEAs look at the impacts of many projects at a macro level as shown in the figure below.

Figure 3: Strategic Environmental Assessment (Source: D. Weerakoon personal comm.)



However, in a context of a disaster, EIAs become inappropriate (CARE, 2003) for reasons shown below.

Table 1: Contextual differences between normal and disaster assessments
(Source: UNHCR and CARE International.)

Normal conditions	Disasters
Considerable lead time	Sudden onset
Legal requirement often exists (country and/or donor)	Rarely a legal requirement but some donor may ask for it
Deliberate and pro-active	Reactive
Will take time, be thorough and extensive: comprehensive data collection	May need to be partial in coverage
'No project' option is a possible outcome	'No project' outcome is not an option
Location chosen	Unpredictable location
Duration planned	Uncertain duration
Beneficiary population identifiable and static	Beneficiary population heterogeneous and dynamic
Environmental goals may be made compatible with socio-economic ones	Priority given to 'life saving' activities sometime difficult to reconcile with environmental goals

Rapid Environmental Assessments

Rapid Environmental Assessments are carried out in the period immediately following a disaster to determine the degree of damage to the environment and ecosystem services and the appropriate response (OECS, 2003).

The Rapid Environmental Impact Assessment (REA) process is designed to:

1. Collect information needed to assess environmental impacts;
2. Provide simple steps for analysing this information to identify important issues; and
3. Review procurement decisions to reduce the potential negative environmental impacts of emergency assistance (CARE, 2003).

Rapid Environmental Impact Assessments are designed with the following considerations that

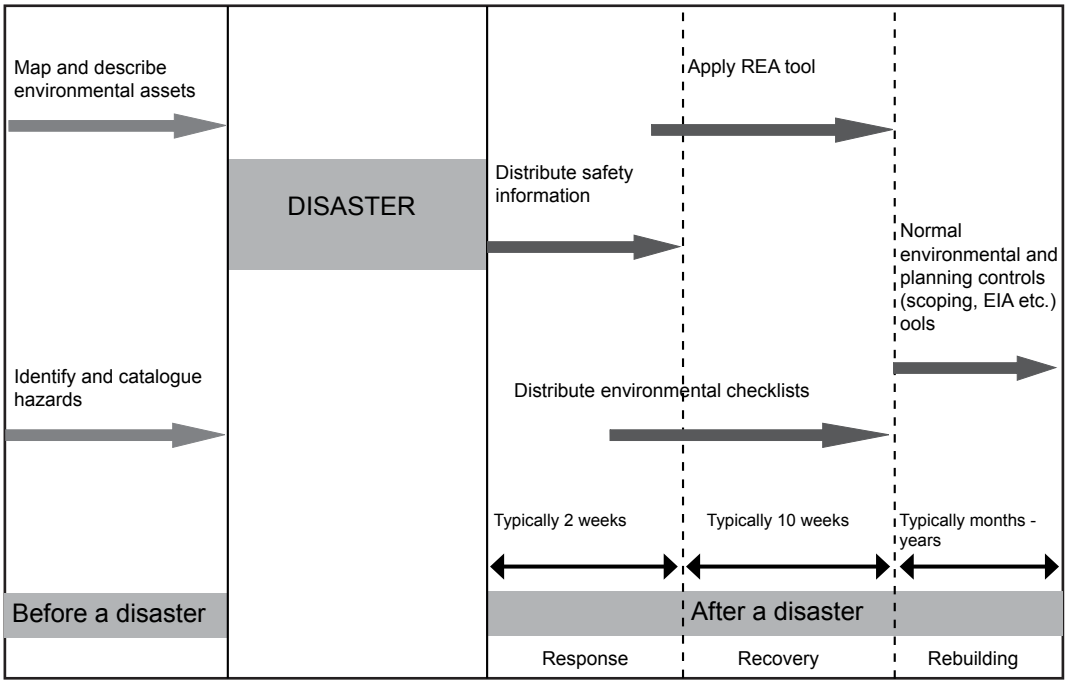
- The environment is considered as an economic asset (as natural capital) that provides various ecosystem services, as described in Volume 1 of this manual.
- The environment also provides welfare through the benefits of non-use values. (See Volume 1.)
- That existing constraints such as:
  - limited availability of time for undertaking the assessment;
  - lack of information on the environment;
  - methodological problems derived from the absence of markets for most of environmental services must be accommodated in the design.

Table 2 below shows the REA process in the context of the disaster management cycle.

Table 2: The REA process in context (adapted from OECS, 2003)

Stage in disaster management cycle	Activities to be undertaken	Outputs
Preparedness	Mapping and describing environmental assets (See Volume 2).	Database of significant environmental assets.
	Hazard mapping and risk assessment (See Volume 2).	Database of hazards and risk.
Disaster		
Response (Damage assesssment: 48hr for an Initial Damage Assessment to several weeks for a Detailed Sector Assessment)	Provide safety information.	Hazard summaries.
	Assess damage to environmental assets.	Systematic categorisation of damage, including financial value.
Response: (typically lasting 2 weeks); Recovery: (typically lasting 10 weeks)	Implement measures to minimise damage to environmental assets.	Environmental control checklists.

Figure 4: Environmental protection in disaster response (adapted from OECS, 2003)



Assessing damage (sourced from OECS, 2003):

Immediately after a disaster, the following needs to be assessed.

- Date and location;
- Nature of incident/threat and cause;
- Impact/potential impact;
- Secondary effects;
- Need for potection of population;

- Evacuation need (if any);
- Life support systems affected/under threat;
- Emergency clean-up/containment measures required;
- Special technical assistance needed (if any).

The damage is then rated according to a) the intensity of the damage and b) the spatial extent of the damage.

Intensity of damage:
This is usually rated as low/medium/high and presented in a matrix as shown below.

Table 3: Rating damage intensity (Sourced directly from OECS, 2003)

Intensity of damage	Definition		
	Individuals	Functioning of asset	Recovery of asset
Minor	Few affected	No effect	Natural
		Limited effect	
Medium	Marked effects on several	No effect	Natural
		Moderate effect	Requires appropriate environmental protection measures
Major	Significant effects on many	Irreversible impairment	Requires appropriate environmental protection measures

Extent of damage:

Extent of damage can be classified simply as
- Less than 10% of the asset affected;
- 10-25% of the asset affected;
- 25-50% of the asset affected; and
- More than 50% of the asset affected.

Based on the intensity and extent of damage, a matrix of damage assessment can be constructed as follows:

Table 4: Overall damage assessment (Sourced directly from OECS, 2003)

Intensity of damage	Area damaged			
	<10%	10-25%	25-50%	50%
Minor	Low	Low	Moderate	High
Medium	Low	Moderate	High	High
Major	Moderate	Moderate	High	Extreme

Mitigation measures:

Mitigation must be assessed on a case-by-case basis, but the following matrix may be used as a guide.

Table 5: Response options (Sourced directly from OECS, 2003)

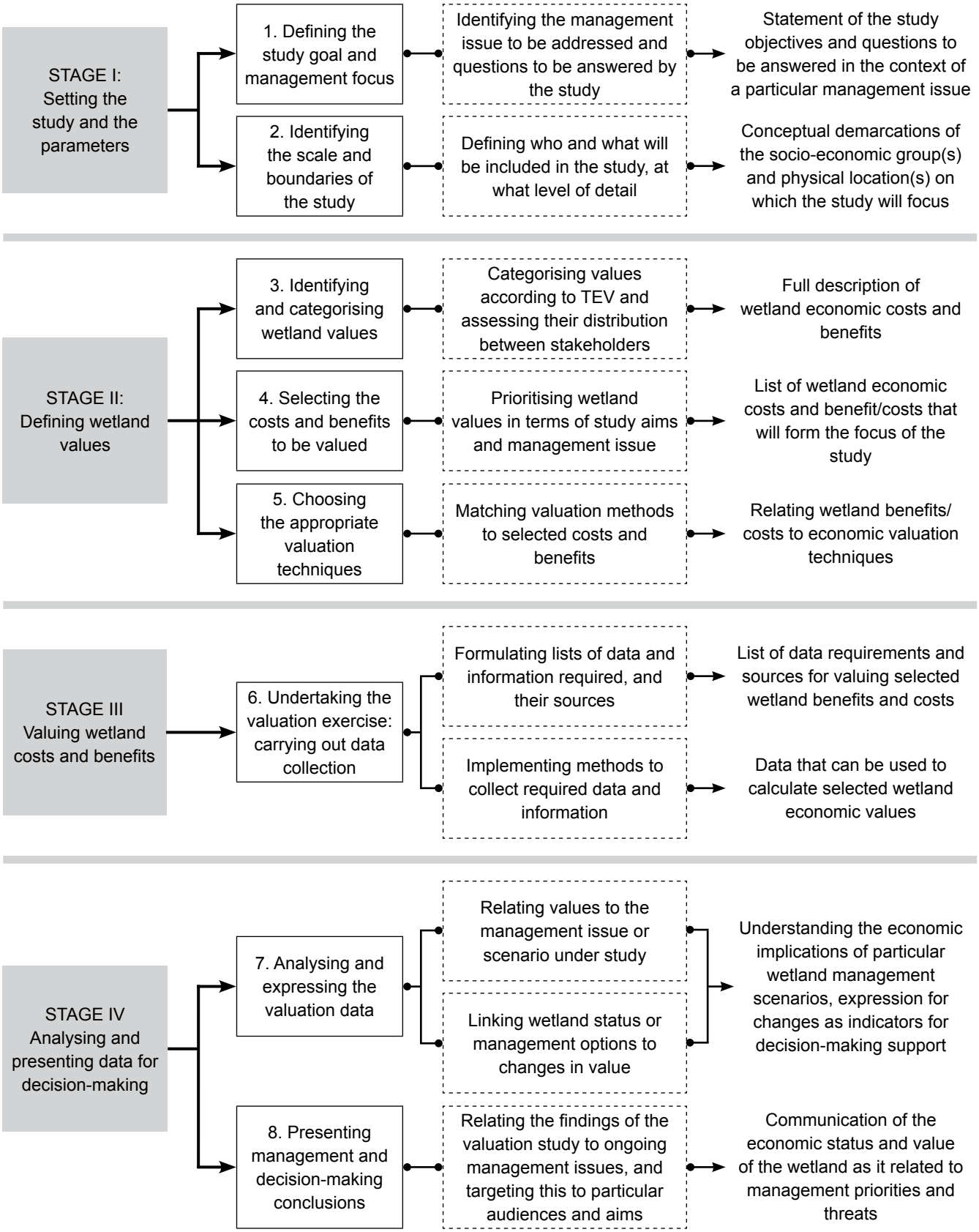
Degree of damage	Response options	
	Use	Corrective/preventive action
Low	No restriction	Minor actions to address specific issues
Moderate	Some restriction	Minor actions to address specific issues
High	Significant medium-term restriction	Some corrective actions required
Extreme	Long-term restriction	Intensive corrective action

Economic Valuation Methodology

Figure 5: Steps, stages and methods for the valuation of wetlands and descriptions of different valuation techniques, sourced directly but simplified from Emerton and Bos (2004)[10] and Springate-Baginski, et al. (in press)[11].

Note that this is a technical annexe that requires considerable knowledge of environmental economics. Economic valuation follows a series of iterative steps that are complementary, and run parallel, to those carried out in biodiversity and livelihood assessment (Sourced directly from Springate-Baginski, et al., in press).

Figure 5: Steps, stages and methods for the valuation of wetlands



[10] Emerton, L. and E. Bos (2004) Counting Ecosystems as Water Infrastructure. Gland: IUCN. 88 pp.

[11] Springate-Baginski, O., Darwall, W., Emerton, L., Allison, E., McIvor, A. and C. Bambaradeniya (in press). A Toolkit for Integrated Wetland Assessment. Cambridge: Freshwater Biodiversity Assessment Unit, International Union for Conservation of Nature.

Setting the study scope and parameters (Stage I)

Step 1: Defining the study goal and management focus:

Economic valuation cannot take place in isolation: it must be directed by a particular management or policy issue that needs to be addressed, or a particular decision that needs to be made about the use of funds, land or other resources.

The information that is generated by a valuation study assists in understanding or dealing with this issue, or in making this decision. It is the management or policy issue which determines the scope, objective and parameters of the valuation study — what it will include, what it will exclude, which values will be considered, and to what ends.

The very first step in wetland valuation is, therefore, to define and understand the management context in which the study is taking place, and the management need and issue it addresses. This, in turn, determines the questions which have to be answered by the valuation study, and the information it needs to generate.

It is impossible to define before what these questions will be — obviously the specific management issue that is being addressed by the valuation study will vary in different cases. There are, however certain types of issues which are faced commonly by wetland managers, and for which valuation studies can provide important information to assist in decision-making. For example:

- Justifying or making a case for wetland conservation;
- Identifying wetland financing needs and mechanisms;
- Assessing the impacts of upstream developments on wetland status;
- Choosing between particular wetland management regimes;
- Assessing the profitability of different sustainable use options;
- Looking at needs and niches for local benefit sharing;
- Setting fees for wetland use, or penalties or fines for illegal activities;
- Estimating the relative profitability, or returns, to different investment, land and resource use options in and around wetlands.

Step 2: Identifying the scale and boundaries of the study:

This step involves defining who and what will be included in the study and at what level of detail.

It is rarely necessary, or practical, for a valuation study to consider each and every value, stakeholder or unit of area associated with a given location. In line with the overall objective or management/policy focus, it is necessary to define the boundaries of the valuation study, and to demarcate the area in which it will actually work. The second stage of a valuation study is, therefore, to identify the scale and boundaries within which the study will focus, including the geographic boundary of the site to be studied, its socio-economic boundary (or user/beneficiary population), as well as the time-period to be incorporated in the study.

Defining wetland values (Stage 2)

Step 3: Identifying and categorising wetland values:

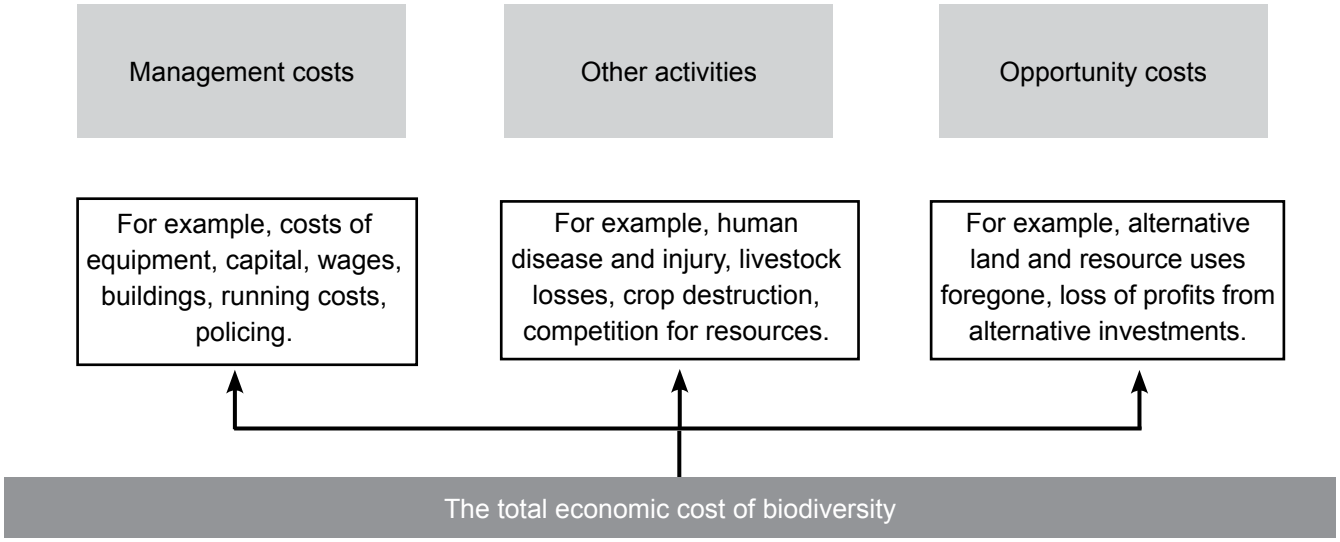
This step involves prioritising wetland benefits and selecting those which will be valued in the study. It should result in a list of wetland economic costs and benefits that will form the focus of the study. Field checklists (#1 and 2) for identifying, listing and selecting wetland costs and benefits to be valued are provided at the end of this chapter.

- Wetlands yield multiple goods and services, and also acquire a range of economic costs. In any valuation study, it is important to define and categorise all the costs and benefits that have relevance to the given wetland. These values should include both direct and indirect values. (See Figure 11, page 36, Volume 1.)

Costs:

There is a tendency, especially in conservation-based assessments, to ignore the fact that wetlands generate a wide variety of costs, which impact on people's livelihoods and economic activities. As in the case for benefits, wetlands costs have tended to be defined narrowly in the past. Valuation must take account of the full range of economic costs associated with wetlands as illustrated in Figure 5 below.

Figure 6: The total economic cost of wetlands (After Emerton and Bos, 2004)



- **Management costs**: management costs are direct physical expenditures on the equipment, infrastructure and human resources required to manage wetlands;
- **Opportunity costs**: opportunity costs are the alternative uses of time, land, money and other resources required for wetlands conservation which could have generated income and profits had they been used differently or allocated elsewhere such as agricultural land uses or unsustainable resource utilisation activities foregone in wetland areas, wetlands polluting industrial technologies and production processes precluded or upstream water developments prevented;
- **Costs to other activities:** costs to other activities are the damage and interference to human and economic activities caused by wetlands resources and species, including human and livestock disease and injury, crop pests and sources of competition over resources.

All of these costs lead to economic losses because they require cash, require expenditures, decrease income or reduce livelihood options. Valuation, in addition to making a monetary estimate of wetlands benefits, attempts to quantify the total economic costs associated with wetlands.

Step 4: Selecting the costs and benefits to be valued

In most cases it is impossible to value each and every economic benefit and costs associated with a particular wetland. For this reason, it is necessary to decide on which benefits and costs the study will value, and how. Once these have been identified, they need to be prioritised in terms of their importance to the overall goal and objectives of the study (which, in turn, is determined by its management focus).

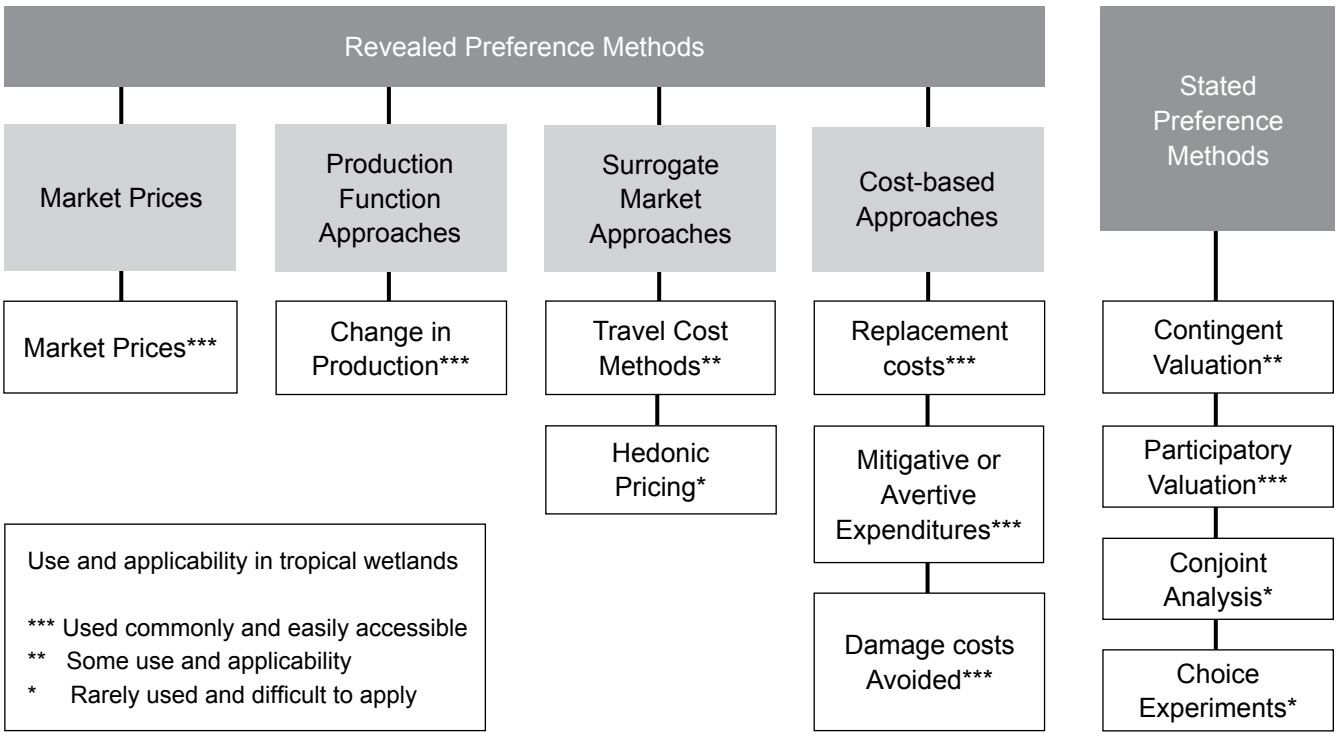
Step 5: Choosing the appropriate wetland valuation techniques

This step involves examining the economic methods and techniques that will be used to value selected wetland benefits/costs. It should result in a list relating wetland benefits/costs to economic valuation techniques. A field checklist (#3) for choosing wetland valuation techniques is provided at the end of this annexe.

A wide variety of methods are now available with which to quantify wetland values. Each method has different requirements, is more or less applicable to different types of wetland costs and benefits, and has varying suitability in different situations. For this reason, having defined and prioritised which costs and benefits the valuation study will focus on, it is necessary to decide on which method(s) will be used to determine the value of each.

After identifying the values and the costs and ranking them, the values and the costs need to be assigned a monetary value. There are a number of techniques that are used to do this, which can be categorised in a number of ways. One way of classifying wetland valuation methods is to distinguish between revealed preference methods (those which rely on observing people's behaviour to ascertain the value of wetland goods and services) and stated preference methods (those which directly ask people the value they place on wetlands). These are illustrated in Figure 6, and described below.

Figure 7: Methods for wetland valuation (From Emerton and Bos, 2004)



- **Market prices**: This approach looks at the market price of ecosystem goods and services as they are bought or sold in the market.
- **Production function approaches**: These approaches, including effect on production, attempt to relate changes in the output of a marketed good or service to a measurable change in the quality of quantity of ecosystem goods and services by establishing a biophysical or dose-response relationship between ecosystem quality, the provision of particular services, and related production.
- **Surrogate market approaches:** These approaches, including travel costs and hedonic pricing, look at the ways in which the value of ecosystem goods and services are reflected indirectly in people's expenditures, or in the prices of other market goods and services.
- **Cost-based approaches**: These approaches, including replacement costs, mitigative or avertive expenditures and damage costs avoided, look at the market trade-offs or costs avoided of maintaining ecosystems for their goods and services.
- **Stated preference approaches:** Rather than looking at the way in which people reveal their preferences for ecosystem goods and services through market production and consumption, these approaches ask consumers to state their preference directly. The most well-known technique is contingent valuation, participatory valuation is gaining currency particularly in situations where wetland use is primarily for subsistence purposes, while less commonly-used stated preference valuation methods include conjoint analysis and choice experiments.

All of these methods are elaborated in detailed in the next few pages. Different categories of method are more or less suitable for different kinds of wetland costs and benefits. Market price and surrogate market price techniques are most suitable for wetland direct values, while wetland indirect values are commonly measured using cost-based and production function approaches. Stated preference methods are, in principle, applicable to any category of wetland benefit, and provide some of the few available methods which can be used to estimate option and existence values.

Valuing wetland costs and benefits (Stage 3)

Step 6: Undertaking the valuation exercise: carrying out data collection:

This step involves formulating a list of the data that must be collected to allow the economic valuation of wetland benefits. It should result in a list of data requirements for valuing selected wetland benefits and costs. A field checklist (#4) for identifying data needs and sources for the valuation exercise is provided at the end of this annexe.

Having prioritised the wetland costs and benefits to be valued, and selected the most appropriate methods by which to do this, it is necessary to determine what data will be required to apply the chosen valuation methods and to identify how these data will be collected. It should be underlined that before starting valuation fieldwork, it is important to have thought through what data will be required, and how they will be obtained. Typically, a valuation study will use various data collection techniques and information sources, including both primary and secondary data collection:

- **Literature review**: including a review of similar valuation studies carried out in other areas or countries, as well as of documents and reports that contain information on the wetland under study such as project eports, government statistics and records, scientific articles and publications.
- **Expert consultation**: including with technical experts (for example, sociologists, hydrologists, biologists and ecologists, civil engineers) as well as with the various stakeholders who are involved in managing and using the wetland (for example, government officials, NGOs, community leaders, local households, wetland user groups).
- '**Traditional' socio-economic information gathering techniques**: such as questionnaires, interviews and statistical analysis.
- **Participatory techniques**: such as focus group interviews, Participatory Rural Appraisal (PRA) and Rapid Rural Appraisal (RRA) techniques.

Having identified the data sources and collection techniques, the next thing to do is to actually apply the selected valuation methods. A detailed description of each of the main valuation techniques is given below, which is primarily drawn from IUCN's toolkit for valuing water-based ecosystem services (Emerton and Bos 2004).

Applying wetland valuation techniques (Stage 3)

Market price techniques:

Overview of the method:
The simplest, most straightforward and commonly-used method for valuing any good or service is to look at its market price: how much it costs to buy, or what it is worth to sell. In a well-operating and competitive[12] market these prices are determined by the relative demand for and supply of the good or service in question, reflect its true scarcity, and equate to its marginal value[13].

In theory, market price techniques can be applied to any ecosystem good or service that can be freely bought or sold. They are particularly useful for valuing the resources and products that are harvested from water-dependent ecosystems, for example, timber, fuelwood, fish, or non-timber forest products.

Data collection and analysis requirements:
There are three main steps involved in collecting and analysing the data required to use market price techniques to value ecosystem goods and services:
- Find out the quantity of the good used, produced or exchanged;
- Collect data on its market price;
- Multiply price by quantity to determine its value.

[12] A market is said to be competitive when there are a large number of buyers and sellers, there are no restrictions on market entry, buyers and sellers have no advantage over each other and everyone is generally informed about the price of goods.
[13] Marginal value is the change in value resulting from one more unit produced or consumed

These data are generally easy to collect and analyse. Market information, including historical trends, can usually be obtained from a wide variety of sources such as government statistics, income and expenditure surveys, or market research studies. In most cases it will be necessary to supplement these secondary sources with original data, for example through performing market checks or conducting some form of socio-economic survey.

When applying this technique it is important to ensure that the data collected cover an adequate period of time and sample of consumers and/or producers. Factors to bear in mind include the possibility that prices, consumption and production may vary between seasons, for different socio-economic groups, at different stages of the marketing or value-added chain, and in different locations.

Applicability, strengths and weaknesses:
The greatest advantage of this technique is that it is relatively easy to use, as it relies on observing actual market behaviour. Few assumptions, little detailed modelling, and only simple statistical analysis are required to apply it.

A major disadvantage is the fact that many ecosystem goods and services do not have markets or are subject to markets which are highly distorted or irregular. In such cases, it is not appropriate to use market price techniques.

- Ecosystem services such as catchment protection or nutrient retention are rarely available for purchase or ale. Because they have many of the characteristics of public goods[14], it is in fact questionable whether the market can ever accurately allocate or price them.
- Many ecosystem goods and natural products are used at the subsistence level. They are not traded in formal markets, and are consumed only within the household.
- There exist a wide variety of subsidies and market interventions which distort the price of natural products or ecosystem-dependent goods. Examples include subsidies to water and electricity, centrally-set royalties and fees for products such as timber, and state controlled prices for basic food and consumer items.
- Because markets for most ecosystem goods and services are not well-developed, they tend not to be competitive, and prices are a poor indicator of true social and economic values. This may be the case where there is an additional social or environmental premium attached to natural goods and services, where there are only a small number of buyers and sellers, or where there is imperfect market information.
- In many cases, even where an ecosystem good has a market and a price, it is impossible to measure the quantities produced or consumed. Especially at the subsistence level, natural resource consumption and sale is often highly seasonal or irregular. For example, particular products are only available at particular times of the year, are used under special conditions, or are collected and used on an opportunistic basis. Ecosystem goods are also often collected and consumed as part of a bundle of items or have high levels of substitution[15] or complementarity[16] with other goods. For example, they are used only when other products are unavailable or unaffordable, or they form occasional inputs into the production of other goods.
- Even where an ecosystem good or service has a market, and quantities bought or sold can be measured, prices do not tell us how important this good or service is to society, nor how much some buyers would actually be willing to pay.

In such cases it is usually necessary to use alternative valuation techniques, such as those described below.

Effect on production techniques:

Overview of the method:
Even when ecosystem goods and services do not themselves have a market price, other marketed products often rely on them as basic inputs. For example, downstream hydropower and irrigation depend on upper catchment protection services, fisheries depend on clean water supplies, and many sources of industrial production use natural products as raw materials. In these cases, it is possible to assess the value of ecosystem goods and services by looking at their contribution to other sources of production, and to assess the effects of a change in the quality or quantity of ecosystem goods and services on these broader outputs and profits.

[14] A public good is characterised by the non-excludability of its benefits – each unit can be consumed by everyone, and does not reduce the amount left for others. Many ecosystem services are pure or partial public goods – for example, scenic beauty (a pure public good), or water quality (which has many of the characteristics of a public good). In contrast a private good is one from which others can be excluded, where each unit is consumed by only one individual. Most natural resources are private goods.

[15] A substitute good or service is one which is used in place of another – for example, kerosene instead of firewood, or bottled water instead of tap water.

[16] A complementary good is one which is used in conjunction with another – for example, between other products and fishing activities such as the collection of reeds for fishing baskets or firewood for fish smoking.

Effect on production techniques can thus be used to value ecosystem goods and services that clearly form a part of other, marketed, sources of production - for example, watershed protection and water quality services, or natural resources that are used as raw materials.

Data collection and analysis requirements:
There are three main steps to collect and analyse the data required for effect on production techniques to value ecosystem goods and services:

- Determine the contribution of ecosystem goods and services to the related source of production, and specify the relationship between changes in the quality or quantity of a particular ecosystem good or service and output;
- Relate a specified change in the provision of the ecosystem good or service to a physical change in the output or availability of the related product;
- Estimate the market value of the change in production.

Effect on production techniques rely on a simple logic, and it is relatively easy to collect and analyse the market information that is required to value changes in production of ecosystem-dependent products (see above, market price techniques).

The most difficult aspect of this method is determining and quantifying the biophysical or dose-response relationship that links changes in the supply or quality of ecosystem goods and services with other sources of production. For example, detailed data are required to relate catchment deforestation to a particular rate of soil erosion, consequent siltation of a hydropower dam and reduced power outputs, or to assess exactly the impacts of the loss of wetland habitat and water purification services on local fisheries production. To be able to specify these kinds of relationships with confidence usually involves wide consultation with other experts, and may require situation-specific laboratory or field research, controlled experiments, detailed modelling and statistical regression.

Applicability, strengths and weaknesses:
Effect on production techniques are used commonly, and have applicability to a wide range of ecosystem goods and services. Their weakness relates to the difficulties that are often involved in collecting sufficient data to be able to accurately predict the biophysical or dose-response relationships upon which the technique is based. Such relationships are often unclear, unproven, or hard to demonstrate in quantified terms. Simplifying assumptions are often needed to apply the production function approach.

An additional concern is the large number of possible influences on product markets and prices. Some of these should be excluded when using effect on production techniques. In some cases changes in the provision of an ecosystem good or service may lead not just to a change in related production, but also to a change in the price of its outputs. That product may become scarcer, or more costly to produce. In other cases consumers and producers may switch to other products or technologies in response to ecosystem change or to a scarcity of ecosystem goods and services. Furthermore, general trends and external factors unrelated to ecosystem goods and services may influence the market price of related production and consumption items. They must be isolated and eliminated from analysis.

Travel cost techniques:

Overview of the method:
Ecosystems often hold a high value as recreational resources or leisure destinations. Even when there is no direct charge made to enjoy these benefits, people still spend time and money to visit ecosystems. These travel costs can be taken as an expression of the recreational value of ecosystems. We can use this technique at the whole ecosystem level, taking into account all of its attributes and components in combination, or for specific goods or services such as rare wildlife, opportunities for extractive utilisation of products such as fishing or resource collection, or for activities such as hiking or boating that are related to its services. In the example given below, improved freshwater ecosystem quality was estimated through looking at visitor travel costs.

Data collection and analysis requirements:
There are six main steps involved in collecting and analysing the data required to use travel cost techniques to value ecosystem goods and services as listed in the following page.

- Discover the total area from which recreational visitors come to visit an ecosystem, and dividing this into zones within which travel costs are approximately equal;
- Within each zone, sample visitors to collect information about the costs incurred in visiting the ecosystem, motives for the trip, frequency of visits, site attributes and socio-economic variables such as the visitor's place of origin, income, age, education and so on;
- Obtain the visitation rates for each zone, and use this information to estimate the total number of visitor days per head of the local population;
- Estimate travel costs, including both direct expenses (such as fuel and fares, food, equipment, accommodation) and time spent on the trip;
- Carry out a statistical regression to test the relationship between visitation rates and other explanatory factors such as travel cost and socio-economic variables;
- Construct a demand curve relating number of visits to travel cost, model visitation rates at different prices, and calculate visitor consumer surplus[17].

Travel cost techniques depend on a relatively large data set. Quite complex statistical analysis and modelling are required in order to construct visitor demand curves. Basic data are usually collected via visitor interviews and questionnaires, which make special efforts to cover different seasons or times of the year, and to ensure that various types of visitors from different locations are represented.

Applicability, strengths and weaknesses:
The travel cost method is limited mainly to calculating recreational values, although it has in some cases been applied to the consumptive use of ecosystem goods.

Its main weakness is its dependence on large and detailed data sets, and relatively complex analytical techniques. Travel cost surveys are typically expensive and time consuming to carry out. An additional source of complication is that several factors make it difficult to isolate the value of a particular ecosystem in relation to travel costs, and these must be taken into account in order to avoid over-estimating ecosystem values. Visitors frequently have several motives or destinations on a single trip, some of which are unrelated to the ecosystem being studied. They also usually enjoy multiple aspects and attributes of a single ecosystem. In some cases travel, not the destination *per se*, may be an end in itself.

Hedonic pricing techniques:

Overview of the method:
Even if they do not have a market price themselves, the presence, absence or quality of ecosystem goods and services influences the price that people pay for, or accept for providing, other goods and services. Hedonic pricing techniques look at the difference in prices that can be assigned to the existence or level of ecosystem goods and services. Most commonly this method examines differences in property prices and wage rates between two locations, which have different environmental qualities or landscape values. In the example given below, the value of urban wetlands was estimated through looking at impacts on property prices.

Data collection and analysis requirements:
There are five main steps involved in collecting and analysing the data required to use hedonic pricing techniques to value ecosystem goods and services:

- Decide on the indicator to be used to measure the quality or quantity of an ecosystem good or service associated with a particular job or property.
- Specify the functional relationship between wages or property prices and all of the relevant attributes that are associated with them, including ecosystem goods and services.
- Collect data on wages or property prices in different situations and areas which have varying quality and quantity of ecosystem goods and services.
- Use multiple regression analysis to obtain a correlation between wages or property prices and the ecosystem good or service.
- Derive a demand curve for the ecosystem good or service.

[17] Consumer surplus is the difference between the value of a good and its price, in other words the benefit over and above what is paid that is obtained by a consumer who is willing to pay more for a good or service than is actually charged. When a benefit is obtained free, all of its value is consumer surplus.

Hedonic pricing techniques require the collection of a large amount of data, which must be subject to detailed and complex analysis. Data are usually gathered through market observation, questionnaires and interviews, which aim to represent a wide variety of situations and time periods.

Applicability, strengths and weaknesses:
Although hedonic pricing techniques can, in theory, be applied to any good or service they are most commonly used within the context of wage and property markets.

In practice, there remain very few examples of the application of hedonic pricing techniques to water-related ecosystem goods and services. One reason for this, and a weakness in this technique, is the very large data sets and detailed information that must be collected, covering all of the principal features affecting prices. It is often difficult to isolate specific ecosystem effects from other determinants of wages and property prices.

Another potential problem arises from the fact that this technique relies on the underlying assumption that wages and property prices are sensitive to the quality and supply of ecosystem goods and services. In many cases markets for property and employment are not perfectly competitive, and ecosystem quality is not a defining characteristic of where people buy property or engage in employment.

Replacement cost techniques:

Overview of the method:
It is sometimes possible to replace or replicate a particular ecosystem good or service with artificial or man-made products, infrastructure or technologies. For example, constructed reservoirs can replace natural lakes, sewage treatment plants can replace wetland wastewater treatment services, and many natural products have artificial alternatives. The cost of replacing an ecosystem good or service with such an alternative or substitute can be taken as an indicator of its value in terms of expenditures saved. In the example below, the value of wetland water quality services was estimated through looking at the costs of replacing these services by artificial means.

Data collection and analysis requirements:
There are three main steps involved in collecting and analysing the data required to use replacement cost techniques to value ecosystem goods and services:

- Ascertain the benefits that are associated with a given ecosystem good or service, how it is used and by whom, and the magnitude and extent of these benefits;
- Identify the most likely alternative source of product, infrastructure or technology that would provide an equivalent level of benefits to an equivalent population;
- Calculate the costs of introducing and distributing, or installing and running, the replacement to the ecosystem good or service.

Data collection is relatively straightforward, and usually relies on secondary information about the benefits associated with a particular ecosystem good or service and alternatives that are available to replace it. In most cases this can be ascertained through expert consultation and professional estimates, supplemented with direct observation.

Applicability, strengths and weaknesses:
Replacement cost techniques are particularly useful for valuing ecosystem services, and have the great advantage that they are simple to apply and analyse. They are particularly useful where only limited time or financial resources are available for a valuation study, or where it is not possible to carry out detailed surveys and fieldwork.

The main weakness of this technique is that it is often difficult to find perfect replacements or substitutes for ecosystem goods and services that would provide an equivalent level of benefits to the same population. In some cases this results in ecosystem under-valuation, as artificial alternatives generate a lower quantity or quality of goods and services. Yet this technique may also lead to the over-valuation of ecosystem benefits, as in some instances the replacement product, infrastructure or technology may be associated with secondary benefits or additional positive impacts. The reality of the replacement cost technique is also sometimes questionable: we may question whether, in the absence of a well-functioning ecosystem, such expenditures would actually be made or considered worthwhile.

Mitigative or avertive expenditure techniques:

Overview of the method:
When an economically valuable ecosystem good or service is lost, or there is a decline in its quantity or quality, this almost always has negative effects. It may become necessary to take steps to mitigate or avert these negative effects so as to avoid economic losses. For example, the loss of upstream catchment protection can make it necessary to desilt reservoirs and dams, the loss of wetland treatment services may require upgrading water purification facilities, and the loss of ecosystem flood control may require the construction of flood control barriers. These mitigative or avertive expenditures can be taken as indicators of the value of maintaining ecosystem goods and services in terms of costs avoided.

Data collection and analysis requirements:
There are four main steps involved in collecting and analysing the data required to use mitigative or avertive expenditure techniques to value ecosystem goods and services:

- Identify the negative effects or hazards that would arise from the loss of a particular ecosystem good or service.
- Locate the area and population who would be affected by the loss of the ecosystem good and service, and determine a cut-off point beyond which the effect will not be analysed.
- Obtain information on people's responses, and measures taken to mitigate or avert the negative effects of the loss of the ecosystem good or service.
- Cost the mitigative or avertive expenditures.

Data collection and analysis is relatively straightforward, and usually relies on a combination of interviews, surveys, direct observation and expert consultation.

Applicability, strengths and weaknesses:
Mitigative or avertive expenditure techniques are particularly useful for valuing ecosystem services. In common with other cost-based valuation methods, a major strength is their ease of implementation and analysis, and their relatively small data requirements.

As is the case with the replacement cost technique, the mitigative or avertive measures that are employed in response to the loss of ecosystem goods and services do not always provide an equivalent level of benefits. In some cases it is also questionable whether in fact such expenditures would be made or would be seen as being worth making. An additional important factor to bear in mind when applying this technique is that people's perceptions of what would be the effects of ecosystem loss, and what would be required to mitigate or avert these effects, may not always match those of 'expert' opinion.

Damage cost avoided techniques

Overview of the method:
Ecosystem services frequently protect other economically valuable assets. For example, the loss of catchment protection services may result in increased downstream siltation and flooding, which leads to the destruction of infrastructure, settlements and agriculture. Such damage costs can be taken to represent the economic value of ecosystems in terms of expenditures avoided.

Data collection and analysis requirements:
There are four main steps involved in collecting and analysing the data required to use damage cost avoided techniques to value ecosystem goods and services:

- Identify the protective services of the ecosystem, in terms of the degree of protection afforded and the on and off-site damages that would occur as a result of loss of this protection;
- For the specific change in ecosystem service provision that is being considered, locate the infrastructure, output or human population that would be affected by this damage, and determine a cut-off point beyond which effects will not be analysed;
- Obtain information on the likelihood and frequency of damaging events occurring under different scenarios of ecosystem loss, the spread of their impacts and the magnitude of damage caused;
- Cost these damages, and ascribing the contribution of the ecosystem service towards minimising or avoiding them.

Data collection is for the most part straightforward, usually relying on a combination of analysis of historical records, direct observation, interviews and professional estimates. Predicting and quantifying the likelihood and impacts of damage events under different ecosystem scenarios is however usually a more complex exercise, and may require detailed data and modelling.

Strengths and weaknesses of the method:
Damage cost avoided techniques are particularly useful for valuing ecosystem services. There is often confusion between the application of damage costs avoided and production function approaches to valuation. Here it is important to underline that whereas this technique deals with damage avoided such as from pollution and natural hazards (which are typically external effects), change in production techniques usually relate to changes in some input such as water (typically internalised).

A potential weakness is that in most cases estimates of damages avoided remain hypothetical. They are based on predicting what might occur under a situation where ecosystem services decline or are lost. Even when valuation is based on real data from situations where such events and damages have occurred, it is often difficult to relate these damages to changes in ecosystem status, or to be sure that identical impacts would occur if particular ecosystem services declined.

Contingent valuation techniques:

Overview of the method:
Absence of prices or markets for ecosystem goods and services, of close replacements or substitutes, or of links to other production or consumption processes, does not mean that they have no value to people. Contingent valuation techniques infer the value that people place on ecosystem goods and services by asking them directly what is their willingness to pay (WTP) for them or their willingness to accept compensation (WTA) for their loss, under the hypothetical situation that they could be available for purchase.

Contingent valuation methods might, for example, ask how much people would be willing to see their water bills increase in order to uphold quality standards, what they would pay as a voluntary fee to manage an upstream catchment in order to maintain water supplies, how much they would contribute to a fund for the conservation of a beautiful landscape or rare species, or the extent to which they would be willing to share in the costs of maintaining important ecosystem water services.

Data collection and analysis requirements:
There are five main steps involved in collecting and analysing the data required to use contingent valuation techniques to value ecosystem goods and services:

- Ask respondents their WTP or WTA for a particular ecosystem good or service.
- Draw up a frequency distribution relating the size of different WTP/WTA statements to the number of people making them.
- Cross-tabulate WTP/WTA responses with respondents' socio-economic characteristics and other relevant factors.
- Use multivariate statistical techniques to correlate responses with respondent's socio-economic attributes.
- Gross up sample results to obtain the value likely to be placed on the ecosystem good or service by the whole population, or the entire group of users.

This valuation technique requires complex data collection and sophisticated statistical analysis and modelling, which are described in detail elsewhere. (See Carson and Mitchell 1989.)

Most contingent valuation studies are conducted via interviews or postal surveys with individuals, but sometimes interviews are conducted with groups. A variety of methods are used in order to elicit people's statement or bids of their WTP/WTA for particular ecosystem goods or services in relation to specified changes in their quantity or quality. The two main variants of contingent valuation are: dichotomous choice surveys, which present an upper and lower estimate between which respondents have to choose; and open-ended surveys, which let respondents determine their own bids. More sophisticated techniques are also sometimes used, such as engaging in trade-off games or using take-it-or-leave it experiments. The Delphi technique uses expert opinion rather than approaching consumers directly.

Applicability, strengths and weaknesses:
A major strength of contingent valuation techniques is that, because they do not rely on actual markets or observed behaviour, they can in theory be applied to any situation, good or service. They remain one of the only methods that can be applied to option and existence values, and are widely used to determine the value of ecosystem services. Contingent valuation techniques are often used in combination with other valuation methods, in order to supplement or cross-check their results.

One of the biggest disadvantages of contingent valuation is the large and costly surveys, complex data sets, and sophisticated analysis techniques that it requires. Another constraint arises from the fact that they rely on a hypothetical scenario which may not reflect reality or be convincing to respondents.

Contingent valuation techniques require people to state their preferences for ecosystem goods and services. They are therefore open to various sources of bias, which may influence their results. The most common forms of bias are strategic, design, instrument and starting point bias. Strategic bias occurs when respondents believe that they can influence a real course of events by how they answer WTP/WTA questions. Respondents may for instance think that a survey's hypothetical scenario of the imposition of a water charge or ecosystem fee is actually in preparation. Design bias relates to the way in which information is put across in the survey instrument. For example, a survey may provide inadequate information about the hypothetical scenario or respondents are misled by its description. Instrument bias arises when respondents react strongly against the proposed payment methods. Respondents may for instance resent new taxes or increased bills. Starting point bias occurs when the starting point for eliciting bids skews the possible range of answers, because it is too high, too low, or varies significantly from respondents' WTP/WTA. With careful survey design, most of these sources of bias can however be reduced or eliminated.

Participatory valuation techniques:

Overview of the method:
It is often difficult to use conventional environmental valuation techniques within largely subsistence-based economies, or to generate realistic estimates of local wetland use. Participatory valuation responds to some of the constraints and problems associated with using conventional valuation techniques, including:

- Many wetland goods have no substitute or market price, or it is unrealistic to use these as a proxy for their value in situations where the majority of the population do not have access to markets or substitutes.
- Cash measures and market prices may have little relevance in a subsistence economy where cash is not the main medium of exchange or indicator of local value.
- People frequently become suspicious when faced with a scenario where they must state a monetary willingness to pay/accept compensation for a natural product, if they suspect that they will be actually subjected to some kind of payment, tax or compensation. They will often under-quote the amount of money they would be willing to pay for wetlands goods if they fear that such charges may actually be made in the future, and over-quote the compensation they require if they think there may be a possibility of actually receiving payments.
- Most wetland uses are illegal in protected areas. People are reluctant to speak openly about their wetland use activities because they fear arrest. Some activities also have ritual or cultural significance, and knowledge is considered the preserve of specialist groups. Whereas households are reticent in the face of direct questioning, indirect techniques are a good means of stimulating discussion and gathering information.

Participatory valuation aims to find a bridge between local economic systems and cash values, and elicit information about wetland use and values at the subsistence, non-market level. It allows people to define wetland values within the context of their own perceptions, needs and priorities rather than according to externally-imposed categories or market prices. It is particularly suitable for valuing occasional, subsistence-based or illegal wetland uses, and for relating wetland values to broader household livelihoods.

Data collection and analysis requirements:
There are seven main steps to collect and analyse the data required for participatory valuation techniques to value ecosystem goods and services:
- Establishing the categories of wetland product, and types of activities, that are carried out in a particular locality;

- Defining a numeraire, or yardstick for valuation which is not cash. This is usually a commodity that forms an important part of the local socio-economy, has wide significance as an item of local value and exchange, and can easily be translated into a cash amount;
- Using picture cards to refer to each wetland product or activity that is used, and to the selected numeraire;
- Performing a ranking exercise on the picture cards, to ascertain the relative importance of different products;
- Establishing values by distributing a set number of counters between different picture cards, including the numeraire;
- Using the number of counters allocated to each card, translating wetland products into numeraire equivalents and converting this to cash amounts based on the price/market value of the numeraire;
- Discounting the resulting figures to give annual wetland use values.

Applicability, strengths and weaknesses:
Participatory valuation techniques have most applicability to subsistence economies, particularly those which are relatively remote and where the majority of the population have a high livelihood dependence on wetland products. They are particularly useful in situations where wetland goods are used for subsistence purposes only, where wetland use is illegal, or otherwise a sensitive topic. One factor to bear in mind is that even where markets for wetland products exist, participatory valuation rarely yields the same value estimates as market prices. This is because it is based on local perceptions of value, which may well not coincide with market-driven prices. Different people will value products differently, as values will reflect their relative importance to them in their daily lives, according to their personal preferences and responsibilities. Participatory valuation often yields far higher estimates of wetland value than other methods, because it incorporates a wide range of perceptions of value and is not confined to market prices alone.

Selection of the numeraire must be undertaken carefully, and a single measure used consistently across the community being studied. It is often challenging to identify a measure which has relevance and value for all concerned, and can be accurately reflected via a monetary value. It should be emphasised that the results of participatory valuation *must* be converted to an equivalent annual amount (or whatever time period that wetland values are being calculated for). This depends on the effective lifespan of the numeraire that has been selected.

Other stated preference techniques: conjoint analysis and choice experiments:

Other stated preference valuation methods include conjoint analysis and choice experiments. Due to their complexity in terms of data needs and analysis, and because there exist very few examples of their application to ecosystem water services (see, for example, DGA & UAC 2000, Griner and Farbver 1996, Kuriyama 2002, Morrison et al 1998), these methods are not described in detail here.

Conjoint analysis was developed originally in the fields of marketing and psychology, in order to measure individuals' preferences for different characteristics or attributes of a multi-choice attribute problem. In contrast to contingent valuation, conjoint analysis does not explicitly require individuals to state their willingness to pay for environmental quality. Rather, conjoint asks individuals to consider status quo and alternative states of the world. It describes a specific hypothetical scenario and various environmental goods and services between which they have to make a choice. The method elicits information from the respondent on preferences between various alternatives of environmental goods and services, at different price or cost to the individual.

Choice experiments techniques present a series of alternative resource or ecosystem use options, each of which are defined by various attributes including price. Choice of the preferred option from each set of options indicates the value placed on ecosystem attributes. As is the case for contingent valuation, data collection and analysis for choice experiments is relatively complex. Usually conducted by means of questionnaires and interviews, choice experiments ask respondents to evaluate a series of 'sets', each containing different bundles of ecosystem goods and services. Usually, each alternative is defined by a number of attributes. For example, for a specific ecosystem this might include attributes such as species mix, ecosystem status, landscape, size of area, price or cost. These attributes are varied across the different alternatives, and respondents are asked to choose their most preferred alternative. Aggregate choice frequencies are modelled to infer the relative impact of each attribute on choice, and the marginal value of each attribute for a given option is calculated using statistical methods.

Analysing and presenting the data for decision-making (Stage 4)

Calculating the economic value of wetlands is not an end in itself. Rather, it is a means of providing information which can be used to make better and more informed choices about how resources are managed, used and allocated. In order for the results of the valuation study to influence real-world policy and practice, it is of critical importance that time and thought is given to analysing the data that has been gathered, and presenting it in a form that captures the attention of decision-makers, and is convincing to them.

Step 7: Analysing and expressing the valuation data.

This step involves relating values to the management issue or scenario under study and expressing changes in wetland status as indicators for decision-making support. It should result in quantified estimates of wetland benefits and costs, understanding of the economic implications of particular wetland management scenarios, and expression of changes in wetland status as indicators for decision-making support.

Decision-makers, whether in conservation or development sectors, are concerned primarily with choosing between different uses of land, funds and other resources - for example, whether to manage a wetland under strict protection or to allow for some form of sustainable use, whether or not to build a dam, irrigation scheme or housing estate, which infrastructure design option to invest in, or whether to zone a wetland for conservation or to convert it to settlement or agriculture (assessing damage to a wetland). To analyse the results of a valuation study thus we need to be able to express ecosystem values as measures that make sense to decision-makers when they weigh up the different funding, land and resource management choices that wetland decisions involve.

Conducting a valuation study provides us with data about the economic value of particular wetland goods and services. However, what is important for decision-making is to be able to understand and express how making choices between alternative uses of land, water, resources or investment funds will influence these values. For example, how much additional flood-related costs would be incurred if a wetland were degraded, and what downstream production losses would arise from additional silt loads? Or what additional investments in water treatment and purification would be required if a particular wetland were reclaimed? Or what potential actually exists for raising revenues from urban dwellers to maintain water quality in a particular river or lake?

In order to answer these questions, and to integrate wetlands values into these decision-making processes, it is necessary to be able to analyse data so as to trace the economic implications of changes in the stock of wetland resources, flows of wetland services, or attributes of wetland systems that result from following a particular course of action, and factor them into measures of its economic desirability. In other words, we need to know what the economic impacts of particular decisions will be in terms of wetland costs and benefits.

Building up a bio-economic model:

Various studies have demonstrated the utility of applying a simple bio-economic model in order to generate information for wetland decision-making (Colavito 2002, Creemers and van den Bergh 1998, Bennett and Whitten 2002). This type of model presents a useful tool for relating wetland values to decision-making, and involves a number of steps which translate baseline data on ecosystem values into information that can be used to assess the economic impacts of decisions on wetlands:

- Establish ecological and socio-economic background and parameters: This involves identifying, defining and understanding the status of the wetland and its links to hydrological goods and services, their benefits and beneficiaries, and the way in which various social, institutional and management aspects affect it.
- Calculate baseline economic values from which to measure ecosystem changes: This involves carrying out the partial or total valuation study.
- Link physical changes in ecosystem status and integrity to changes in these economic values: This involves tracing the effects of different decisions on the provision of wetland goods and services, and determining the impacts of these changes on economic values.
- Express the results as indicators or measures that can be integrated into broader economic appraisal or analysis processes: This involves expressing the results of value changes as quantitative indicators or measures that can be integrated into wider decision-support frameworks. The next two sections look at

two of the most commonly used techniques for expressing wetland values in decision-making: cost-benefit analysis and multi-criteria analysis.

Cost Benefit Analysis:

Cost-Benefit Analysis (CBA) remains the most commonly used decision-making framework for using the results of a wetland valuation study in order to assess and compare economic and financial trade-offs. It is the standard tool for appraising and evaluating programmes, projects and policies and one that is a required part of many government and donor decision-making procedures. CBA is a decision tool that judges alternative courses of action by comparing their costs and benefits. It assesses profitability or desirability according to net present benefits - the total annual benefits minus total annual costs for each year of analysis or project lifetime, expressed as a single measure of value in today's terms.

In order to bring a project's benefits and costs over time to their present value, each is discounted. Discounting is essentially the inverse of applying a compound interest rate, and gives values relatively less weight the further into the future they accrue. It accounts for the fact that people generally prefer to enjoy benefits now and costs later, and that any funds tied up in a project could be used productively to generate returns or profits elsewhere. In most cases, the discount rate is therefore based on the opportunity cost of capital - the prevailing rate of return on investments elsewhere in the economy.

ICBA presents three basic measures of worth, which allow different projects, programmes or policies to be assessed and compared with each other:

- **Net Present Value (NPV)** is the sum of discounted net benefits (i.e., benefits minus costs), and shows whether a project generates more benefits than it incurs costs.
- **Benefit Cost Ratio (BCR)** is the ratio between discounted total benefits and costs, and shows the extent to which project benefits exceed costs.
- **Internal Rate of Return (IRR)** is the discount rate at which a project's NPV becomes zero.

In general, a project can be considered to be worthwhile if its NPV is positive and its BCR is greater than one and if its IRR exceeds the discount rate. A positive NPV and a BCR greater than one means the project generates benefits that are greater than its costs. An IRR above the discount rate means that the project generates returns in excess of those which could be expected from alternative investments.

There are basically two types of Cost-Benefit Analyses: financial and economic. Financial CBAs look only at the private returns accruing to a particular individual or group. They calculate costs and benefits at market prices, reflecting the actual cash profits and expenditures that people face. A financial CBA might for example measure and compare the relative profitability of different dam design options for a hydropower company, the returns to improved water and sanitation facilities for urban consumers, or the highest earning mix of irrigated crops for a farmer. Here, wetland values will primarily be incorporated into CBA calculations as they influence private costs and benefits, affect investments and are expressed through market prices.

In contrast, economic CBAs examine the effects of projects, programmes and policies on society as a whole. They consider all costs and benefits, for all affected groups. Sometimes weights are assigned to prioritise particular groups, benefits or costs that are considered to be of particular importance in economic terms. As such, economic CBAs are mainly carried out by public sector and donor agencies, who are concerned with broad development impacts. For example, an economic CBA would consider the total costs and benefits of different hydropower design options, such as relocation costs and loss of production incurred by reservoir flooding, income from increased employment in the power sector and benefits associated with improved earning opportunities arising from electrification. An economic CBA of different irrigated crop mixes might include consideration of the premium attached to foreign exchange earnings from export crops, improved food security benefits, and revenues in agro-processing and value-added industries.

Because economic CBAs assess the desirability of a given course of action from the perspective of society as a whole, they usually adjust financial costs and benefits to account for the various imperfections and distortions in the market. It recognises that market prices are not a good indicator of the true social and economic value of goods and services. This means that wetland values should form an integral component of economic CBAs.

Other economic decision-support tools:

CBA remains the most widely used tool for the financial and economic appraisal of projects, programmes and policies. Other, less commonly-used, value-based measures of profitability or economic/financial desirability include:

- *Cost-effectiveness analysis*: This decision-support tool judges the minimum cost way of attaining a particular objective. Is useful where a project has no measurable benefits, or where a particular goal has already been set (for example, maintaining a certain water quality level). It involves calculating all the costs of attaining the given objective, discounting them, and pointing to the option with the lowest NPV.
- *Risk-benefit analysis:* This decision-support tool focuses on the prevention of events carrying serious risks (for example, investing in flood prevention). It assesses the costs of inaction as the likelihood of the specified risk occurring. The benefit of inaction is the saving in the cost of preventive measures. Is useful where risk is a major consideration in projects, and can be captured via monetary values.
- *Decision analysis:* This decision-support tool weights the expected values of a given course of action (in other words, the sum of possible values weighted by their probability of occurring) by attitudes to risk, to give expected utilities. It draws up and assesses decision makers' preferences, judgements and trade-offs in order to obtain weights that are attached to outcomes carrying different levels of risk.
- *Multi-criteria analysis:* Multi-criteria analysis provides one of the most useful and increasingly common tools for integrating different types of monetary and non-monetary decision criteria. It has been developed to deal with situations where decisions must be made taking into account multiple objectives, which cannot be reduced to a single dimension. Multi-criteria analysis is usually clustered into three dimensions: the ecological, the economic and the social. Within each of these dimensions certain criteria are set, so that decision-makers can weigh the importance of one element in association with the others. Here, monetary values and CBA measures can be incorporated as one of the criteria to be considered, and weighed against the others in decision-making.

Step 8: Presenting management and decision-making conclusions.

This step involves relating the findings of the valuation study to on-going management issues, and targeting this to particular audiences and aims. It should result in a convincing report on the economic status and value of the wetland as it relates to management priorities and threats.

However good the results of a valuation study are, they will have little impact on decision-making if nobody sees, reads or is persuaded by them. There is an art to presenting information, and communicating it effectively. In many cases, the technical experts who carry out the valuation study itself may not be the best placed to do this – there is often a need for professional communicators and a properly-designed communications strategy.

Information about wetland values will be easiest to communicate when decision-makers find it useful, and it is helps them to address or better understand a particular situation or problem. Many people are involved in shaping decision-making, and communication of the results of valuation studies must usually take place at many levels of scale. Making the results of valuation convincing to these different groups requires different types of communications strategies, different messages and different ways of presenting information.

In a perfect world where all decisions were made for the good of society, merely making valuation information available might be enough to ensure that water decisions took fair account of ecosystems. Unfortunately this is not usually the case. There exist multiple, and often competing, interests in wetlands. Fostering cooperation and balancing these competing interests is critical when the results and recommendations of wetland valuation studies are presented. Here, it is important to be tactical and work with the different constituencies who actually have the political will, and power, to influence wetlands. Just as wetland valuation aims to articulate particular costs and benefits that have traditionally been ignored in decision-making, it also represents the interests of many of the groups who have often been excluded from these decisions.

Table 6: Valuation checklist #1: identifying and listing wetland values

Category of value	Values found in study wetland	Beneficiary or cost-bearing group
Direct values		
Indirect values		
Option values		
Existence values		
Direct costs		
Opportunity costs		
Costs to other activities		

Table 7: Valuation checklist #2: selecting wetland costs and benefits to be valued

Benefit/Cost	Values found in study wetland	Beneficiary or cost-bearing group

Values found in study wetland	Beneficiary or cost-bearing group	Include ☐	Exclude ☐

Values found in study wetland	Beneficiary or cost-bearing group	Include ☐	Exclude ☐

Table 8: Valuation checklist #3: choosing wetland valuation techniques

Values found in study wetland	Beneficiary or cost-bearing group	Include ☐	Exclude ☐

Values included in study	List of possible valuation techniques	Technique to be used ☐	Technique not to be used ☐

Values included in study	List of possible valuation techniques	Technique to be used ☐	Technique not to be used ☐

Table 9: Valuation checklist #4: identifying data needs and sources

Values included in study	List of possible valuation techniques	Technique to be used ☐	Technique not to be used ☐

Values included in study	Selected valuation technique	Data required	Source of data

Values included in study	Selected valuation technique	Data required	Source of data

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Steps, stages and methods for the assessment of livelihoods in a village (extracted from CARE 2008)[18]

Note that this is a technical annexe that requires knowledge of sociology and Participatory Rapid Appraisal (PRA) techniques.

Objectives of socio-economic profiles

The objectives of household livelihoods (HLS) assessment are to:

- Assess livelihood security and the underlying causes of poverty amongst selected target groups at [focal site].
- Analyse the underlying causes of poverty in [focal site] in order to promote appropriate livelihood security programming options.
- Identify the most appropriate interventions likely to have the largest sustainable impact related to targeted outcomes, i.e., social positions, human conditions, and enabling environment.
- Train staff on how to develop and conduct an HLS assessment: and
- Train staff on a procedure for using the results of an HLS analysis to design a programme or project.

This assessment uses a variety of exercises that employ Participatory Rapid Appraisal (PRA) techniques, as described below.

A combination of data collection procedures is used, including:

- Qualitative community profiles of different villages representing different combinations of livelihood systems and potential target groups. Participatory analysis tools used for this assessment include:
  - Key informant interviews;
  - Focus group discussions with separate community groups of men and women;
  - Wealth ranking exercise aimed at understanding community-perceived social differentiation;
  - Venn diagramming exercise to understand social and institutional positions of key community institutions;
  - Household opportunity analysis to identify 'positive deviant' households representing success stories in managing risks; and
  - CBO case studies to understand the power dynamics between the organisation or institution being studied and other entities in or around the community.
- Household survey of a specified number of households from specified villages.

The qualitative assessment aims at enhancing our understanding about local livelihood systems – the economic, socio-cultural and political context, including human conditions, social positions, and the enabling environment. The teams used a variety of tools to analyse the constraints to food and livelihood insecurity, vulnerabilities, marginalisation, and risks of poor families living within this context. The major objective is to gain maximum in-depth knowledge regarding the underlying causes of poverty among vulnerable populations.

The assessment team can be subdivided into teams of facilitators each with a supervisor, who visit villages, spending two days in each village, facilitating male and female focus group discussions, key informant interviews, household survey questionnaires, CBO case studies, venn diagrams, case studies of relatively resilient households, and wealth ranking exercises. All of the team members can then spend evenings and a full day entering a substantial amount of qualitative data into matrices used for analysis. Table 1 on the following page outlines the three day process for each of two cycles – four villages in each cycle.

[18] Extracted from Care (2008) Household livelihoods assessment in Jaffna, Sri Lanka. Volume 1: Report of the findings. Prepared by Tango International.

Table 10: Three-day data collection and analysis process

Day 1		
Activity	Number	Tools and targeted group
Transect walk and large group		Introduction to the village, recruitment of participants, introduction of the team to the village, purpose and process of 2-day community exercise.
Focus group interviews	2	Topical outline – Focus group with men and women of different livelihood strategies.
Wealth ranking exercise	1	Wealth ranking matrix, flip charts; group of poor residents; results used to establish household survey participants to be visited later.
Venn diagram exercise	2	Flip charts; men and women groups.
Key informant interviews	1-3	KI format; meet with 1-3 individuals.
Household interviews	5 HH	HH survey questionnaire; meet with man and woman of the household together.
Day 2		
Activity	Number	Tools and targeted group
Focus group interviews	2	Topical outline – focus group with men and women of different livelihood strategies.
Resilient HH case studies	4	Topical outline – Households identified during focus group discussion.
CBO case study	At least 1	Topical outline, problem ranking.
Household interviews	5 HH	HH survey questionnaire.
Day 3		
Objective: To process the information obtained in the previous two days to draw conclusions to be entered in the matrices and assessment summary formats.		
Activity	Tools	
Data entry into focus group matrices and compilation of summary information	Matrices for focus groups, wealth ranking, CBO and resilient HH case studies, venn diagrams, summary formats, notes on various tools used, visual displays.	
Quantification of HH surveys	Tables quantifying 80 household surveys.	

1. Qualitative community profiles

A. Key Informant Interviews

Assessment team members meet with key informants in each of the eight communities selected in order to obtain a 'snapshot' of community issues and a community profile. The key informant interview topical outline sought information about:

- Demographic trends;
- Settlement history;
- The economic base and village resources of the community;
- Community infrastructure, including water, schools, health facilities, extension service facilities, markets, and roads; and
- Decision-making and power relations within the community.

The key informant village profile format is presented on the following page.

Village profile

1. Identification:

	Particulars	Name
A. Name of KI	___ division	
B. Age in years	___ division	
c. Status/Occupation	Village	

- How was the village formed?
- What changes have occurred in the village over the last 20 years?
- In the last 20 years, what have been the major events affecting the village?
- What are the strengths and weaknesses of the village?

2. Demographic features:

Type of household (Including ethnic or IDP)	Number of HH	Headed by		Total population		Remarks
		Male	Female	Male	Female	
Total						

Number of disabled people in the village: _____ men _____ women.

3. Major livelihoods:

- What are the major sources of livelihoods for people residing in the village?
- For those people living in the village who are extremely poor, what are their major sources of food and income?
- For those people living in the village who are poor, what are their major sources of food and income?

4. Natural resources:

- What are the major types of land in the village?
- What are the major crops grown?
- What are the major tree crops that are grown?
- What are the major water resources available to the village (irrigation systems, tanks, rivers, ocean)?
- What kinds of livestock and poultry are produced in the village, on what scale?
- Do people in the village have access to wild animal, fish or bird resources?

Common property natural resources for the community:

- What common resources are available in the village? How are these resources used? Who makes decisions about their use?
- Who has access to the common resources? Which types of livelihoods groups use these common resources? Which groups are not allowed to use the resources? Why?
- What role does the government or other institution(s) play to ensure access to the common resources?

Environmental quality:

- What changes have occurred environmentally over the last 20 years?
- What major environmental problems does the village face and how do these affect the village?

5. Basic services

i) Infrastructure

Is electricity available in the village? Yes No

If Yes, how many households have access? _____
If no, what is the coping strategy? _____

ii) Transport services

Types of transport services	Quality of services

iii) Potable water and sanitation

Sources of drinking water in the village (indicate number of sources):

Piped water:_____Open well:_____Tube well/bore well: _____
Other (specify): _____
Latrines in the village:

Status	Number		
	Latrine	House	Well
Permanent			
Semi-permanent			
Common			
No fixed place			

- Where do people get water for other uses?
- How would you describe the quality of the water? (For example, is there arsenic, iron, other?)
- How do the sources of water change over the seasons?
- Who owns the water sources or if they are common sources, who makes decisions about accessing the water?
- Which people in the village do not have access to clean water? Why do they not have access?
- How much does water cost?

iv) Education

Educational facilities in the village:

Type of school	Distance from village	Number of children attending	Number of girls attending
Primary school			
High school/college			
Technical institution/university			
Non-formal education (NGO)			
Others (specify)			

- What is the literacy rate in the community?_____
- How does this differ between men and women? Men_____Women_____

v) Health services/Medical facilities

SL #	Type of medical facility	Fees/cost (in relevant currency)	Distance(in km)
1	Teaching hospital		
2	Base hospital		
3	District hospital		
4	Divisional hospital		
5	Dispensary		
6	Mobile clinic		
7	Private clinic		
8	Indigenous medical practice		
9	Other (specify)		

How often does the public health inspector visit the community? _____
How often does a midwife visit the community? _____

6. Decision-making and power

i) Social decision-making

Official	Distance	Time (in hours)	Quality of service
District secretariat			
Divisional secretariat			
Provincial council / Municipal council			
Lower division			
Civil affairs			

- Who represents the community with local authorities, including government?
- Does this person live in the village? If not, how often does he or she come to the village?
- If the village has a problem with a neighbouring village, how does that problem get solved?
- If two households or two groups of households in the village have a problem with each other, how does that problem get solved? Give an example.
- How have these social problem-solving mechanisms changed over the last 20 years?

ii) Social groups

a. Number of RDS members from the village: _____
b. Number of WRDS members in the village: _____
c. Are there any CBOs?: Yes_____No_____
If Yes,

Name	Activity	# of M/W members	Active/Inactive	Representative at district / division levels?

How have these groups changed over the last 20 years?

Are there any local or international NGOs implementing activities in the village? Yes ____ No ___

Name of NGO	Activities	Current or past?	If NGO stopped implementing activities, why?

iii) Access to government extension services

Extension service	How often do they visit the village?	If not, why not?	Type of service provided
Agriculture			
Livestock			
Fisheries			
Health			

iv) Access to capital

- If someone in the village needs to money because of an emergency, what do they do?
- Which kinds of people can do this and which cannot?
- Under what terms are they able to get access to money for an emergency?
- What about accessing money for income-generating activities?
- What do different kinds of people in the village do?
- How have the sources of money changed over the last 20 years?

Sources of capital:

SL#	Financial institution	Distance (in km)	Types of loans	Terms and conditions of loan
1	Name of state bank			
	Name of private bank			
2	Cooperative society/rural bank			
3	Government schemes in village			
4	NGO			
5.	Other (specify)			
6	Other (specify)			

B. Focus Group Discussions

The assessment team can facilitate focus group discussions, including at least one all-female focus group, and other focus groups by livelihood strategy, such as farming households with land and farm labourers without land, or wealth group, in each of the eight villages. Facilitated focus group discussions can follow the topical outline but should be allowed to develop naturally with greater attention paid to topics the participants felt are the most important. Gathering information from different focus groups proves useful in comparing perceptions and priorities. The focus group discussions should include:

- Community profiles;
- Community perceptions of access to and quality of services, resources, and infrastructure, including transport, schools, markets, and health facilities;
- Area features, including forests, water, climate, and erosion;
- Social capital, political capital, and human rights within the community;
- Livelihood strategies, including agriculture, animal husbandry, horticulture, fishing, wage labour, and other income generating activities (IGAs); and
- Summaries of community problems and priorities.

The focus group topical outline is presented below.

Topical outlines for data collection

Focus Group Discussions

Village_____
Division_____ Division_____
Facilitator _____ Recorder_____
Focus group gender _____
Number of people in group discussion: _____ Date_____

Collect qualitative information in each of the selected villages. Use four Focus Group (FG) discussions in each qualitative sample village: male and two female groups, with approximately six to ten members each. Select the four male and female focus groups according to wealth or livelihood categories. Interview the men's and women's groups separately.

Two survey team members should conduct each group discussion: one facilitator and one note-taker or recorder. It is important that a female member of the team facilitates the women's group and a male member of the team facilitates the men's group.

Begin by meeting a large community group in order to introduce yourselves and the purpose of the household livelihoods assessment to the focus groups. Use the large community group to identify the different focus groups, based on wealth categories, livelihood categories, and gender. Explain that the discussion will take at least two to three hours. Another hour will be needed for the wealth ranking exercise.

What follows is not a list of formal interview questions, but an outline to guide small group discussions. This is a guideline to help guide the discussion, not a list of questions to be filled in. Keep the conversation flowing and encourage discussion within the group.

I. *Village information:*
   Village history:
   - Settlement pattern: How long have people lived here? From where? Reasons for moving?
   - What changes have occurred in the village in the last 5-10 years? Good changes; bad changes. Why?
   - What are the major strengths and weaknesses of the community? Why?

   a. Household demographics:
      - Is there seasonal migration? Who migrates? Why do people migrate?
      - Where do people migrate?
      - How long is the migration period?
      - What are the major challenges people face when they migrate? Why?
      - Do men and women both migrate? What do women do when men migrate? Which people are more vulnerable? Why?

   b. Infrastructure: perceptions about access/quality:
      - Transport (road type, seasonal accessibility, transport service)
      - Schools (all levels):
        - What types of schools? (Primary, secondary, other schools)
        - Accessibility (time/distance, fees);
        - Where are the nearest schools?
        - Quality of school (desks/latrine/books, teachers);
        - Valued by community? for both boys and girls?
        - Drop outs and reasons: Why do children drop out?
        - Any difference for boys/girls? Why?
        - General problems and participation in school management;
        - How has quality of schools changed over the past three years?

- Common markets
  - Describe the most commonly used common market.
  - Accessibility: time/distance/transport available, costs, if accessible all seasons;
  - Availability of different items in the market;
  - Type/frequency: (Village, regional);
  - Why do you go to market? (primary and secondary uses);
  - Do you get fair prices? How do you know the fair prices (for sale/purchase)?
  - Have prices or availability changed over the past three years? How?
- Other community structures (including community centres, CBO centres)

c. Health facilities
   1. Health services and quality:
      - Accessibility: (time/distance/cost);
      - What kinds of health facilities are available?
      - Are the different health facilities accessible and used? Why/why not?
      - Describe the quality of service of the health facilities.
      - Do you consult traditional health providers?
      - For what types of health issues or diseases?
      - Why do you use traditional health providers instead of government health facilities?
      - What types of traditional health providers are commonly used?
      - Where do you seek antenatal care?
      - Where do you go for birth/delivery?
      - Describe the quality of maternal child care? Why?
      - Common childhood diseases? Causes of child death?
      - Any knowledge of HIV/AIDS? Is HIV/AIDS found in the community? How has HIV/AIDS affected the community?

d. Area features
   1. Water (drinking/irrigation/non-drinking)
      - Sources – seasonal availability, distance, reliability;
      - Time to collect;
      - Quality of water;
      - Control of access to water (community/government/private – cost?);
      - Methods of storage of water, water treatment procedure, Costs of water and use pattern;
      - Trends in access to water over the past five years? Any changes? Describe the changes.
   2. Natural disasters
      - Have there been erratic rains over last decade, flash floods, major floods, cyclones?
      - How was the village affected by the tsunami?
      - How does the village cope with disasters?
      - Any activities to protect village and households from disasters? Describe protection activities.
      - Trends/changes over the past five to ten years?
      - Any major environmental problems? Please describe.
      - Any major climate changes over the past five to ten years? Please describe.

II. Livelihood strategies (All major livelihood activities):

a. Agriculture: Crop production
   1. Major crops grown in order of importance (food crops for domestic consumption/for sale as cash crops) by land type/quality;
   2. Access to agriculture inputs:
      - Sources and availability of seeds (local seeds/hybrid seeds);
      - Fertiliser use: sources and extent of use (manure, compost, chemical)?
      - When and which crops use fertiliser?
      - Pest control: cultural, mechanical, biological, chemical?
      - Animal traction: use, own or rent, cost, availability?
      - Irrigation: regular or irregular, source of irrigation, methods of irrigation;

- Which crops are irrigated?
- Who has access to inputs; who has no access?

3. Access to government or NGO services
   - Types of services: credit, extension?
   - Agricultural extension: access and quality;
   - Access to credit facilities (formal/informal, terms of repayment, specify NGO, Government, moneylender;
   - Type of credit, quality, usefulness, frequency of use.
4. Crop/Food storage
   - Types, length of storage, amount of losses, reasons for losses;
   - Measures taken to prevent or control losses.
5. Marketing of agricultural produce – farmgate marketing
   - Where is the farmgate market?
   - Which products do you market and when?
   - Are the prices you receive fair? Why or why not?
   - Major problems or constraints associated with marketing (Rank).
   - How has marketing changed in the past five years? Why are there changes?
6. Problems associated with production
   (Ranking exercise)
   - Potential solutions to the problems listed above.
   - Has production been increasing or decreasing? Why?
7. How has the war affected agricultural production?
8. Land tenure systems – ownership/access patterns
   - Who owns land? What is the average landholding?
   - Is landlessness a problem? Why?
   - Is there sharecropping (terms, conditions and trends)? Why?
   - What are the sharecropping arrangements? (lease, mortgage, etc.)
   - Is there any conflict over land? Describe.
   - Trends in access to land.

b. Horticulture
   1. What kinds of horticultural activities are practiced?
      - Homestead gardening?
   2. What is normally grown?
   3. Who participates in this activity?
   4. What are the seasons?
   5. Is the production for sale or for consumption (for each crop)?
   6. Do most households have gardens or arable land nearby? How far away normally?

c. Animal Husbandry
   1. Types of animals raised, in order of importance
      - Uses of livestock (production, animal traction, slaughter, consumption, sale)
      - Rearing practices and patterns (hybrid and indigenous livestock types)
      - When are livestock sold and for what reasons?
   2. Availability of pasture: is there any conflict over pasture land, fodder (availability, changes in accessibility).
   3. Major animal diseases, availability of veterinary services.
   4. Poultry types:
      - What are your perceptions and knowledge of avian flu?
   5. How has the war affected animal husbandry? What types of livestock were most affected? Why?
   6. Changing trends in animal husbandry over the past five to ten years.
   7. Major constraints and potential solutions.

d. Fishing
   1. Types of fishing;
   2. Fishing gear owned or funded, boat, nets, costs;

3. What is the moneylending and renting system, credit access for fishing and availability
   - Extension service availability and quality;
4. Fishing production/harvest amounts;
5. Extent of dry fish making;
6. Marketing arrangements, price and seasonal variations;
7. Changes in availability/scarcity?
8. Describe the quality/availability/access to fishing inputs (boats, nets, etc.), markets, and storage facilities;
9. Problems or constraints to production? How to solve these problems?
10. Access to water bodies: What water bodies can households access?
    - What water bodies do you do not have access to? Why?
    - Purposes of use of water bodies.

e. Other Income Generating Activities (IGAs)
   1. Type of activity, extent of practice, and number of activities practiced:
      - Artisan production;
      - Agricultural enterprise;
      - Weaving;
      - Petty vending and trading;
      - Small shops/boutiques;
      - Service;
      - Other IGA;
   2. When do you do each of these activities? (Year-round, annually?)
   3. How much do you earn from each IGA?
   4. Demand and use of credit: is credit available?
      - Source of credit for IGAs (moneylenders, government, NGOs);
      - Terms of credit (interest rates, loan terms, mortgages);
   5. Any support service provided by government? By NGOs?
      - Any technical skills training? Extension services? Who provides?
   6. Availability of wage labour: How many days/month do you participate?
      - Months/year;
   7. Migration for work: where to, why, who goes, when, for how long?
   8. Remittances: from where, when?
   9. Any constraints in earning enough from this activity?
   10. Trends over the past 5-10 years.

f. Wage labour
   1. What kinds of daily labour activities do households undertake?
   2. Who is involved from the household?
   3. How often and when do these activities occur?
   4. What kind of compensation do men and women receive?
      - Differences between men and women's compensation?
   5. What are the major constraints or problems to wage labour activities? Why?
   6. What opportunities exist to increase income from wage labour activities?
   7. Why are households not pursuing these opportunities?
   8. Describe trends and changes in these activities in the last five to ten years.

g. Changes in livelihood strategies in the past several years?
   - Which households are more successful at making these changes?
   - What do these households do?
   - Identify households for the PD case study.

III. Social capital

a. Borrowing or lending relationships:
   1. If a household in this livelihoods group faces a crisis or shock, from whom can they go to borrow money or food? Do you borrow from someone in a different or same social class or social caste? Why?
   2. What is owed back after borrowing money or food? What is expected?

3. How strong are relationships between social classes or social castes? Please describe the differences.
4. What are major constraints to different groups working with each other?
5. How have social relationships changed in the past five to ten years? Describe.

b. Human Rights
1. Are there any rights that people feel are not being respected?
   - What kinds of rights are not respected? Why?
2. Are there any groups in the village who are denied equal rights?
   - Who are these groups?
   - Why are they denied equal rights?
   - Who denies them their rights?
3. How have human rights changed in the past five to ten years?
4. What should be done to change this situation?
5. What has the community already accomplished?

IV. Political capital

a. Power relationships:
1. How are decisions made in this community?
2. Please describe how decision-making occurs in this community.
   - Is decision-making fair and transparent? Why or why not?
   - Who makes the decisions?
3. Do all households have equal participation in decision-making?
   - Why or why not?
4. How have power relationships changed in the past five to ten years?

b. Political parties or groups:
1. Do some groups have more power than others in this community?
   - Why or why not?
2. Do any groups control the assets or resources?
3. Have any groups' assets been lost to another group? Please explain.
4. Please describe any changes in the past five to ten years.

V. Community constraints and solutions:

Rank in order of importance, and address strategies/trends for each.

a. Major problems: Thinking about the issues discussed above and others not discussed, what are the major problems facing the community?
   - What are the major causes of these problems? Prioritise – ranking exercise.

b. Trends :Are these problems getting worse or better over the last three to five years?
   - Why is it worse or better?

c. Interviewer summarises key problems discussed, asks if anything was left out.

d. What can the community do?/Is the community doing to solve these problems?
   - List and rank the most important initiatives.

e. Prosperity
   If we had the power to change one thing to improve the quality of life in the village, what would we do?
   - Why?
   - Who would be positively affected by the change?
   - Who would be negatively affected?
   - What is the fundamental cause of this particular problem?
   - What is the village currently doing at address this particular problem?

C. Wealth Ranking Exercise

Select residents comprising men and women from the community were asked to participate in an exercise to determine:

- Perceptions of poverty and vulnerability;
- Wealth groupings by community-defined attributes;
- Proportions of community residents belonging to the identified wealth categories; and
- Specific household identification for participation in the household questionnaire survey, based on proportionality of wealth groups.

Community residents define three or four wealth categories, ranging from 'very poor' to 'poor' to 'middle' or 'middle poor' to 'better-off' to 'rich'. The wealth ranking exercise provided the assessment team with key indicators of poverty and vulnerability by wealth category, including (amongst other variables):

- Food consumption patterns;
- Access to land, livestock, and assets;
- Income sources;
- House types; and
- Social capital within the community.

The wealth-ranking format is presented below.
Village_____
Division_____ Division_____
Group ggender _____ Date_____
Facilitator_____ Recorder_____

Wealth categories				
Indicators	Category 1 _____	Category 2 _____	Category 3 _____	Category 4 _____
Food/diet (quality and quantity)				
Access to land and size of landholding				
Livestock (types and numbers)				
House (type/size)				
Assets (productive and non-productive)				
Types of employment (e.g. fishing, wage labour, govt., business, etc.)				
Membership in institutions (including CBOs)				
Remittances from abroad				
Water and sanitation (Water sources and toilets)				
Levels of education				
Other				
Number and proportion of HH in this category				

Observations:	

D. Venn Diagrams

The research team should also conduct an institutional and social positioning exercise, in order to describe issues around social capital within the community, including community and household inter-relations. Starting with the community at the center, focus group participants should be asked to describe and then to place the most Important institutions serving community and households. Which institutions do community residents deem to be closest to them; which institutions are furthest from their interests or participation? The research team should facilitate two Venn diagram sessions per community, allowing different groups of men and women to reflect on their position *vis-à-vis* institutions within the community. Residents should be asked to comment why they positioned the institutions in relation to trust and institutional importance.

The Venn diagramming exercise is presented below.

Venn diagramming exercise:

- This is a social and institutional positioning exercise.
- Describe community and household relations with key institutions.
- Begin with community at the centre.
- Describe important community institutions and organisations.
- Which institutions are most important from the perspective of the focal group discussion?
- Which institutions does the community trust and feel closest to?
- From which institutions does the community feel alienated?

Venn diagram exercise process:

- Draw institutions as defined by community.
- Draw the most and least important in relation to community and households.
- Facilitator asks for reflection and feedback.
- Rearrange the Venn diagram.
- Why are these institutions positioned in such a way?
  - Trust and importance of institutions for community
- What would be better?
  - Recommendations
- Does everybody in the focal group discussion agree?
- Draw two Venn diagrams per community: 1 male and 1 female group.
- Compare and contrast male/female Venn diagrams during analysis stage.
- Specifically ask about NGOs.
  - Which NGOs are operating in the community?
  - What are NGOs doing? Describe NGO programming activities.
  - How close is community to NGOs?
  - Assess NGO effectiveness in responding to community priorities and needs.

E. Opportunity analysis of resilient or ‘positive deviant’ households

As part of the focus group discussions, researchers should ask community participants to identify ‘positive deviant’ households representing success stories in managing risks. These households, who share similar attributes to other focal group discussion participants, have nevertheless managed to be more successful, through their adoption of different types of adaptive strategies. The team should interview four such households within each village in an effort to understand the enabling factors contributing to household self-resilience.

The household opportunity analysis topical outline is presented below.

Household opportunity analysis using positive deviance: Topical outline:

Theme: What are the enabling factors that contribute to household self resiliency?

1. Characteristics of this household
   - Landholdings;

- Asset base;
- Income sources;
- Education.

2. Household decision making by different members of household

3. What shocks have affected this community in the last five years?
   - How have you prepared for such shocks?
   - How did you cope with these shocks?
   - What have you done to recover from these shocks?

4. Capacity to adapt to vulnerability
   - What opportunities exist and have been used by the household? Probe.
   - Is there some behaviour that makes your household unique? Please explain.
   - What are some of the enabling factors for your household to become self-resilient? Probe.

5. What does it mean to be self-resilient in the community?

F. Community Based Organisation (CBO) case study:

The assessment team can garner information from a CBO or other community-based social institution to understand to what level the principles of good governance are practised by that institution. The tool can also be used to capture information to understand the power dynamics that exist in the community between the organisation or institution being studied and other entities in or around the community.

The CBO topical outline is presented below.

Tropical outline for CBO case study:

(The field team leader should make the decision on the type of CBO or village leadership institution)

Name of the Village: _____
Name of the CBO: _____
Type of CBO: _____

Person(s) interviewed:

Name: _____ Position: _____
Name: _____ Position: _____
Name: _____ Position: _____
Name: _____ Position: _____
Name: _____ Position: _____
Name: _____ Position: _____
Name: _____ Position: _____
Name: _____ Position: _____

I. History and profile of organisation

a. Organisational purpose
   - What is the purpose of the organisation?
b. Formation
   - When was the organisation formed?
   - How was it formed?
   - How has the organisation changed over the years since it was formed?

c. Membership:
   - What is the composition of the organisation? Who are members of the organisation?
d. Organisational Vision:
   - What is the vision for the organisation?
   - What does the organisation want to look like in the future, ten years from now?

II. Programme activities:

a. Current activities:
   - What are the current activities of the organisation?
   - How long have these activities been underway?
   - Why have these activities been undertaken?
b. Beneficiaries:
   - Who are the targeted beneficiaries for these activities?
c. Completed activities:
   - What other activities has the organisation undertaken in the past that are now completed?
   - What was the impact of these activities?
d. Planned future activities:
   - What kinds of activities would the organisation like to undertake in the future?
   - Why these activities?
   - What is the organisation doing to make these activities a reality?
e. Success story:
   - Of all of the activities presently undertake or undertaken in the past, of which of these is the organisation most proud? Why?

III. Resources:

a. Human resources
   - What human resources does the organisation have?
   - What are the roles of the various officers?
b. Material assets
   - What material resources does the organisation have (buildings, furnishings, office equipment, vehicles)?
   - How were these obtained?
c. Financial assets
   - What is the current annual budget for the organisation?
   - What are the sources of revenue?
   - How have these changed over the years?
d. External relations
   - What relationships does the organisation have for resources, technical support, political support or other reasons?
e. Government relations
   - Describe your relationship with the government.
   - Is anybody monitoring your activities?
   - When was the last time monitoring took place?
   - What was the impact of the monitoring?

IV. Governance system:

- Who are the leaders of the organisation?
- How were they chosen?
- For how long do they serve?
- What process is in place for changing leadership?
- How often are changes in leadership supposed to occur?
- Who are the members of the organisation?
- How many are men and how many are women?
- How much of the village does the membership represent?

- Are there any parts of the village that are not represented within the organisation? Why not?
- How does the organisation decide what kinds of activities to undertake?
- Who is involved in developing plans for these activities?
- How does the organisation report back to constituents on implementing progress and use of resources?

V. Current issues:

- What are the current issues that the organisation is working on?
- When was the last meeting of the organisation?
- What were the issues that were discussed?
- Why are these issues important?
- Who decided to work on these issues?

VI. Perceptions of the underlying causes of poverty:

a. Priority problems
   Of all of the problems in the village, what are the five most important? Rank these in priority order. Why are these five issues the most important?
   1.
   2.
   3.
   4.
   5.

b. Most important underlying causes of poverty
   - Considering the priority problems discussed above, what is the most important fundamental or underlying cause of poverty and social injustice?
   - If, while working together, we had the power to eliminate one cause of poverty and injustice, what should we do?

2. Household survey

Members of each of the assessment teams should visit ten households in each village. The wealth ranking exercise serves as a selection mechanism. Households should be were selected based on proportional identification by community members of wealth categories, which normally range from very poor to poor to middle to relatively rich. Assessment team members should then administer a household questionnaire to each selected household participating in the survey.

The household questionnaire is presented below.

Household survey questionnaire:

Questionnaire ID number: _____

I. Identification team ___ village_____ HH

SL	Particulars	
1.1	DS division	
1.2	GS division	
1.3	Village	
1.4	Interviewer signature	
1.5	Date	

II. Demographic information
- Name of the respondent: _____
- Religion: for example, Buddhist/Christian/Muslim/Hindu/Others (specify)_____
- How many years has your household lived in the village? _____
- Wealth category: _____

- Number of family members:
  Male adults _____ Female adults _____
  Male youth (ages 12-17) _____Female youth (ages 12-17) _____
  Male children (ages 6-11)_____Female children (ages 6-11) _____
  Male children under 5 years _____ Female children under 5 years _____
  Total household members _____
- Total earning members of the family Male_____ Female_____ Total_____

List the above in the table below and provide the information shown.

First name (start with family head)	Sex	Age	Education	Livelihood activities (food production or income generation)		
				Most important	Next most important	Other activities

Education: None=N; Primary=P; Secondary=Sec; University=Un; Technical school=Tec

III. Livelihoods assets:

- In the 12 months, has the household lost possession of any assets (excluding sales)? ____
- Which assets? _____
- What is the estimated value of the assets lost? Relevant currency _____
- What happened? _____
- Household assets:

Type of asset	Current quantity	Value of asset (relevant currency)	# of assets sold in past 12 months	Why was asset sold?
Crop paddy land *(select unit of area)*				
Crop highland *(select unit of area)*				
Homestead land *(select unit of area)*				
Tubewell				
Open well				
Shared well				
Cows				
Sheep or goats				
Chickens				
Ducks				
Other livestock or poultry				
House for residence				
Shop or other building				
Toilet				
Plough				
Mammotty				
Sprayer				
Water pump				
Boat (type) _____				
Boat (type) _____				

Type of asset	Current quantity	Value of asset (relevant currency)	# of assets sold in past 12 months	Why was asset sold?
Fishing nets				
Cart with bullock				
Skill tools				
Bicycle				
Motor bike				
Mobile phone				
Savings (monthly in rupees)				

IV. Livelihood activities:

a. Food production activities
   i. Please provide the following information on the sources of food for the family over the last month.

Source of food	Percentage of household food
Food crop production	
Livestock production	
Poultry production	
Fishing	
Food rations	
Purchased food	
Borrowed food	
Total	100%

   ii. For how many months in the past 12 months did your family eat three meals per day? _____
   iii. Which months did you have food shortage? _____
   iv. What were the major causes of this food shortage? (state major two)
   _____

	Household food consumption by food group	Yes	No
iv. Has your household consumed any food falling under the following food groups in the last 24 hours?	a. Grain staples (rice, sorghum, maize, millet)	1	2
	b. Tubers (potato, sweet potato, manioc)	1	2
	c. Pulses (dhal, beans, cow peas)	1	2
	d. Yellow to orange fruits and vegetables (papaya, pumpkin, mango, carrot)	1	2
	e. Fruits (banana, pineapple, jackfruit, grapes)	1	2
	f. Green leafy vegetables	1	2
	g. Other vegetables (tomatoes, gourds)	1	2
	i. Dairy (milk, cheese, yoghurt)	1	2
	j. Meats (beef, mutton, chicken, other poultry, …)	1	2
	k. Fish (fresh fish, dried fish, smoked fish)	1	2
	l. Eggs	1	2
	m. Sugar	1	2
	n. Oils/fats (soybean oil, mustard oil, cooking oil, ghee)	1	2
	o. Beverages (tea, coffee, toddy)	1	2

b. Income-generation activities:

i. Please provide information on the estimated annual total income on major income sources of the family and income earned in the last month.

Income sources	Average monthly amount in relevant currency over last 12 months
Agriculture	
Poultry	
Non-farm day labour	
Livestock	
Farm day labour	
Handicraft products	
Small business or petty trade	
Fishing/fish catch/drying	
Toddy or jaggery sales	
Skilled trades (masonry, carpentry, etc.)	
Service trades (barber, etc.)	
Government salary	
NGO salary	
Government payment (widow's fund, etc.)	
Remittances from relatives abroad_____	
Others (specify)	

ii. How have your sources of income changed in the last five years? Better/Same/Worse (Circle) Why? (2 possible reasons) _____
_____

iii. Are there other income generating activities you would like to pursue? Yes_____
No_____

iv. What are these other activities? _____

v. What do you need to pursue these activities? _____

c. Health security

- How many days were different household members sick last year?

Adult or child	Sex	Number of days sick	What type of illness	Cost

d. Asset building activities:

i. Technical advice

- Have you received any technical advice from anyone that enabled you to increase your food production or income? Yes _____No _____
- Who provided this advice? _____
- What kind of advice was it? _____

ii. Education

1. Please list the members of the household under 21 years old who are/were attending school.

Age of HH member	Sex	Grade/Level	Cost	If dropped out of school why

iii. Social capital

2. Please list the members of the household who are members of various groups in the table below.

Household member	Name of group	Attend meetings or other events? How often?

3. If you do not belong to a CBO or group, why not? _____
_____
4. Would you like to belong to a group or CBO? Yes _____ No _____
5. What group would you like to join? _____
6. Why? _____

iv. Access to capital for expanding livelihoods or for household emergencies

- Has anybody in the household taken a loan for any reason in the past three years?
  Yes_____ No_____
- Please list all loans:

Source of the loan	Amount borrowed (relevant currency)	What was the main purpose of the loan?	Annual interest rate	Amount repaid

e. Asset conversion activities

i. Regular production marketing

Please indicate items the household produced that were sold in the market last year:

Product	Quantity	Where sold (Which market)?	Total amount received

- How many times per week do household members go to the market to sell production?
  _____

ii. Input supply

Describe your household use of inputs to produce food or generate income in the last 12 months.

Type of input	Purpose of input	Amount spent on input

iii. Distress sales

- In the last 12 months, have any members of the household sold something in order to generate cash for an emergency? Yes _____No _____
- What was sold? _____
- What was the emergency? _____

V. Shocks and coping strategies

During the last three years, did your household suffer any shocks due to conflict, natural disaster, or other shocks?		Yes____ No ____
Please specify the shocks (up to 3)	1.	
2.	3.	

During that time, if there have been times when you did not have enough food or money to buy food, how often did your household have to:

SN	Coping option	Times per week			
		Every day	2-6 times per week	1-6 times per week	Never
a	Rely on less preferred and less expensive foods?				
b	Borrow food, or rely on help from friends or relatives?				
c	Purchase food on credit?				
d	Gather wild food?				
e	Consume seed stock held for next season?				
f	Send household members to live elsewhere?				
g	Limit portion sizes at mealtimes?				
h	Restrict consumption of adults so children can eat?				
i	Reduce the number of meals eaten in a day?				
j	Skip entire days without eating?				
k	Sell jewelry or household items to purchase food?				
l	Sell livestock to purchase food?				
m	Sell farm or fishing implements to purchase food?				
n	Other (specify)				
o	Other (specify)				

The survey questionnaire should solicit data about:

- Demographics, including education and economic activities;
- Food consumption and food expenditure patterns;
- Household expenditures, incomes and assets;
- Savings and loan patterns;
- Household livelihood strategies;
- Health security; and
- Shocks and coping strategies

The following is quoted directly from (http://www.mangrovesforthefuture.org/Assets/documents/RTC-Semarang-18-11-2008/Document/RTC-Coastal%20Climate%20Change%20considerations%20and%20Disaster%20Risk%20Reduction/RTC-Summary%20of%20CRISTAL%20(April%205%2007)-18-11-2008.pdf and Hammill, A., www.c3d-unitar.org/c3d_private/modules/knowledgebox/io/file.php-).?entry=235&field=1-).

Ecosystem management and restoration can reduce vulnerability to climate-related disasters but climate-related disasters will worsen. In this context, IUCN, the International Institute for Sustainable Development (IISD), the Stockholm Environmental Institute (SEI-US) and Intercooperation - the Swiss Foundation for Development and International Cooperation developed a decision-support tool called CRISTAL[19] to help project planners and managers better understand the links between climate change, livelihoods, and their work. By focusing on community-level projects, CRiSTAL promotes the development of adaptation strategies based on local conditions, strengths and needs. Its goal is to promote the integration of climate change adaptation into community-level projects (Hammill, A., www.c3d-unitar.org/c3d_private/modules/knowledgebox/io/file.php?entry=235&field=1-).

CRISTAL seeks to:
- help users to understand systematically the links between livelihoods and climate;
- enable users to assess a project's impact on community-level adaptive capacity; and
- assist users in making project adjustments to improve its impact on adaptive capacity.

Designed for community-level project designers and managers, it is user-friendly and offers multiple formats and as part of a suite of tools (Hammill, A., www.c3d-unitar.org/c3d_private/modules/knowledgebox/io/file.php?entry=235&field=1 -).

CRISTAL intends to enhance local adaptive capacity through a better understanding of:

- how current climate hazards and climate change affect a project area and local livelihoods;
- how people cope, looking specifically at the resources needed to cope with climate stress;
- how project activities affect livelihood resources that are vulnerable to climate risk and/or important to local coping strategies; and
- how project activities can be adjusted so they adaptive capacity.

CRISTAL is designed around two modules. The first module synthesises information about climate and livelihoods. It asks two questions:
- What is the climate context, examining the impacts of climate change, current hazards, the impacts of hazards and copies strategies.
- What is livelihood context, examining resources, how they are affected by hazards, how important they are to coping.

Module 2 plans and manages projects for adaptation. Again, it asks two questions:
- What are the impacts of project activities on livelihood resources that are a) vulnerable to climate risks; and b) important to coping.
- How can project activities be adjusted to reduce vulnerability and enhance adaptive capacity, and looks at synergies and barriers.

CRISTAL has been field tested in planned or ongoing natural resource management projects in Mali, Bangladesh, Tanzania, Nicaragua and Sri Lanka.

CRISTAL can be downloaded from http://www.sei-us.org/Cristal/Cristal_Setup.exe.

[19] http://www.mangrovesforthefuture.org/Assets/documents/RTC-Semarang-18-11-2008/Document/RTC-Coastal%20Climate%20Change%20considerations%20and%20Disaster%20Risk%20Reduction/RTC-Summary%20of%20CRISTAL%20(April%205%2007)-18-11-2008.pdf

IUCN's Best Practice Guidelines for Environmentally Sound Reconstruction After the Tsunami

After the Indian Ocean tsunami of December 2004, IUCN Sri Lanka was requested by various government agencies to produce some documentation on introducing environmental safeguards into post-tsunami reconstruction. A series of 14 best practice guidelines[20] were produced, published and disseminated in both national languages as well as in English. The guidelines presented the issues, impacts, the need, guiding principles and key steps to follows for a series of 14 topics: 1) Where to build; 2) Invasive alien species; 3) Materials for reconstruction; 4) Beach clean ups; 5) Solid waste management; 6) Recovery of marine ecosystems; 7) Restoring tourism; 8) Preparing for natural disasters; 9) Environmental laws; 10) Restoring terrestrial ecosystems; 11) Water pollution; 12) Restoring wetlands; 13) Restoring home gardens and 14) Safeguarding marine protected areas.

These guidelines can be adapted easily to fit a specific situation in a specific locale.

Series on Best Practice Guidelines (Sri Lanka) Information paper No. 1 After the tsunami: where to reconstruct environmental issues

The issues:
Environmental concerns are not receiving adequate attention in the process of identifying locations for reconstruction and resettlement.

- There is an urgent need to rehabilitate displaced human communities and set them on the path to sustainable lives and livelihoods.
- A coastal no-build zone of 100m in the south and west and 200m in the north and east has been proposed by the government.
- The government of Sri Lanka and other parties are seeking actively suitable land for construction and alternate building areas.
- A danger and immediate threat to ecologically and economically important sites such as wetlands and mangroves could be posed if they are cleared to provide relocation sites for temporary and permanent housing. If this is within or near protected areas, this is illegal under various laws of the country (the Fauna and Flora Protection Ordinance, the Forest Ordinance, the Coast Conservation Act and the National Environmental Act, among other laws).
- Many state and non-governmental agencies as well as many private individuals are working on reconstruction and restoration. Knowledge about existing zoning laws and protected habitats is not circulated adequately. Therefore, laws are not always enforced.

The impacts:

- Habitats such as mangroves are home to a wide range of economically and ecologically important species such as fish and crustaceans. They provide a range of livelihoods for coastal communities. Already damaged by the tsunami, further loss and clearing of mangroves will, in the long term, worsen the living conditions of coastal communities.
- Mangroves buffer the coastline against extreme weather and thereby prevent erosion, limit salt-water intrusion and protect communities against tidal surges and storms. Further loss of coastal vegetation will leave coastal communities even more vulnerable to recurrent extreme weather events such as cyclones and storms.
- Low lying wetlands function like sponges to retain water and prevent floods. They also trap and retain sediments that are washed off to the sea from rivers. Wetlands also purify water by filtering sediments and decomposing matter and converting them into usable nutrients. Construction on wetlands could result in flash floods, loss of topsoil, increased sedimentation and a very quick reduction in the capacity of the ecosystem to support coastal livelihoods.
- Construction on low-lying wetlands would also cause changes to the water-table by reducing the amount of water retained and reducing the amount that reaches deep. This could lead to increased water-shortage during periods of drought.
- Construction in wetland areas would reduce drainage and increase the likelihood of flooding.
- Housing in wetland areas where water is usually stagnant could also increase diseases such as those that are borne by mosquitoes.
- Haphazard and unplanned building will worsen the above impacts.

[20] Citation: IUCN (2005). http://data.iucn.org/places/asia/coastalinfo/best_practise.htm

The need:
There is an urgent need to select construction sites based on sound guidelines that also integrate environmental concerns. Ensuring that natural ecosystems are not destroyed is essential to securing sustainable livelihoods for coastal populations. Natural ecosystems are also vital in protecting human settlements and maintaining essential services such as flood and storm protection, water supply and quality and easing the effects of floods.

Guiding principles:
- Uphold and follow the existing laws and policies that relate to environmental management and protection.
- Avoid clearing ecologically sensitive sites such as mangroves, scrubland and forests.
- Avoid building on/filling lowland wetlands and watershed areas.
- Minimise destruction by clearing only the essential, minimal area for each building.
- Ensure that natural water courses, watershed areas, flood plains, etc. are not blocked by construction.
- Make efforts to restore and conserve ecosystems as part of the reconstruction process.
- Integrate environmental concerns in development. The methodology for carrying out very rapid Initial Environmental Examinations (RIEE) is currently available. It is advisable that such RIEEs should be carried out prior to reconstruction.

Key steps:
- Prior to selecting sites for construction, consult the Urban Development Authority (UDA) - which has offices in affected districts - to identify whether the site is ecologically sensitive. (See Box 1 for details.)
- Consult the Coast Conservation Department (CCD) if the proposed construction is within 300m of the Mean High Water Line (MHWL). (See Box 3 for details.)
- Consult the Forest Department if the proposed construction is close to a forest area and/or on mangrove/ wetland state land. (See Box 2 & 3 for a list of proposed conservation areas and details.)
- Construction within nature reserves protected by the Department of Wildlife Conservation (DWC) (Strict Natural Reserves, National Parks, Nature reserves, Jungle corridor refuges and Marine reserves) is prohibited. (See Box 2 for a list of protected areas in affected districts.)
- Consult the DWC if proposed constructions are within a Sanctuary or Buffer zone. (See Box 3.)
- Consult the CEA/DWC if proposed constructions are within 200m radius of a Sanctuary or one kilometre radius of any other protected area.
- Construction within a buffer zone needs approval under the National Environmental Act. Consult the CEA. (See Box 3 for details.)
- Involve affected communities in the process of reconstruction, and invest in providing alternate livelihoods and immediate source of income as part of the reconstruction process.

Box 1 provided information on the following, related to the UDA:

Location	District	Name of officer-in-charge	Address	Contact details

Box 2 detailed protected areas in coastal districts affected by the tsunami:

District	Name	Status
Protected Areas under the Department of Wildlife Conservation (Source: Department of Wildlife Conservation)		

Box 3 gave contact details of focal personnel in relevant organisation such as:

- The Urban Development Authority;
- The Central Environmental Authority;
- The Forest Department;
- The Department of Wildlife Conservation;
- Coast Conservation Department;
- IUCN.

Series on Best Practice Guidelines (Sri Lanka) Information paper No. 2 After the tsunami: tealing with Invasive Alien Species

What is an Invasive Alien Species (IAS)?
Invasive alien species are those non-native (non-indigenous or exotic species) that, when introduced outside their natural range, have the capability to exceed their limits imposed on them. They grow rapidly, compete vigorously and in the absence of their natural predators, push out native species and alter ecosystems. They have the potential to cause damage to the environment, human health, livelihoods and the economy.

The issue:
Coastal IAS have been transported inland by the tsunami and are now spreading rapidly, posing a threat to native biodiversity. Degraded ecosystems are very vulnerable to invasion by alien species. Debris collection areas can become ideal places for the spread of IAS. Species such as Mesquite (*Prosopis juliflora*) prefer saline soils, and hence may establish themselves in areas that have been flooded with seawater.

Displaced domestic cats and dogs could also cause problems to wildlife in protected areas.

Common IAS spreading inland as a result of the Tsunami:

Prickly pear
(Opuntia dillenii)

Mesquite
(Prosopis juliflora)

Some potential impacts of IAS:
- They alter ecosystems.
- They destroy and deplete native species.
- They become agricultural pests.
- They transmit diseases and can cause illness and/or death.
- They facilitate the spread of forest fires.
- They cause pollution of water bodies.
- Because they are agricultural pests, they reduce native species and cause fires and pollution. They are economically very damaging to communities.
- They are also costly to control and eradicate, once they have been established.

The need:
There is an urgent need to prevent the spread of IAS that have been transported inland by the tsunami. (Examples include the Prickly pear cactus, and seeds of Mesquite.)

Guiding principles:
Encourage the re-establishment of native species and eliminate invasive alien species during the process of rehabilitation.

Key steps:

- Prevent spreading by uprooting known IAS plants such as the Prickly pear Cactus and Mesquite.
- Ensure that the roots are also uprooted.
- Prevent dumping these uprooted IAS on the roadside or in rubbish dumps because they will start growing on site.
- Burn what has been removed in a safe place, away from other vegetation.
- Use native species where replanting is needed.
- Ensure that displaced domestic dogs and cats are sent to animal shelters and do not become feral (wild).
- Watch for exotic species known to be invasive in Sri Lanka (see Box 1) and contact the Department of Wildlife Conservation or IUCN for advice on eradication/control measures that should be adopted.

Contact details of relevant organisations were listed.

Box 1: List of species known to be invasive to Sri Lanka:
(from Bambaradeniya C. N. B. (2001) Aliens in Sri Lanka: The status of invasive alien species, IUCN Sri Lanka).

Animals:

Name	Habitat/Ecosystem affected
Rainbow trout *(Oncorhynchus mykiss)*	Streams
Clown knife fish *(Chitala ornata)*	Tanks, ponds, slow flowing rivers, marshes
Plectosomus catfish *(Hypostomus plecostomus)*	Tanks, ponds, slow flowing rivers, marshes
Walking catfish *(Clarias batrachus)*	Marshes, streams and canals
Guppy (*Poecilia reticulata)*	Tanks, ponds, slow flowing rivers, marshes
Western mosquito fish *(Gambusia affinis)*	Marshes, streams and canals
Mozambique tilapia *(Oreochromis mossambicus)*	Tanks, ponds, slow flowing rivers, marshes
Carp (*Cyprinus carpio)*	Tanks, reservoirs
Snake-skin gouramy *(Trichogaster pectoralis)*	Tanks, ponds, slow flowing rivers, marshes
Red-eared slider turtle *(Trachemys scripta)*	Marshes, streams, canals
Golden apple snail *(Pomacea bridgesii)*	Tanks, ponds, marshes
Giant African snail *(Achatina fulica)*	Natural and managed terrestrial habitats
Slug (Laevicaulis alte)	Natural and managed terrestrial habitats
Garden slug (*Deroceras reticulatum)*	Disturbed and managed terrestrial habitats
House mouse (*Mus musculus)*	Natural and managed terrestrial habitats
Ship rat *(Rattus rattus)*	Natural and managed terrestrial habitats
Feral cat *(Felis catus)*	Natural and managed terrestrial habitats
Feral dog *(Canis familiaris)*	Natural and managed terrestrial habitats
Feral buffalo *(Bubalus bubalus)*	Forests

Plants:

Name	Habitat/Ecosystem affected
Water hyacinth *(Eichhornia crassipes)*	Tanks, ponds, marshes, streams
Salvinia *(Salvinia molesta)*	Tanks, ponds, streams
Water lettuce (*Pistia stratiotes)*	Tanks and marshes
Hydrilla (*Hydrilla verticillata)*	Tanks, ponds, streams, canals
Pond weed *(Najas marina)*	Coastal aquatic habitats
Alocasia macrorhiza	Marshes and riparian areas
Colocasia esculenta	Marshes and riparian areas
Cattail *(Typha angustifolia)*	Estuaries, tanks and marshes

Plants contd.

Name	Habitat/Ecosystem affected
Phragmites karka	Marshes, riverbanks
Annona glabra	Coastal lagoons, marshes, riverbanks, stream banks
Cocklebur *(Xanthium indicum*)	Marshes, villus, tank margins
Dillenia suffruticosa	Marshes, streambanks, riverbanks
Giant sensitive plant (*Mimosa pigra)*	Riverbanks
Alligator weed *(Alternanthera philoxeroides)*	Fallow fields, marshy/riparian areas
Prickly Lantana *(Lantana camera)*	Shrub Scrubland, degraded open forests
Gorse *(Ulex europae)*	Montane forests, wet grasslands
Mistflower *(Eupatorium riparium)*	Shrub Montane forests
Siam weed *(Chromolaena odorata)*	Forest edge and pathways
Cestrum aurantium	Shrub Montane forests
Mesquite (*Prosopis juliflora)*	Thorn scrublands
Prickly pear cactus *(Opuntia dillennii)*	Thorn scrublands
Koster's curse *(Clidemia hirta)*	Rainforests
Mahogany *(Swietenia macrophylla)*	Disturbed forests
Mimosa invisa	Disturbed forests
Ipil ipil (Leucaena leucocephala)	Dry-mixed evergreen forests
Clusia rosea	Rock outcrop in forests
Congress weed *(Parthenium hysterophorus)*	Fallow fields, marshy areas
Wedelia *(Wedelia trilobata)*	Forest edge
Myroxylon balsamum	Dry-mixed evergreen forests
Velvet plant *(Miconia calvescens)*	Disturbed forests
Tithonia diversifolia	Secondary forests
Mile-a-minute weed *(Mikania micrantha)*	Disturbed forests and scrubland
Strawberry guava *(Psidium littorale)*	Montane forests
Alstonia macrophylla	Secondary forests
Millingtonia hortensis	Disturbed forests and scrubland
Imperata cylindrical	Disturbed forests and scrubland
Guinea grass *(Panicum maximum)*	Disturbed forests and scrubland
Fern (*Pteridium aquilinum)*	Disturbed montane forests and wet grasslands

Series on Best Practice Guidelines (Sri Lanka) Information paper No. 3: After the tsunami: materials for reconstruction

The issues:
Present post-tsunami clearing up and reconstruction efforts may have an adverse impact on the environment and therefore on human well-being.

- There is an urgent need to reconstruct almost 80,000 completely destroyed and more than 40,000 partially destroyed housing units, as well as schools, private and public sector buildings.
- The construction process itself, as well as human settlements, could give rise to undesirable environmental impacts.
- This massive reconstruction process is leading to an enormous increase in the demand for building materials.
- As a consequence of this increased demand, there is a sudden and excessive demand for natural resources such as sand, clay, timber, metal aggregates, coral-based lime, etc.
- There is already a ban on coastal sand and coral mining and a restriction on river sand mining. The increased demand for these natural resources is likely to cause an increase in illegal activities.
- There is a moratorium on logging of timber in forest reserves. The increased demand for timber (for temporary housing) is already resulting in the clearance of ecologically sensitive areas such as mangroves and may cause an increase in illegal tree felling.
- It is illegal to clear mangroves, wetlands and forests on state land

The impacts:

- Extraction of river and coastal sea sand will intensify coastal erosion and seawater moving up rivers (saline intrusion).
- Untouched sand dunes provide protection to the coastline. Extraction of sand from these sand dunes will, again, intensify erosion and leave coastal communities more vulnerable to extreme weather events.
- Coral reefs, which have been damaged and are already stressed from the impacts of the tsunami, will be under increased pressure by coral extraction. This would have serious negative impacts, as reefs are known to absorb the majority of wave energy. They not only protect the shoreline from erosion but also build up beaches (accretion) over many centuries.
- Further damage to coral reefs through extraction for lime will affect and retard the restoration of livelihoods in coastal communities as part of the ecosystem on which they depend will be destroyed.
- Destruction of the existing tree stands for timber will, again leave the coastline and coastal communities more vulnerable to natural disasters. There are clear data to prove that large mangrove stands functioned to reduce the impacts of the tsunami.
- Destruction of mangroves affects the retention of floodwater and increases surface water run off. This will intensify extreme floods in urban areas.
- Increased extraction of clay and to a lesser extent metal aggregates would involve the clearing of more vegetation leaving soil exposed to erosion.
- All of the above leaves the coastline and coastal communities more vulnerable to recurrent natural disasters such as cyclones, heavy storms, floods and droughts.

The need:

There is an urgent need to ensure that post-tsunami reconstruction does not further damage already affected ecosystems, which in turn affects coastal communities that are dependent on these ecosystems for their livelihoods.

Guiding principles:

- Reconstruct according to sound land use principles, based on minimum land use and minimum environmental impact at an acceptable cost.
- Follow proper building design and construction practices, including respecting relevant laws and policies.
- Reconstruct in a manner that does not further damage the environment.
- Environmentally friendly alternatives should be used as raw materials wherever possible for reconstruction.
- Ensure that from the beginning, relevant government departments - such as the Coast Conservation Department, Central Environmental Authority, the Forest Department, the Department of Wildlife Conservation and the Urban Development Authority - are consulted.
- Ensure that from the beginning, government agencies, local communities, local and national NGOs, humanitarian and donor agencies etc. integrate environmental concerns into reconstruction.

Key steps to be taken:

- Immediately stop extraction of coastal sand and coral, and any illegal river sand mining.
- Reuse and recycle as much building material as possible. For example, concrete debris could be crushed and used as a coarse base for road reconstruction, intact tiles can be reused etc.
- Encourage the use of environmentally friendly alternatives such as recycled wood, recycled glass; use masonry cement for plastering, etc.
- Use alternatives to tropical hardwood timber, for example, plantation timber or timber aggregates.
- As an immediate measure, explore the possibility of using offshore sand already extracted.
- Consult the Central Environmental Authority, Coast Conservation Department and the Geological Survey and Mines Bureau to explore the possibility of extracting sea sand by offshore dredging and to identify sites that are not environmentally sensitive for offshore dredging.
- Identify metal aggregate quarry sites (for producing both coarse and fine aggregate) that would cause minimal environmental damage.
- Recruit affected communities for the process of reconstruction, thus providing alternate livelihoods and immediate sources of income.

(Contact details of focal persons in relevant officers were given.)

Series on Best Practice Guidelines (Sri Lanka) Information paper No. 4: After the tsunami: cleaning up reefs and beaches

The issues:
Coral reefs have been damaged by the tsunami in a variety of ways. Abundant debris and litter on and adjacent to the reefs is causing additional damage.

- In some areas, the receding tsunami waters carried with them waste and debris from land. Much of this debris (both organic and human-made) has been deposited on coral reefs and beaches.
- Debris can physically damage the reef structures and can also stress the corals, preventing successful recovery of these important marine ecosystems.
- Debris and litter on beaches is an eyesore and discourages tourists. It can also injure people walking on the beach.
- Human-made litter can be consumed by living organisms, with sometimes fatal consequences, or it can form potentially lethal obstacles, either causing entrapment or physical harm.

The impacts:

- Coral reef ecosystems provide habitats, breeding and feeding grounds for many important species of fish harvested for commercial purposes or as food for families. The livelihoods of many coastal communities already affected by the tsunami in the short term through loss of gear and materials, can therefore also be seriously affected in the longer term by damage to the ecosystem that sustains them.
- Clean beaches and healthy coral reefs are vital for tourism. Tourism is the fourth largest contributor to Sri Lanka's GDP and brought in a revenue of nearly 400 million USD in 2004. About 50% of the registered hotels in affected areas in Sri Lanka were damaged by the tsunami and income from tourism has dropped sharply with losses estimated between 65 - 130 million USD. Debris-filled beaches and coral reefs will retard seriously the revival of coastal tourism, and the much needed revenue this brings to coastal communities.
- Reefs protect low lying coastal areas from extreme, recurrent weather events such as tropical storms and cyclones. Damage to these reefs will leave coastal communities vulnerable to recurrent natural disasters and will, therefore, weaken community development.
- Reef systems act as buffers, protecting coastal areas from erosion. Depleted reef areas can lead to coastal erosion, which will adversely affect livelihoods and infrastructure.

The need:
There is an urgent need to remove the debris and litter that has been deposited on the reefs and beaches as this is preventing the natural recovery of the coral reef ecosystem and thereby retarding the restoration of the livelihoods of coastal communities.

Guiding principles:

- Ensure that reef clean-up operations are carried out under the guidance of experienced marine specialists. Contact IUCN for further information and assistance in debris clearance. (See Box 1 for contact details.)
- Beaches with debris still remaining should be identified and cleaned. Care should be taken during the reconstruction process not to leave additional debris on the beaches as this can create a negative visual impact, or can be washed into the sea and be deposited on the reefs.
- Plan, well beforehand, the clean up process so that the necessary equipment and the expertise are available and necessary approvals obtained.
- Care and attention towards the living reef is vital – participants should be patient, and move in a slow, non-destructive way, with the minimum of disturbance to the reef as possible. The cleanups should not cause additional stress to the reef.
- Human safety is also extremely important. A safety coordinator with first aid training should be appointed, medical kits should be readily available, emergency telephone numbers should be known, and all participants should be briefed on working signals and any potential hazards.
- Debris should be sorted, separating recyclable components from non-biodegradable litter. All recyclable debris should be separated and reused, and all other debris taken to official dumping grounds.
- Ensure that collected debris is taken away and disposed in designated disposal sites. A list of dumping sites is given in Box 2. If you are uncertain about where debris should be taken, please check with the relevant authority.

Key steps (adapted from Good environmental practices: underwater cleanup: © CORAL)

- *Snorkelling*
  - Diving is not always necessary, but planning and setting protocols even when snorkeling is essential. Although snorkellers may work alone, they should follow the same basic safety protocols as divers, have the same cleanup targets, and take similar care of the reefs.
- *Planning the dive*
  - Always dive with a buddy and be sure to check equipment and review diver signals beforehand.
  - Make sure underwater conditions and weather are suitable for diving to ensure safety of divers and underwater organisms.
- *Gearing up*

  In addition to normal dive gear, divers will need:
  - Mesh sacks;
  - Gloves for protection from rubbish and sharp objects;
  - Shears or scissors for cutting fishing line and tin cans.
- *Dive protocol*
  - Work slowly and carefully.
  - Dive in a head-down position with fins up to avoid making contact with the bottom.
  - Adjust buoyancy throughout the dive as collected garbage gets heavier.
  - Make sure equipment is secured and the mesh sack is held so that nothing can trail or snag on corals.
  - One diver should collect garbage with gloves on while another holds the mesh sack.
  - Place glass, needles and hooks inside other garbage for safety.
  - Never try to remove anything that cannot be easily lifted, such as tires or car batteries.
- *Cleanup targets*
  - Plastics, especially plastic bags;
  - Cloth items or rice sacks;
  - Fishing line, netting, and broken lobster pots or fish traps;
  - Batteries, bottles without marine growth, and tin cans;
  - Cigarette butts and bottle caps;
  - Concrete debris;
  - Wood from furniture, boats;
  - Organic debris.
- *What to remove and what to leave*
  - Be cautious not to remove articles that have already been incorporated into the reef and are helping to support life.
- *Check it before you bag it*
  - Make sure nothing is living in or on each item before removal.
  - Do not remove bottles that are covered in growth.
  - Cut open tin cans to ensure that there is nothing living inside.
  - Hold cups or cans close to sandy parts of the sea bed and shake out sand or silt.
- *What to leave*
  - Anything that is ‘stuck’ or encrusted with growth;
  - Anything, no matter how ugly, which has become overgrown with marine life;
  - Anything that may be dangerous;
  - Heavy items - never use your buoyancy control device to lift heavy objects;
  - Metal drums and containers that might contain hazardous materials.
- *Plastic fishing line*
  - Never try to pull fishing lines free. Cut and remove it.
  - Use shears or scissors rather than a knife.
  - Wrap the line around an object or hand to control it.
- *After the dive*
  - Arrange for garbage to be collected or taken to an official site - do not leave it on the beach.

(Contact details of focal persons in relevant organisations were given.)

Series on Best Practice Guidelines (Sri Lanka) Information paper No. 5: After the tsunami: solid waste management

The issue:
The recent tsunami damaged buildings, infrastructure and natural vegetation. The debris created from this damage has generated a considerable amount of solid waste, both biodegradable and non-biodegradable.

- This solid waste needs to be cleared up and disposed of properly, ensuring that there is no further damage to the environment.
- Under normal circumstances, certain wastes – such as hazardous and flammable wastes – are required to be disposed with extra care. Such wastes released because of the tsunami from damaged industrial plants and fuel stations can be dangerous to human health and damaging to ecosystems.
- Solid waste can also serve as breeding grounds of disease vectors such as flies and other pests. Because of this, debris from the tsunami can increase the spread of infectious diseases.
- Debris detracts from the beauty of the environment.

The impacts:

- Dumping of debris into the sea and in lagoons will cause further damage to already damaged ecosystems and will further retard the recovery of livelihoods such as fisheries that are dependent on the healthy functioning of these ecosystems.
- Dumping of debris in low lying wetlands will affect their ability to act like sponges to absorb the run off from rainwater and damage the normal functioning of mangrove ecosystems, which have been proven to act as buffers to protect coastal communities against the action of waves. It will also increase the probability of floods during the rainy season.
- Debris that is contaminated with chemicals such as petrol, kerosene and diesel, as well as industrial chemicals can contaminate ground water for many years to come and affect potable sources of water. Numerous coastal sources of fresh water - such as wells and tanks - have already suffered damage due to the infiltration of salt water from the tsunami waves. Already 62,000 wells and other sources of fresh water have been contaminated with salt water. Further contamination can place these communities at high risk from chemical poisoning.
- Chemical contamination of groundwater from solid waste, can lead to grave water shortages, particularly in arid areas such as the Hambantota district that are already annually affected by drought.
- Biodegradable solid and liquid waste - from damaged sewage tanks and cesspits or overflowing mains or waste material blocking water drainage systems and sewers - can seriously affect sanitation, and increase the risk of spreading water borne diseases such as typhoid, dysentery, cholera, respiratory tract infections and skin diseases.
- Hazardous wastes such as carcinogens in containers washed out by the tsunami, asbestos from roofs and medical waste that has been displaced from disposal sites have the potential of causing cancers in the future.
- The communities most at risk will be those displaced and already severely disadvantaged.
- Unsightly debris and dumping debris into the sea can retard the recovery of tourism, the fourth biggest contributor to the GDP and an industry that supported both directly and indirectly a total of 130,000 jobs in 2004.

The need:
There is an urgent need for solid waste to be disposed of effectively and efficiently, to carefully selected sites of disposal, in a manner that does not further damage livelihoods, affect human health or negatively impact the environment.

Guiding principles:

- Waste needs to be separated into biodegradable (vegetative) waste and non-biodegradable in a rapid manner.
- Waste needs to be disposed of safely, both for humans and for the environment.
- Recycle and reuse wherever possible.

Key steps:

- Before disposing debris, contact the Central Environmental Authority for identification of recommended disposal sites. (See Box 1 & 2 for details.)
- Prevent the irresponsible dumping of wastes.

- Provide safety training and involve communities in sorting waste.
- Ensure that those who are engaged in clearing debris have adequate protection in the form of gloves and boots as well as anti-tetanus coverage.
- Monitor the disposal sites over time, to check for chemical and biological pollutants leaching into groundwater.
- Separate biodegradable from non-biodegradable waste and recycle as much as possible as follows:

Type of waste	Potential use	Comments
Non-biodegradable waste		
Construction and demolition debris: such as aggregates, gypsum, tiles, asphalt, concrete, bricks, road masonry and stone.	Reuse tiles and bricks wherever possible. Impact and use for landfill and for road bases.	The debris should not contain hazardous chemicals or by-products.
Wood	Use in reconstruction or as part of vegetative matter. (See below.)	
Dirt (non-specific, including sand deposited by the tsunami)	Use as fill for potholes and eroded areas.	The dirt needs to be screened to remove other waste products.
Plastic (non-specific)	Send for recycling.	The debris should not include hazardous chemicals.
Metal (all types)	Send for recycling.	Cut or crush for easy transportation.
Asbestos	For careful disposal.	Should be handled very carefully when wet, bagged and buried. Masks should also be worn when handling asbestos.
Glass	Send for recycling.	
Biodegradable waste		
Vegetative waste, paper, spoilt food items etc.	Compost for land regeneration	Most waste should be shredded before composting in order to quicken the composting process.

Adapted from: Pasche and Kelly (2005).

(Contact details of focal persons in relevant organisations were given.)

Literature reviewed:
Pasche, A. and C. Kelly (2005). Concept Summary: Improving the Disposal of Tsunami-Generated Waste UNDAC/Sri Lanka.

WMinE Group (2005). Waste Management following Asia Tsunami Earthquake: Key Issues. http://www.redr.org/WMinE/TsunamiWasteAction.pdf

Series on Best Practice Guidelines (Sri Lanka) Information paper No. 6: After the tsunami: recovery of marine ecosystems

The issues:
Key marine ecosystems - such as coral reefs and seagrass beds - have been damaged by the tsunami. The successful recovery of these ecosystems may be threatened by poorly planned reconstruction activities.

- Certain areas of coral reef and seagrass habitat were damaged physically by the mechanical impact of the tsunami, as well as increased sedimentation and deposition of debris as a direct result of the tsunami.
- In many of these areas litter and debris are still present and pose a threat to the successful recovery of these systems.
- Planned reconstruction activities and livelihood activities must be carried out in an environmentally sensitive manner so as not to further threaten these already stressed habitats.

The impacts:

- Reefs protect low lying coastal areas from extreme weather events such as tropical storms and tsunamis and need to be maintained for the future security of coastal communities. If marine habitats are not allowed to recover, there will be a severe reduction in the capacity of natural ecosystems, as well as human economic and social systems, to withstand future extreme weather events.
- Marine ecosystems - such as reefs and seagrass beds - support important subsistence and commercial marine species. Failure to rehabilitate these ecosystems will compromise the sustainability of livelihoods in areas affected by the tsunami, both in the short and longer term.
- Illegal use of resources – mining for lime, sand mining in rivers, blast fishing – are still widespread in certain parts of the coast. These damaging methods of extraction seriously affect the productivity of reefs and in turn, affect coastal livelihoods.
- Reef systems and mangroves act as buffers, protecting coastal areas from erosion. The damage of reefs through mining for lime, and sand mining in rivers (which interrupts the natural deposition of sand to beach areas), has lead to severe coastal erosion – measured at one metre per year. This may adversely affect current and planned coastal developments. The rehabilitation of reef systems will reduce the susceptibility of the coastline to erosion.
- Clean beaches and healthy coral reefs are important for tourism. If marine and coastal ecosystems are not effectively rehabilitated the revival of coastal tourism will be negatively affected.

The need:

There is an urgent need to facilitate the recovery of tsunami-damaged marine habitats because they provide vital economic, livelihood and ecosystem functions.

Guiding principles:

- Management of marine ecosystems should focus on stress relief rather than active restoration.
- Emphasise the urgent need to remove negative pressures – such as increased sedimentation and pollution through the inappropriate discharge of waste, unsustainable exploitation of marine resources (damaging fishing practices, sand and coral mining, etc) - on marine ecosystems in order to facilitate natural recovery. This is imperative.
- Allow reef and seagrass habitats to recover naturally. (The composition and structure may change and the recovery rate will depend on external influences.) The active restoration of reef habitats should only be carried out by experienced personnel and is only appropriate in certain circumstances. (See Box 1 for details.)
- Apply an adaptive management approach (for example, modifying and continuously reviewing management techniques in line with up to date information) in the planning and implementation of ecosystem rehabilitation. This is necessary given the complexity and uncertainty of the current situation, and the knowledge gaps that still exist about the post-tsunami status of many marine habitats.

Key steps:

- Do not dispose tsunami debris and waste on the shoreline and in marine areas. Use designated waste disposal sites. (See Box 2 for a list of disposal sites recommended by the CEA.)
- Disposal of waste is prohibited under the National Environmental Act No. 47 of 1980 (NEA) as amended, Marine Pollution Prevention Act No. 59 of 1981, Nuisance Ordinance enacted in 1862, the Penal Code enacted in 1880 and the Criminal Procedure Code No 15 of 1979 in concurrence with Section 261 of the Penal Code. (See Information paper no 9: Knowing about environmental laws and policies.) Even disposal of treated waste requires permits from the Central Environmental Authority and the Coast Conservation Department.
- Existing debris should be removed from coral and seagrass areas. However, it is important that this is done using appropriate methods (see After the tsunami: cleaning up reefs and beaches, Information Paper 4). Contact IUCN for further information on and assistance in debris clearance. (See Box 3 for contact details.) Such clean up operations have already been carried out by IUCN at Hikkaduwa and Unawatuna.
- Damaging resource use practices such as blast fishing, coral mining (which are illegal under the Coast Conservation Act) and other destructive fish harvesting practices targeting ornamental fish should be prevented, so that already stressed marine systems are not degraded further.

Box 1: The active restoration of reef habitats should only be carried out by experienced personnel and is only appropriate in certain circumstances.

Contact IUCN for support on coral transplantation. (See Box 2 for details.)

Coral reef restoration may be achieved by enhancing rates of natural colonisation through providing artificial substrates, or by using active restoration techniques such as transplanting coral to areas that are degraded (using either existing substrates or artificial substrates). It is important to remember that:

- Coral restoration techniques tend to be labour intensive and expensive, and are only suitable in special circumstances.
- Transplanted corals may have lower rates of growth and survivorship than surviving colonies and new recruits. Similarly,
- species diversity may be lower in transplanted coral colonies.
- Even if restoration is pursued, removing external pressures on reef systems is the key to ensure the survival of transplanted, as well as existing, corals.
- The extent to which restoration can be carried out is limited.
- Natural recovery is recommended strongly as it is faster and will encourage higher species diversity.

Box 2 listed street addresses of disposal sites in each affected coastal district.

Box 3 listed contact details of focal persons in relevant organisations.

Series on Best Practice Guidelines (Sri Lanka) Information paper No. 7: After the tsunami: restoring tourism - environmental issues

The issues:
Tourism, the fourth largest contributor, in terms of foreign exchange earnings, to GDP in Sri Lanka, was affected severely by the tsunami.

- The tourism industry makes a major contribution to the Sri Lankan economy, at both national and local levels. Directly and indirectly tourism supports nearly 120,000 jobs per annum and generates about 350 million USD per year in foreign exchange earnings.
- Many hotels were damaged by the tsunami and tourist arrivals to the island decreased drastically. As a consequence, many people lost their jobs and livelihoods are at risk.
- There is a danger that in the rush to restore the tourism industry, environmental concerns may not be addressed adequately.
- Reconstruction is taking place slowly but delays have been encountered mainly due to importation of materials, insurance related issues and confusion about where to rebuild.
- Ecotourism and environmentally-friendly tourism represent a high-value growth market which could be integrated successfully into planning for future tourism sector developments.

The impacts:

- The damage from the tsunami to hotels is an estimated 200 million USD to rooms and another 50 million USD for tourism related structures (souvenirs shops, etc.). The Sri Lanka Tourist Board carried out a survey to estimate the cumulative value of loss based on book values and estimates this at 50 million USD. Neither of these estimates includes attendant losses associated with coastal communities such as the losses to livelihoods or the multiplier effects of tourism on related sectors (such as transport, recreation, restaurants, souvenirs and other support industries) or employment (the many families that rely on earnings from tourism).
- Clean beaches and healthy coral reefs are vital for tourism. The receding tsunami waters carried with them waste and debris from land and much of this – both organic and human-made - has been deposited on coral reefs and beaches. There are also some reports that debris cleared from inland is being dumped in the sea. Debris on beaches and coral reefs will seriously retard the revival of coastal tourism, and the much-needed revenue this brings to coastal communities.
- Nature tourism has been known to cause changes in behaviour patterns in communities from consumptive use of natural resources to non-consumptive use - for example, from collecting turtle eggs for sale to taking tourists to view marine turtles lay eggs. There is a real danger that without regular income, there could be a reversal to previous habits and unsustainable use of natural resources.

- Reconstruction without reference to environmental issues could lead to wastage of scarce resources such as energy and water, and the discharge of wastes without attention to recycling. This will, in the long term, have negative impacts on the environment.

The need:
Global trends towards nature-based tourism are on the increase. There is also a demand and high willingness to pay for environmentally-friendly tourism on the part of foreign tourists to Sri Lanka. Many hotels in Sri Lanka are already conscious of the need to conserve the environment and to develop non-consumptive and sustainable consumptive use of natural resources. The reconstruction and rehabilitation process offers an unique opportunity to maximise environmental and socially sustainable design and construction, benchmark key performance areas such as energy and water conservation, minimise pollution, ensure adequate land use planning and management, enhance ecosystem conservation, and reduce harmful environmental, social and cultural impacts from tourism.

Guiding principles:
- Ensure that policy guidance issued by TAFREN on re-building is followed.
- If new construction is envisaged, then obtain fresh approvals from the Coast Conservation Department, the Urban Development Authority and the Central Environmental Authority, in keeping with relevant Sri Lankan laws.
- Ensure that a wide consultative process is followed in planning reconstruction, in order to adhere to legal requirements and to ensure that all stakeholders are kept informed.
- In the long term, aim for globally accredited best practice guidelines in relation to environmental management such as Green Globe 21 or ISO 14000 accreditation.
- Ensure that community based programmes are integrated in to reconstruction in order to maximise corporate social responsibility.

Key steps (adapted from the Green Globe 21 company standards):
- Ensure that all national and local laws are followed before and while reconstructing. (See also 'After the tsunami: knowing about environmental policies and legislation.)
- Ensure that environmental management, ecosystem conservation and community outreach programmes are integrated into company policy.
- Where complete reconstruction is required, use low-impact designs, materials and construction methods. (See also After the tsunami: materials for reconstruction, Information Paper 3.)
- Set baseline environmental performance benchmarks in key performance areas, in order to ensure vigilant environmental monitoring. These key areas should include:
  - Energy conservation and optimisation (such as energy efficient lighting and solar heating);
  - Water conservation (such as dual flush toilets and low-flow showerheads, collection of rain water);
  - Waste water management (such as sewage treatment plants);
  - Maintenance of air quality and reduction of emissions of greenhouse gases (such as banning aerosols and careful selection of environmentally friendly cleaning agents);
  - Erosion control and landscaping (such as using only indigenous species, moving away from monoculture);
  - Reducing, recycling and reusing natural resources (such as composting kitchen waste, recycling glass and paper);
  - Switching to using environment-friendly products (such as switching from plastic to glass, wood and ceramic products; using environment-friendly cleaning agents).
- Once these benchmarks are achieved, consider working toward achieving international standards such as Green Globe 21 standards, for value-addition to the service provided.
- Incorporate sustainable use of natural resources and enhancing local livelihoods through community outreach, training and education programmes and adopting focussed programmes of corporate social responsibility.
- Ensure that due consideration in given to designs so that they take into consideration extreme weather events such as tidal waves and storm surges.
- Ensure that natural barriers such as mangroves and sand dunes are protected and enhanced as these acted as effective barriers against the tsunami.
- Establish early warning systems, evacuation and disaster management plans - in case of any eventuality.

(Contact details of focal persons in relevant organisations is given.)

Series on Best Practice Guidelines (Sri Lanka) Information paper No. 8: After the tsunami: learning to prepare for natural disasters

Recurrent natural disasters:
Tsunamis in the Indian Ocean are not frequent, and a tsunami of the magnitude and impact of the recent tsunami on December 26th 2005 is not likely to recur in the near future. However, climate change experts have predicted that as a result of global warming, recurrent natural disasters - extreme weather events such as intense rainstorms, cyclones, floods, fires, and worsened droughts - will become more frequent.

The issues:
Certain communities in Sri Lanka are extremely vulnerable to recurrent natural disasters, which are predicted to become more frequent. Such recurrent natural disasters could weaken social welfare, equity, and sustainable development of coastal communities.

Coastal communities are vulnerable to the after effects of cyclones and storms. In addition, recent research indicates that the structure of the seabed has changed as a consequence of the tsunami and hence, regular monsoonal waves may become stronger. Therefore, these communities are not only already vulnerable, but have been made even more vulnerable after the tsunami.

- Communities in the Sabaragamuwa Province are vulnerable to earth slips and floods as a consequence of the instability of hill slopes. Year in year out, many people are made homeless during monsoonal rains that cause floods and earth slips.
- Communities in the arid zone - particularly in the Hambantota and Mannar districts - are affected severely by drought, as there is little or no rain annually from May to September.
- Ecosystems such as coral reefs and mangroves in the coast as well as forests on slopes have been proven to serve as barriers against natural disasters, acting as natural buffers. Degradation of these ecosystems have left communities more vulnerable to the full forces of these natural disasters.
- Inadequacies in existing methods of communication to spread news quickly of extreme weather events can endanger many lives.
- The lack of disaster management plans including planned methods of evacuation can, again, endanger many lives.
- The lack of a permanently established and well-coordinated programme for providing relief and rehabilitation to people displaced in these recurrent extreme weather events seriously hampers community development.

The impacts:

- Most coastal communities have already been affected severely by the tsunami. They are at risk of further damage from the imminent south west monsoons on south western coast, and/or other tropical storms arising in the Indian Ocean, that are predicted to recur, as a result of climate change. This will worsen the living conditions of communities that have already lost their meagre assets, their resources and livelihoods.
- In 2003, heavy monsoonal rains, accompanied by intense winds caused landslides and flooding in the southern districts of Kalutara, Galle, Matara and Hambantota districts and the Sabaragamuwa province, the extent of which was the worst in 50 years. Massive infrastructural damage was also inflicted, seriously retarding the progress of development in those areas.
- Fifty five thousand people were affected by drought in the Hambantota district in 2001. Due to the drought nearly 15,000ha of arable land was abandoned and damage to livestock was also reported. Even when the rains came the following year, many small-scale farmers were unable to recover because they had had no income. Thus, traditional livelihoods are seriously affected by recurrent natural disasters.
- Change in weather patterns, predicted as a consequence of climate change, results in geographical changes in the range of disease carrying species - such as mosquitoes - with the result that epidemics of vector-borne diseases can spread rapidly. It is estimated that some families may spend 10% of their annual income per episode of malaria, which is substantial when family income has been depleted due to natural disasters.

The need:
It is essential that vulnerable communities are empowered to adapt and cope with recurrent natural disasters. Given that coastal communities - already been battered by the tsunami - are now even more vulnerable to extreme

weather events, there is an urgent need to ensure that preventative actions are taken now to reduce the after effects of extreme weather events.

Guiding principles (Adapted from the Guidelines for natural disaster prevention, preparedness and mitigation, UNISDR 1994):

- Planning in anticipation of an event is better than reacting hurriedly to it.
- Some communities (such as those listed above) are more at risk than others and they should be given priority attention.
- Disaster prevention should be integrated into development planning.
- Creating awareness and educating vulnerable communities to cope with recurrent natural disasters is essential.
- Empowering vulnerable communities by including them in decision-making and creating a sense of community ownership is also essential.
- Environmental protection as a component of sustainable development is urgently needed as a tool for the management of natural disasters.

Key steps:

- Prioritise, through wide stakeholder participation, the needs and capabilities of vulnerable communities to respond to natural disasters.
- Formulate, using wide stakeholder participation, practical disaster preparedness plans for vulnerable communities such as coastal communities, those at risk from droughts and those at risk from floods and landslides. These plans should include, among other components, early warning systems, rapid and effective communication of warnings, set evacuation routes, set evacuation shelters, apid and planned relief operations.
- Ensure that where infrastructure and buildings need reconstruction/construction, due attention is given to strengthening such structures against recurrent natural disasters. For example, households are not built on sharp and bare slopes in the Sabaragamuwa province and houses on the coast are not built out of temporary materials that are not proof against the elements.
- Actively conserve those ecosystems – such as coral reefs, mangroves sand dunes and lowland rainforests - that provide protection to vulnerable communities. Where necessary, these ecosystems should be restored.

(Contact details of focal persons in relevant organisations were given.)

Series on Best Practice Guidelines (Sri Lanka) Information paper No. 9: After the tsunami: knowing about environmental policies and legislation (prepared in collaboration with the Environmental Foundation Ltd.).

The issue:

There is a need to enhance awareness about existing policies and laws concerning tsunami-affected areas, as there is currently a great deal of confusion about what is permissible.

- Given the large number of governmental, non-governmental, and international organizations involved in post-tsunami reconstruction, and the rush to rebuild, many existing policies, laws and regulations are not being given due consideration.
- There is great uncertainty about whether, and which, new policies and regulations have been established post tsunami.
- This has resulted in much confusion about where to reconstruct, and is slowing down the process of rehabilitation.
- It is reported that many people are concerned about the lack of clarity in newly-established policies.
- It is reported that many people are going ahead with reconstruction without due regard to established policies, existing laws and regulations or ecologically sensitive sites.
- All the above could further damage already affected ecosystems, thereby exacerbating adverse impacts on livelihoods.

The impacts:
Many laws and regulations have been established in Sri Lanka in order to regulate human behaviour so that ecosystems and species, and thereby the goods and services provided by them, are conserved. This, in turn, ensures the protection of livelihoods. Failing to uphold these laws and regulations leads to many far reaching and damaging impacts, including increased vulnerability to coastal erosion and recurrent weather events, decreased agricultural production, and diminishing natural resources, including fish stocks. Laws also ensure that our natural capital is managed sustainably and equitably.

The need:
There is an urgent need to ensure that post-tsunami reconstruction is carried out in a timely and equitable manner with reference to existing laws and regulations, as well as to proposed laws and new policies.

Legal definition of the coastal zone:
The coastal zone is defined in the Coast Conservation Act no 57 of 1981 'as the area lying within a limit of 300m landward from mean high water line (MHWL). In the case of rivers, streams, lagoons or any other body of water connected to the sea, either permanently or periodically, the landward boundary extends to a limit of two kilometres 2km measured perpendicular to the straight base line drawn between the natural entrance points thereof and includes waters of such rivers, streams and lagoons or any other body of water so connected to the sea.'

Guiding principles:
- Reconstruct according to existing laws and regulations.
- Become aware of and be knowledgeable about new policies and laws with respect to construction and use of natural resources in affected areas. Contact relevant authorities if in doubt. (See Box 2.)

Key steps to be taken:
(A list of ordinances and acts relevant to environmental issue related to reconstruction is given in Box 1. See also 'Rebuilding after the tsunami keeping it legal' by the Environmental Foundation Ltd.)

Know the legal boundaries of where reconstruction cannot occur. (See also IUCN Information paper 1: After the tsunami: where to reconstruct – environmental issues)
- The government has proposed a no build zone of 100m in the south and west and 200m in the north and east.
- Unauthorised construction is banned within the coastal zone as defined by the Coast Conservation Act (CCA).
- It is mandatory that a permit be obtained from the Coast Conservation Department (see Section 14 of the CCA) for any developmental activity (any activity that is likely to alter the physical nature of the Coastal Zone in anyway). These activities include
  - building,
  - deposition of wastes,
  - removal of sand, sea shells, natural vegetation, sea grass and other substances,
  - dredging and filling,
  - land reclaiming and
  - mining and mineral extraction.

For any of the above activities, the Director of the Coast Conservation Department may call for an Environmental Impact Assessment (EIA).
- No construction activities are permitted in National Reserves (under the jurisdiction of the Department of Wildlife Conservation – see the Fauna and Flora Protection Ordinance No. 2 of 1937 as amended) and Forest Reserves (under the jurisdiction of the Forest Department – see the Forest Ordinance of 1907 as amended), which are state lands.
  The following are National Reserves
  - a Strict Natural Reserve
  - a National Park
  - a Nature Reserve
  - a Jungle Corridor
  - a refuge
  - a Marine Reserve
  - a buffer zone
  (See Information Paper 1 for a list of protected areas in affected districts.)

- Sanctuaries, also declared under the Fauna and Flora Protection Ordinance, may include privately held land. Consult the Department of Wildlife Conservation if reconstruction is proposed in sanctuaries.
- Construction within one mile radius of a national reserve, sanctuary or buffer zone needs permission from the Department of Wildlife Conservation. (See the Fauna and Flora Protection Ordinance No. 2 of 1937 as amended.)
- Any development activity within a fishery reserve requires the permission and approval of the Director of Fisheries and Aquatic Resources. (See the Fisheries and Aquatic Resources Act No. 2 of 1996.)
- Under the National Environmental Act No. 47 of 1980, the environmental impact assessments process is applicable to certain prescribed activities. Under the National Environmental Act No. 47 of 1980, the environmental impact assessment process is applicable to certain prescribed activities. IEE/EIAs are mandatory for the following activities. The list is representative and not complete. Please check with the regional offices of CEA for details.
  - All river basin development and irrigation works;
  - Reclamation of land, wetlands exceeding four hectares;
  - Conversion of forests covering areas exceeding one hectare into non-forest uses;
  - Clearing of land exceeding 50ha;
  - Housing and building construction;
  - Resettlement;
  - Water supplies;
  - Pipelines;
  - Hotels.
- No development or encroachment of any kind is permitted in archaeological reserves declared under the Antiquities Ordinance No 9 of 1940 as amended (Section 34). The Director General of Archaeology is empowered to conduct an archaeological impact assessment of areas that may be affected by development, industrial or other projects proposed by the government or any person. (Antiquities Ordinance No. 9 of 1940 as amended, Antiquities (Amendment) Act No. 24 of 1998.)
- Using paddy land for a purpose other than agricultural cultivation without the written permission of the Commissioner General is a punishable offence under the Agrarian Development Act No. 46 of 2000 (Section 32).
- Local government approval should be sought prior to reconstruction to ensure that the proposed area does not fall within an area allocated for a public purpose/reservation etc.
- There are also subsidiary laws that must be complied with for land use and allocation.

Know what you may build.

- Approval from the local authority under which a land is situated i.e., the Urban Development Authority, the Municipal Councils, the Urban Councils and the Pradeshiya Sabhas is required when reconstruction and rebuilding take place. Structural and other specifications are taken into consideration when processing an application.

Know which activities are prohibited. (See also IUCN Information Paper 2.)

- Extraction of corals. (See Coast Conservation Act No. 57 of 1981 (CCA) as amended.)
- Removal of sea sand except in areas identified by Coast Conservation Department under permits granted by them. (See Coast Conservation Act No. 57 of 1981 (CCA) as amended.)
- Removal of river sand. (See Mines and Mineral Act No. 33 of 1993.)
- Extraction of any resources from designated protected areas. (See the Fauna and Flora Protection Ordinance No. 2 of 1937 as amended, the Forest Ordinance of 1907 as amended.)
- Extraction or excavation in archaeological reserves (See the Antiquities Ordinance No 9 of 1940 as amended and Antiquities Ordinance No. 9 of 1940 as amended, Antiquities (Amendment) Act No. 24 of 1998.)
- Any development activity that will significantly degrade the quality of any area designated as being exceptional ecosystems and habitats of threatened species, for enhancing the natural beauty of the wilderness of Sri Lanka. (National Heritage Wilderness Act, No 3 of 1988.)
- Indiscriminate disposal of waste. (National Environmental Act No. 47 of 1980 (NEA as amended), Marine Pollution Prevention Act No. 59 of 1981, Nuisance Ordinance enacted in 1862 The Penal Code enacted in 1880, Criminal Procedure Code No 15 of 1979 in concurrence with Section 261 of the Penal Code further elaborates on Public Nuisance.)

Know which activities within the coastal zone require a permit from the CCD.

- Dwelling houses and related structures;
- Tourism, commercial and industrial structures;
- Recreational and/or water sport facilities;
- Harbour structures and navigation channels;
- Roads, bridges and railway lines;
- Public and religious structures;
- Shoreline protection work to be carried out by any private individual or group;
- Sewage treatment facilities and ocean outfalls;
- Aquaculture facilities;
- Disposal of solid waste;
- Dredging, filling, grading and breaching of sand bars;
- Mining and mineral extraction;
- Removal of sand or seashells;
- Removal of vegetation;
- Removal of coral for research purposes;
- Power generation projects;
- Reclamation and grading;
- Construction of conveyance lines;
- Construction, mining and breaching related to flood control or hazard control by any private individual or group;
- Any other activity likely to alter the physical nature of the Coastal Zone.

Know which activities may be conducted without a permit.

- Fishing;
- Cultivation of crops that do not destabilise the coast.
- Planting of trees and other vegetation. Caution must be used in the choice of species which should, ideally, be species common in the area.
- Construction and maintenance of coastal protection work carried out by the Coast Conservation Department in accordance with the Coastal Zone Management Plan.

Box 1 presented laws relevant to the reconstruction process. (See Volume 2 page 23 for this list.)

Series on Best Practice Guidelines (Sri Lanka) Information paper No.10: After the tsunami: restoring terrestrial coastal ecosystems

The issues:

Terrestrial coastal ecosystems, such as palm plantations, home gardens, mangroves, lagoons and other tree-dominated landscapes (*Casuarin*a plantations, scrub forest, etc.) suffered considerable damage from the tsunami. In some areas these have been further threatened by post-tsunami rehabilitation and reconstruction activities. Limiting further damage to these important ecosystems and restoring them in a participatory and sustainable manner is therefore a key priority.

- Terrestrial coastal ecosystems such as mangroves, home gardens, lagoons, palm and other coastal tree plantations are important livelihood resources for many coastal communities and provide a range of vital ecosystem goods including nutrition, timber, fuelwood, medicines and fisheries. They also provide services such as protecting the coastline, absorbing, storing and releasing carbon in a form that plants can use, and providing habitats for biodiversity.
- These ecosystems have been damaged significantly by the tsunami.
- In some areas, post-tsunami rehabilitation and reconstruction activities, for example, through land clearance for setting up temporary shelters, are further threatening these habitats.
- The Sri Lankan government has proposed the development of a no-build coastal green belt aimed at restoring tree/vegetation cover along coastal areas.
- However, restoration activities such as mangrove replanting, establishment of shelterbelt plantations, etc. need careful thought and implementation, and framed within the broader context of integrated coastal zone management based on the existing land uses prevalent in the area.

The impacts:

- Habitats such as mangroves are home to a wide range of economically and ecologically important species such as fish and crustaceans. They provide a range of livelihoods for coastal communities. Already damaged by the tsunami, further loss and clearing of mangroves will, in the long term, worsen the living conditions of coastal communities.
- On the ground assessments have revealed that intact and mature mangrove stands buffered the coastline against damage from the tsunami. Broad intact stands of mangroves, shelterbelt plantations, stablised and vegetated sand dunes are known to protect communities against tidal surges, storms and extreme weather conditions and thereby prevent erosion and limit salt-water intrusion. Further loss of coastal vegetation will leave coastal communities even more vulnerable to recurrent extreme weather events such as cyclones and storms.
- Managed coastal vegetation such as palm (coconut and palmyrah) plantations and home gardens, were affected severely by the tsunami. These managed systems help to support the livelihoods of local people in several areas by providing food, timber and thatching for housing/fencing, fuelwood and sources of other income.

The need:

There is an urgent need to restore damaged terrestrial ecosystems as they provide vital goods and services and support local livelihoods.

Guiding principles:

- Carry out ecosystem restoration in coastal terrestrial areas with reference to existing national laws.
- Carry out ecosystem restoration in coastal terrestrial areas by matching local needs and priorities with the goods and services that ecosystems provide, rather than implementing predetermined and inflexible land use configurations in a top-down manner.
- Ensure that from the beginning, the process is participatory involving sufficient consultation among all stakeholders within that landscape and builds on traditional knowledge available on the management of natural and managed ecosystems within the local communities.
- Ensure that, from the beginning, all relevant government departments – such as the Forest Department, the Coast Conservation Department, Central Environmental Authority, Urban Development Authority and the Department of Wildlife Conservation – are consulted and play a central role in restoration together with the local communities.
- Ensure that, from the beginning, restoration activities are carried out in a way that does not harm the interests of the poor, the displaced and other marginalised communities. Activities should, therefore, be not only participatory but also transparent and negotiated fairly. Activities should strive to provide direct livelihood benefits in an equitable manner i.e., through the provision of employment for planting, nursery activities, etc.
- Formulate a clear vision that links and balances restoration with medium to long-term benefits to local communities as well as the environment. When restoration options are selected, make every effort to ensure that the trade-offs, wherever they arise, are equitably (not necessarily equally) distributed among all stakeholders and that the balance between ecosystem and human livelihood needs is maintained.
- Adopt a landscape approach to restoration. Ecosystems do not function as closed units but as open systems that are affected by ecological process that occur on a larger scale. Because of this, every effort at restoration should be assessed in the context of the landscape i.e., it is necessary to look at the broader picture, not just the specific restoration site alone.
- Use indigenous, multiple-use and locally beneficial species while carrying out restoration.
- Follow adaptive management practices that are based on continuous monitoring and improvement, because complexity and uncertainty makes it impossible to predict accurately the outcomes of restoration. There is a need to recognise that the balance of goods and services provided by ecosystems today may not be the goods and services required in the future. Thus, adaptive management practices are critical.

Key steps:

- Tsunami-debris should be removed from affected ecosystem areas – beaches, home gardens, palm plantations, lagoons, etc. Fallen timber and other recyclable material (bricks, tiles, etc.) should be salvaged for use or sale. (See After the tsunami: beach and reef clean ups, Information paper 4; and After the tsunami: solid waste management, Information Paper 5, for more details.)

- Great care should be taken to ensure that restoration activities do not harm or displace existing natural ecosystems of each area. For example, turtle nesting sites or sea grass beds should not be replaced by planted mangroves or *Casuarinas*/other tree plantations.
- While undertaking cleanup operations or reconstruction activities in tsunami-affected areas, measures should be taken not to harm ecosystems/vegetation that are undamaged by the tsunami, or that which can regenerate naturally.
- Care should be taken to preferentially use indigenous species and not to introduce invasive alien species such as Mesquite (*Prosopis juliflora*) as a part of restoration process.
- Specific areas should be identified, where ecosystem restoration is a priority and have high support from the local communities and from the government.
- Local communities and government officials should be consulted to identify and agree upon local needs, local restoration priorities, preferred species, division of roles and responsibilities, and mechanisms for sharing costs and benefits of restoration over the short, medium and long term. (See below for a list of recommended species for specific ecosystems.)
- The specific restoration action needed for a particular area (i.e., protection/social fencing in areas with good root stock, assisted natural regeneration, ground preparation, planting, etc.) needs to be identified.
- Local forest department officials should be consulted for technical guidance on how to start planting activities in the selected areas. (For example, what should be the specific area, the mix of species, the spacing between the saplings, etc.)
- It is essential that before commencement of restoration, sufficient nursery material (For example, seeds, propagules, saplings, etc.) is available.
- It is also essential that a system for regular maintenance and monitoring of the plantation (For example, removal of weeds, control of pests, thinning, guarding against grazing/browsing, illegal extraction, etc.) is established.
- Immediate measures should be taken to bring under control the unsupervised and free-roaming livestock that have been feeding on undamaged natural/managed vegetation and agricultural areas after the tsunami.

Box 1 listed contact details of focal persons in relevant organisations.

Box 2 listed names of divisional forest officers and thier contact numbers.

Box 3: Suitable woody plants for site rehabilitation in tsunami affected areas – for dry/arid zones (Ampara, Batticaloa, Hambantota, Jaffna, Mullaitivu and Trincomalee districts)					
Name			Site preference		
Sinhala name	Tamil Name	Scientific name	Behind beach	More interior	Remarks on site suitability
		Acacia auriculiformis		X	
Beli	*Vilvam*	*Acronychia marmelos*		X	Homegardens
Suriya mara	*Kona/Vakai/Vagei*	*Albizia lebbeck*		X	
Rukattana	*Elilaippalai*	*Alstonia scholaris*		X	
Caju	*Montin-kai*	*Anacardium occidentale*		X	Homegardens
Kohomba	*Vembu*	*Azadirachta indica*	X	X	
	Ichanku/Iynaku	*Azima tetracantha*	X	X	
Halmilla	*Chavandalai*	*Berrya cordifolia*		X	
Thal	*Panai*	*Borassus flabellifer*	X	X	
Ketakela	*Mul-venkai*	*Bridelia retusa*		X	
Ranawara	*Avarai*	*Cassia auriculata*	X	X	
Ehala Tirukkontai		*Cassia fistula*	X	X	
Ratu-wa	*Vakai*	*Cassia roxburghii*	X	X	
Burutha	*Mutirai*	*Chloroxylon swietenia*		X	
Lolu	*Naruvilli/Vidi*	*Cordia dichotoma*		X	
Thimbiri	*Panichchai*	*Diospyros malabarica*		X	Riverine
Kolon	*Manchal Kandampa*	*Haldina cordifolia*		X	
Godakirilla	*Ayil/Kauchia/Velaylii*	*Holoptelea integrifolia*	X		
Makulu	*Makul*	*Hydnocarpus venenata*		X	Riverine
Divul	*Willa maram*	*Limonia acidissima*	X	X	
Mee	*Illupai*	*Madhuca longifolia*		X	Riverine
Amba	*Mangai*	*Mangifera indica*		X	Homegardens
Palu	*Palai/Passippayeru*	*Manilkara hexandra*	X		
Murunga	*Murungamaram*	*Moringa oleifera*		X	Homegardens
Bakmee	*Atuvangi, Vammi*	*Nauclea orientalis*		X	Riverine
Wathabanga	*Lecchai kedda*	*Pisonia grandis*	X	X	
Karanda	*Poona/punka/punku*	*Pongamia pinnata*	X	X	
Delum	*Madalai/Madalunkai*	*Punica granatum*		X	Homegardens
Malittan	*Viyay*	*Salvadora persica*	X	X	
Para Mara	*Enal vakai*	*Samanea saman*		X	Avenue plant
Kon	*Puvu*	*Schleichera oleosa*		X	
Kathurumurunga	*Akatti/Agati-keerai*	*Sesbania grandiflora*		X	Homegardens
Goda-kaduru	*Eddi/Kanchurai*	*Strychnos nux-vomica*		X	
Madan	*Naval/Perunaval*	*Syzygium cumini*	X	X	
Siyambala	*Puliyem*	*Tamarindus indica*		X	
Teak	*Thekku*	*Tectona grandis*		X	
Kumbuk	*Marudu*	*Terminalia arjuna*		X	Riverine
Kottamba	*Kottai*	*Terminalia catappa*	X	X	
Suriya	*Kavarachu/Puvarachu*	*Thespesia populnea*	X	X	
Milla	*Kaaddamankku*	*Vitex altissima*		X	

Box 4: Suitable woody plants for site rehabilitation in tsunami affected areas – for the wet zone (Kalutara, Galle and Matara districts)					
Name			Site preference		
Sinhala name	Tamil Name	Scientific name	Behind beach	More interior	Remarks on site suitability
		Acacia auriculiformis		X	
Rukattana	*Elilaippalai*	*Alstonia scholaris*		X	
Kos	*Pala/Pila*	*Artocarpus heterophyllus*		X	Homegardens
Una	-	*Bambusa vulgaris*		X	Homegardens
Mudilla	-	*Barringtonia asiatica*	X		
Domba	*Dombakottai/Punai*	*Calophyllum inophyllum*	X	X	
Kasa	*Chanku/Chabukkai*	*Casuarina equisitifolia*	X		
Pulungas/ Pulum ibmul	-	*Ceiba pentandra*		X	Homegardens
Burenda	*Dangamkuppi/Koika*	*Clerodendron inerme*	X		
Pol	*Thangai*	*Cocos nucifera*	X	X	
Mal mara	*Mayaram*	*Delonix regina*		X	Avenue plant
Erabadu	*Mulumurukku*	*Erythrina spp.*	X	X	
Pihimbiya	*Chittirai vempu*	*Filicium decipiens*		X	
Kona	*Kona*	*Gliricidia sepium*		X	Homegardens
Belipatta	*Artia/Nir-paraththi*	*Hibiscus tiliaceus*	X		
Makulu	*Makul*	*Hydnocarpus venenata*		X	Riverine
Mee	*Illupai*	*Madhuca longifolia*			Riverine
Amba	*Mangai*	*Mangifera indica*		X	Homegardens
Lunumidella	*Malaivembu*	*Melia azedarach*		X	Homegardens
Na	*Nagacuram/Naka*	*Mesua ferrea*		X	Avenue plant
Murrunga	*Murungamaram*	*Moringa oleifera*		X	Homegardens
Wetakeyiya	*Talai*	*Pandanus odoratissimus*	X		
Wathabanga	*Lecchai kedda*	*Pisonia grandis*	X	X	
Araliya	*Arali*	*Plumeria rubra*	X	X	Homegardens
Karanda	*Poona/Punka/Punku*	*Pongamia pinnata*	X	X	
Pera	*Koyia*	*Psidium guajava*		X	Homegardens
Para Mara	*Enal vakai*	*Samanea saman*			Avenue plant
Kathurumurunga	*Akatti/Agati-keerai*	*Sesbania grandiflora*		X	Homegardens
Madang	*Naval*	*Syzygium cumini*		X	Homegardens
Mahogany	*Nangi*	*Swietenia mahogoni*		X	Homegardens
Siyambala	*Puliyem*	*Tamarindus indica*		X	Homegardens
Teak	*Thekku*	*Tectona grandis*		X	
Kumbuk	*Marudu*	*Terminalia arjuna*		X	Riverine
Kottamba	*Kottai*	*Terminalia catappa*	X	X	
Suriya	*Kavarachu/Puvarachu*	*Thespesia populnea*	X	X	

Series on Best Practice Guidelines (Sri Lanka) Information paper No.11: After the tsunami: water pollution (Prepared in collaboration with the International Water Management Institution - IWMI)

The issue:
The Tsunami waters and debris have contaminated groundwater, wells and other water storage tanks.

- Most sources of drinking and bathing water including wells, tanks and groundwater in the coastal area were contaminated with seawater after the tsunami and were salinised initially and inconsumable.
- Sludge, dirt and debris were also brought in with the waters and contaminated sources of drinking and bathing water.
- Chemicals such as petrol, kerosene and diesel, as well as industrial chemicals can contaminate ground water for many years to come and affect potable sources of water.
- Manholes and sewers, which overflowed as a result of the tsunami, could also have contaminated freshwater, increasing the risk of water borne-diseases.
- Improper disposal of organic matter and post-tsunami debris could lead to further contamination of water. Debris is being dumped in abandoned paddy fields, marshy lands and roadsides, creating breeding grounds for mosquitoes and other pests. This could lead to outbreaks of disease in the future.
- Natural flushing and purification of contaminated sources of water has occurred in some affected areas but in other areas it has been too dry, particularly in the southeast and east.

The impacts:

- Numerous sources of fresh water in the coastal zone - such as wells and tanks - have already suffered damage due to the infiltration of salt water from the tsunami waves. Already 62,000 wells and other sources of fresh water have been contaminated with salt water.
- There is considerable potential for negative health impacts such as diarrhoea and dysentery in the short term due to lack of access to adequate supplies of good quality water, general environmental pollution and the lack of sanitation.

The need:
Freshwater sources need to be restored completely in order to provide people with access to clean water for domestic and agricultural use. This is a priority need that is being addressed by the Task Force for Rebuilding the Nation (TAFREN). (See Box 1 for details.)

Guiding principles:

- Provide all residents with easy access to adequate quantities of clean, safe, freshwater for drinking, preparing food and bathing.
- Immediate solutions will require innovation and improvisation, leading to gradual improvement, progressing from basic to robust and sustainable services.
- Water resources must be protected from further contamination, especially of faecal waste.
- Organic and inorganic debris should be disposed of in a proper manner so that water bodies are not polluted. (See After the tsunami: solid waste management, Information Paper 5.)
- All interventions should be undertaken in full consultation with the appropriate authorities such as the Urban Development Authority (UDA), the Rural Development Authority (RDA), the Government Agent (GA) and the National Water Supply and Drainage Board (NWSDB). They should also be undertaken in accordance with national plans by TAFREN. (See Box 1 for details.)
- All plans should also be devised in full consultation with local communities to ensure needs are met in a culturally acceptable way and in accordance with local practices and water use rights. Such traditions may be over ridden in times of disaster but it is necessary to avoid actions that enhance tensions or lead to conflict.
- Housing and new construction should ensure good sanitation facilities and sewage systems. The UDA may be contacted for further information and guidance. (See Box 2 for contact details.)
- Emergency water-supply responses should be implemented in conjunction with hygiene promotion to reduce the risk of the disaster impacting on health.
- Construction designs should ensure good drainage systems in place as approved by relevant local authorities.
- The rebuilding process should take into consideration disaster preparedness for possible future disasters (not only tsunamis). This should include vulnerability assessments (of people and infrastructure), robust designs and disaster mitigation plans.

Key steps to be taken:

- *Quantity of drinking water:*
  - The minimum quantity recommended by the WHO in post-disaster situations is 15 litres per person per day. However, it is recommended that this should increase to a minimum of 50 litres per person per day for drinking water, hygiene, sanitation and food preparation when conditions improve.
- *Quality of drinking water*:
  - Advise people on the quality of water required for certain activities and suitable sources for that water. Drinking water and water for making baby food must obviously be of higher quality than water for bathing or washing dishes.
  - Ensure that all bottled water comes from a safe source.
  - Educate people to boil water for drinking purposes. Boiling water is the preferred way to kill harmful bacteria and parasites. Bringing water to a rolling boil for one minute will kill most organisms. However, boiling brackish water for longer than five minutes can increase concentrations of sea salts and other contaminants.
  - Water can also be treated with chlorine tablets, iodine tablets, or unscented household chlorine bleach (5.25% sodium hypochlorite). If chlorine is used, levels should be such that a free chlorine residual of 0.4-0.5mg/l is achieved immediately after treatment or 0.2-0.5mg/l at the point of distribution (WHO, 2002, p.119). (See Box 3 for details on chlorination.)
  - Store water in covered tanks to allow sediment to settle out. This makes the water more drinkable and also improves the effectiveness of chlorination.
- *Wells*:
  - Prior to use, chemical analysis should be carried out on wells and other water sources that were either contaminated or suspected of being contaminated. See WHO (2004) guidelines for recommendations and methods.
  - For wells that have not been cleaned, a modified cleaning method is to just pump moderately (say total volume equal to 0.5-1m^3 or a depth of 30cm in a 1.5m diameter well), with the submersible pump at the bottom, to extract salty water as well as accumulated sludge. Water should be replenished by more freshwater from the shallow groundwater. Then, the well should be left for further natural flushing and cleaning from rainfall. (See Box 4 for further details.) Chlorination may be performed according to suitable standards (See Box 3 for further details.)
- *Aquifers*:
  - In some areas aquifers have also been contaminated and these should be left for natural restoration when the rains arrive.
- *Surface water*:
  - Ground water should be used in preference over surface water for drinking but this may not always be possible. In such cases, surface water should be protected from contamination by segregating water uses and protecting water sources.
- *Disposal of waste*:
  - Remove solid waste from open water bodies and dispose of appropriately. (See After the tsunami: solid waste disposal, Information Paper 5 for a list of CEA recommended sites.)
- *Construction of septic tanks*:
  - Septic tanks should be constructed at a minimum of 9.144 metres and ideally, 15.24 metres from water sources such as wells.

Box 1 listed the steps in the action plan by the Sri Lankan Presidential Task Force for Rebuilding the Nation (TAFREN).

Box 2 listed contact details of focal persons in relevant organisations.

Box 3: Disinfecting drinking water

The most common method of disinfecting water in emergency situations is chlorination, because it is the simplest. Calcium hypochlorite it generally used. All chlorine compounds should be handled with care. Free residual chlorine levels of more than 0.3mg/l for more than 30 minutes are required to kill bacteria and most viruses. Chlorination of stored water for consumption is best achieved using a one percent stock solution of chlorine. This contains 10% of chlorine per litre, which is equivalent to 10,000mg/l or 10,000ppm. Skin contact should be avoided when making or using the solution, as should inhalation of fumes. The solution should be made fresh everyday in the following way:

To make one litre of one percent stock solution mix the following quantities with water and make up to one litre in a glass, plastic or wooden container:

Chemical source	% available chlorine	Quantity required	Approximate measures
Bleaching powder	35	30g	2 heaped tablespoons or 8 teaspoons
Stabilised / tropical bleach	25	40g	3 heaped tablespoons or 12 teaspoons
High-test hypochlorite	70	14ml	1 tablespoon solution
Liquid laundry bleach	5	200ml	1 teacup or 6oz milk tin
Liquid laundry bleach	7	145ml	10 tablespoons
Javelle water	1	It is a 1% stock solution	

Source: WHO (2002)

Box 4: How to clean contaminated wells:

- Wells should only be cleaned and pumped by qualified and trained personnel with reporting to the local authorities (NWSDB).
- Wells should not be pumped to decrease salinity. Natural recovery is the best method for this.
- To remove sludge and debris, pump slowly (preferably with a sludge pump at the bottom). The drawdown (the extent of lowering of water) in the well must not exceed 0.5m for more than 15 minutes.
- If the well has been pumped or cleaned before, and the salinity has increased, then the well should not be cleaned again.
- When wells are cleaned, salinity at the top and bottom should be monitored, both before and after cleaning.
- Do not repeatedly chlorinate wells.
- Do not repeatedly empty wells.
- Drinking water should be purified separately (for example, by chlorine tablets or by boiling, or by the SODIS (Solar Disinfection) method.
- Wells that are salty or becoming salty should be pumped less or abandoned temporarily.
- Abandoned wells should be covered to reduce risk of mosquito breeding, and to indicate that the well is not in use.
- Deep wells (more than 5m deep) and wells pumped with motorized pumps should be regularly monitored for salinity as they stand a greater risk of salinisation.
- Wells should not be deepened in the coastal aquifers in an attempt to avoid saltwater.
- New deep wells should not be drilled in the coastal aquifers in an attempt to get fresh water.
- Stagnant water bodies should be cleaned for debris. In case of suspicion of pollution of the water body (for example, by visible oil film on the surface) cases should be reported to the authorities who should take action in the clean-up.

Series on Best Practice Guidelines (Sri Lanka) Information paper No.12 After the tsunami: restoring terrestrial coastal wetlands (Prepared in collaboration with the International Water Management Institute - IWMI)

Coastal Wetlands:
The Ramsar Convention on Wetlands defines wetlands as 'areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres.'

This information paper restricts itself to discussion on coastal wetlands, and hence, wetlands referred to in this paper will include the following habitats:

- *Estuarine waters* (permanent water in estuaries and estuarine systems);
- *Inter-tidal mud flats, inter-tidal marshes* (including salt marshes, salt meadows, salt flats, raised salt marshes, tidal brackish and freshwater marshes);
- *Mangroves and coastal brackish/saline lagoons* (brackish to saline lagoons with at least one relatively narrow connection to the sea).

The issues:
Coastal wetlands such as mangroves, lagoons and mudflats, under severe considerable threat due to coastal development demands, suffered considerable damage from the tsunami. In some areas they are further threatened by post-tsunami rehabilitation and reconstruction activities. Minimising the damage to these important wetlands and restoring them in a sustainable manner through participatory mechanisms has become a priority.

- Coastal wetlands already under considerable threat were further damaged significantly by the tsunami.
- In some areas, post-tsunami rehabilitation and reconstruction activities, for example, through land clearance for temporary shelters and by infilling through the disposal of rubble, are further threatening these habitats.
- The Sri Lankan government has proposed the development of a 'no-build' zone along the coast.
- Restoration activities such as mangrove replanting, removal of rubble, and preventing pollution need careful thought and implementation, and should be framed within the broader context of integrated coastal zone management.

The impacts:

- Mangroves are home to a wide range of economically important species, such as fish and crustaceans, supporting a range of livelihoods for coastal communities. Damage caused by the tsunami and further loss and clearing, pollution of lagoons, estuaries and marshes, and indiscriminate infilling will, in the long term, worsen the living conditions of coastal communities who depend on these resources.
- Tsunami-generated debris accumulating in wetlands impedes fishing activities by the reduction in capacity of lagoons and estuaries.
- Natural waterways that facilitate exchange of water between different wetland habitats have been blocked by debris/sediment carried by the tsunami.
- Coastal wetlands not only provide important livelihood resources for rural coastal communities, but also supply other vital ecosystem services, such as protection against extreme weather events and erosion, limits salt-water intrusion and buffers tidal surges and storms. Empirical evidence in some locations has revealed that mature, intact stands of mangroves served as effective barriers against the tsunami waves. Loss of coastal vegetation will leave coastal communities more vulnerable to recurrent extreme weather events such as cyclones and storms.
- Low-lying wetlands function as sponges and limits the impact of floods. Loss of wetland areas can lead to increased flash floods.
- Wetlands trap and retain sediments that are carried in by rivers and floodwaters. Degraded wetlands are less likely to trap and retain sediments and could also contribute sediments to floodwaters through increased erosion. Increased erosion within the wetlands will further reduce the capacity of the ecosystem to support coastal livelihoods.
- Coastal wetlands also function as traps of carbon and other minerals and with time convert them into useable nutrients.
- Coastal wetlands provide many habitats for species uniquely adapted to changes in salinity and water levels. They are important storehouses of biodiversity. We need to recognise that the diverse wetlands affected by the tsunami are part of a connected ecosystem and that many species move between them to feed or breed.

The need:
There is an urgent need to restore degraded coastal wetland ecosystems as they provide vital goods and services and support local livelihoods.

Guiding principles (adapted from the Ramsar Wetland Convention's principles and guidelines for wetland restoration):

- Carry out wetland restoration in coastal areas with reference to existing national laws.
- Carry out wetland restoration within the context of the national wetlands policy and action plan.
- Carry out wetland restoration only in areas where similar habitats had been damaged by the tsunami or by human activities. The establishment of wetlands in other places, such as sandy beaches that did not previously support wetlands, is not recommended and could undermine the successful functions already provided, for example, a reduction in coastal protection currently provided by sand dunes.
- Ensure that the goals and objectives of restoration will achieve as many purposes as possible, in recognition of the fact that wetlands provide a diversity of services (i.e., biodiversity conservation, flood control, water purification, food resources etc).
- Ensure that, from the beginning, the process is transparent and participatory involving effective and fair consultation and negotiation with all stakeholders within the landscape (both nearby as well as upstream).
- Integrate appropriate traditional knowledge into the restoration and management of wetland ecosystems and encourage multiple uses, through the re-establishment of indigenous and locally beneficial species.
- Ensure that, from the beginning, all relevant government departments – such as the Forest Department, the Coast Conservation Department, Central Environmental Authority, Urban Development Authority and the Department of Wildlife Conservation – are consulted and play a central role in restoration together with the local communities.
- Adopt a landscape approach to restoration - ecosystems do not function as closed units but as open systems that are affected by ecological processes that occur on a larger scale. Every effort at restoration should be assessed in the context of the landscape i.e., it is necessary to look at the broader picture and all wetland types within it - not just the local area or one wetland in isolation.
- Follow adaptive management practices that are based on continuous monitoring, learning and improvement, because complexity and uncertainty makes it impossible to predict restoration outcomes accurately. There is a need to recognise that the balance of ecosystem services provided by wetlands may not be the services required for in the future.

Key steps:

- Tsunami-debris should be removed from wetlands. Fallen timber and other recyclable material (bricks, tiles, etc.) should be salvaged for use or sale. [See information papers on beach and reef clean ups (Information Paper 4) and Solid waste management (Information Paper 5) for more details.]
- Great care should be taken to ensure that restoration activities do not harm or displace existing natural wetlands. For example, mangrove replanting or replanting of any other vegetation should not replace turtle nesting sites or seagrass beds.
- While undertaking cleanup operations or reconstruction activities in tsunami-affected areas, measures should be taken to avoid harming wetlands/vegetation that were relatively unscathed by the tsunami, or those that can regenerate naturally.
- Wetland species should be planted only in wetland habitats and not in other areas such as sandy beaches.
- Care should be taken to replant with indigenous species suitable for the area and not introduce exotics species as a part of the restoration process.
- Any invasive alien plants such as Prickly pear (*Opuntia dillennii*) that may have been deposited in coastal wetland habitats by the tsunami should be removed.
- Priority for restoration should be given to specific wetlands that have high support from within the local communities and from the government.
- Local communities and government officials should be consulted to identify and agree upon local needs, local restoration priorities, preferred species division of roles and responsibilities and mechanisms for sharing costs and benefits of restoration over the short, medium and long term. (See below for a list of recommended species for restoration of wetlands.)
- The specific restoration action needed for a particular area (i.e., protection/social fencing in areas with good nursery stock, assisted natural regeneration, ground preparation, planting, etc.) needs to be identified.
- It is essential that before commencement of restoration sufficient nursery material is available.
- It is essential that a system for regular maintenance and monitoring of the restored wetland (for example, guarding against illegal extraction of vegetation, etc.) be established.

Box 1 listed contact details of focal persons in relevant organisations.

Box 2 listed divisional forest officers and contact numbers.

Box 3: Suitable species for mangrove rehabilitation in Tsunami affected areas
N: north NE: North East E: East SE: South East S: South W: West NW: North West

Name			General site suitability in Sri Lanka								Remarks
Sinhala name	Tamil name	Scientific name	N	NE	E	SE	S	SW	W	NW	
-	*Kannamaram/ Venkandal*	*Avicennia marina*	X	X	X	X	X	X	X	X	
-	*Kanna/Upatha*	*Avicennia officinalis*	X	X	X	X	X	X	X	X	
-	-	*Bruguiera cylindrica*			X				X	X	
Mal-kadol	-	*Bruguiera gymnorhiza*	X	X	X	X	X	X	X	X	
-	-	*Cerbera manghas*	X	X	X	X	X	X	X	X	Tidal influence is not so critical
	Chiru-kandal	*Ceriops tagal*		X	X	X	X	X	X	X	
Diyadanga	*Vilpadri*	*Dolichandrone spathacea*			X				X		Tidal influence is not so critical
Attoona/ Homediriya	*Chonmuntiri*	*Heritiera littoralis*		X	X	X	X	X	X	X	
Ginpol	-	*Nypa fruticans*					X	X	X		
Kadol	*Kandal*	*Rhizophora apiculata*	X	X	X	X	X	X	X	X	
Kadol	*Kandal*	*Rhizophora mucronata*	X	X	X	X	X	X	X	X	
Kirala	*Kinnai*	*Sonneratia caseolaris*	X	X	X	X	X	X	X	X	Tidal influence is not so critical

Series on Best Practice Guidelines (Sri Lanka) Information paper No.13 After the tsunami: restoring home gardens (Prepared in collaboration with Rainforest Rescue International (Pvt) Ltd.)

The issues:
In the aftermath of a natural disaster, ensuring a proper nutritional balance in food intake becomes important. In many households affected by the tsunami, traditional gruels and curries made from herbs and trees from home gardens provided a variety of vitamins and other nutrients. However, many of these home gardens have been affected by the tsunami.

- The intrusion of salt water destroyed the production capacity of most home gardens.
- Food plants in home gardens were destroyed.
- There is no accessible source of these traditional foods in refugee caps or in returnee households.
- With this lack of accessibility from regular food sources, there is a risk that people may become malnourished.
- Home gardens provided income for women, who tended them.

The impact:
Displaced persons returning from camps to re-build their homes are left with home gardens with poor production capacities and the additional burden of purchasing nutritional supplements from outside sources.

The need:
There is thus an urgent need to restore the productivity of home gardens with a unique mix and diversity of species. There is also a concomitant need to identify and restore soils that have been contaminated by salt water intrusion and ensure their recovery.

Guiding principles:

- Identify affected soils.
- Identify an effective suite of plants to restore nutritional security in affected households.
- Identify an effective suite of plants to restore ecological functionality.
- Encourage rapid restoration programmes for home gardens as a source of subsistence and livelihoods restoration.
- Encourage the use of natural fertilisers in the restoration of home gardens.

Key steps to be taken

- Assess the growing capacity of soils before attempting home garden restoration. (See Box 1 for details.)
- If soil is salinised or otherwise affected, then proceed with soil restoration. (See Box 2 for details.)
- Develop a list of utility plants that are fast growing and that provide a good mix. (See Box 3 for complete details of suitable species.) Seedlings are available with RRI. (See Box 5 for contact details.)

  Suitable trees species:
  - *Murunga* (*Moringa oleifera*), which has leaves of high nutritive value as well as pods that are edible. It grows fast in salinated soil and helps to reduce soil salinity.
  - *Katuru Murunga* (*Sesbania grandiflora*) is a very fast-growing, nitrogen-fixing species that breaks up the soil and makes a good texture for agriculture. It also has edible leaves and flowers.
  - Papaya (*Carica papaya*) will withstand some salt breeze, grows rapidly and provides valuable fruits.
  - Curry leaves (*Murraya koenigii*) is a flavour giver and has many medicinal properties. Its roots encourage soil growth.
  - Lime or lemon (*Citrus spp.*) is indispensable in cooking, provides a rich source of vitamin C and has valuable medicinal properties.

  Suitable herbaceous plants:
  - *GotuKola* (*Centella asiatica*), Spinach (*Basella alba)*, Kang Kung (*Ipomoea aquatica*), are all easily grown vegetables that provide a dark green leafy dietary input. They are used in *mallungs* (leaf salads) and *kola kenda* (porridge) and form a very important part of the daily nutritional intake. They are also creeping plants that cover the soil and prevent erosion.
  - Lemon Grass (*Cymbopogon citratus*) and Pandanus *(Pandanus odoratissimus*) are herbs, which provide the flavours that are appreciated in traditional cooking. These plants are fairly long-living and maintain the soil ingood condition.

    These plants begin the process of restoring the soil as well as providing essential nutrition to families. They also provide the focus around which other horticultural activities can begin.

- Restoring and tending the home garden may also provide a source of comfort and healing for the mind as well as the body.
- Develop effective methods of integrating the plant stock into households and transit camps.

Box 1: A simple test to determine the growing capacity of the soil (Developed by Rainforest Rescue International (RRI))

- Take two containers of equal size.
- Ensure that there is adequate drainage.
- Fill each with an equal quantity of soil. One with tsunami affected soil that needs testing and one with good farmyard soil from a farm, unaffected by the tsunami.
- Place 10 seeds of Mung bean or Green gram or 20 mustard seeds in each container.
- Water and place in a sunny spot.
- After one week, observe the growth of plants. (Observe both germination and the colour and health of seedlings that grow.)
- If growth in both containers is about equal, begin farming.
- If growth is affected, then it is very likely that the soil has been affected by the tsunami. If so, begin soil restoration (See Box 2.)

Box 2: Restoring affected soils.

If the soil tested (See Box 1) is found to be affected by salinisation, then one of two paths may be followed.

1. Allow for natural regeneration. The speed at which the original ecosystem recovers will depend on the level of rainfall washing and leaching, assisted by vegetation growth. In cases where the salinisation is heavy in slow draining soils natural regeneration will be slow. Often exotic species may invade the disturbed habitat. If these species are known to be invasive species such as *Prosopis* and *Opuntia*, they should be eradicated.

   or

   Assist in regeneration. This can range from the removal of exotic species to building up farmyard and home garden soils. As the soil ecosystem has been affected a primary goal is its restoration. This is best effected by using plants that assist in the restoration of the soil ecosystem. (See Box 4 for a list of species that assist in such restoration.)

2. Also, household crops can be grown in raised beds. These are formed by placing a rectangle defined by planks, bamboos or similar barrier to a height of about eight inches and filling the rectangle with good soil or compost. Because the bed is above the affected soil, it will grow crops effectively. While the crops are growing in the raised beds, the transfer of plant waste and microorganisms into the soils below will assist in the recovery process. Plants could also be grown in sacks that have been filled with good soil and compost. Various plants can be planted in slits made at different levels and fed with water through an inserted bamboo.

Box 3: Potential plants for tsunami affected home gardens, developed by Rainforest Rescue International (RRI)				
Common name	*Sinhala name*	*Tamil name*	*Scientific Name*	Remarks
Gotukola	*Gotukola*	*Vallarai*	*Centella asiatica*	Leafy vegetable
Papaya	*Gas labu/Papol*	*Pappali*	*Carica papaya*	Fruit
-	*Katurumurunga*	*Akatti/Agati-keerai*	*Sesbania grandiflora*	Leafy vegetable + Nitrogen fixing
Lime	*Dehi*	*Thesikai*	*Citrus aurantifolia*	Essence + Medicinal
Horse radish tree	*Murunga*	*Murungamaram*	*Moringa oleifera*	Vegetable, Leafy vegetable + Live fence
Sweet potato	*Bathala*	*Vel-kelengu*	*Ipomoea batatas*	Edible yam
Bird pepper	*Kochchi*	*Kochchi*	*Capsicum frutescens*	Condiment
Ginger	*Inguru*	*Inji*	*Zingiber officinale*	Medicinal
	Mukunuwenna	*Ponankani*	*Alternanthera sessilis*	Leafy vegetable
Sweet orange	*Pani dodang*	-	*Citrus sinensis*	Fruit
Banana	*Kehel*	*Valappalam*	*Musa sp.*	Fruit
Chaya			*Cnidoscolus chayamansa*	Leafy vegetable
Coriander	*Koththamalli*	*Koththamalli*	*Coriandrum sativum*	Condiment
Mustard	*Aba*	*Kaduku*	*Brassica juncea*	Condiment
Bitter gourd	*Karavila*	*Pavakkai*	*Momordica charantia*	Vegetable
Spinach	*Nivithi*	*Pasalai*	*Basella alba*	Leafy vegetable
Lemon grass	*Sera*	*Serai*	*Cymbopogon citratus*	Condiment + insect repellent
Curry leaves	*Karapincha*	*Karivempu*	*Murraya koenigii*	Essence + medicinal
Passion fruit	*Vel dodang*		*Passiflora edulis*	Fruit + leafy vegetable
Pomegranate	*Delum*	*Madalai /Madalunkai*	*Punica granatum*	Fruit
Grape jasmine	*Watu-sudda*	*Nandi-battai*	*Tabernaemontana divaricata*	Flower is used for religious activities

Box 4: Plants that assist in soil restoration developed by Rainforest Rescue International (RRI)			
Sinhala name	*Tamil name*	*Scientific name*	Benefit to soil
Katurumurunga	*Akatti/ Agati-keerai*	*Sesbania grandiflora*	Adds organic nitrogen to the soil.
Murunga	*Murungamaram*	*Moringa oleifera*	Adds soil colloids.
Papol	*Pappali*	*Carica papaya*	Breaks up the salt aggregated soils.
Karapincha	*Karivempu*	*Murraya koenigii*	Encourages growth of soil macrorganisms
Kangkung		*Ipomoea aquatica*	Helps reduce the soil toxicity, especially in swampy situations.
Lunuwila		*Bacopa monnieri*	Helps reduce the soil toxicity, especially in swampy situations.

Box 5 listed contact details for relevant organisations and their focal personnel.

Series on Best Practice Guidelines (Sri Lanka) Information paper No.14 After the tsunami: safeguarding Special Area Management sites (SAM), Ramsar Sites and Marine Protected Areas (MPAs)

Special Area Management (SAM) sites: (A map showed locations of these sites.)
Special Area Management uses local and geographically specific planning and active stakeholder participation in order to plan for optimal sustainable use of natural resources, ensure economic well-being as well as ecological

integrity, and to practise sound natural resource management. This key concept was introduced in the 1980s as a tool for resource management in the coastal zone and has been an integral part of the coastal zone management plan of the Coast Conservation Department, since the 1990s.

Since the late 1990s, nine SAM sites have been chosen based on agreed criteria such as severity of issues relating to resource use, richness of biodiversity, economic significance and the process of participatory management. Work in these sites is already ongoing. Benefits gained from the SAM process include zoning of sites to maximise ecological protection yet allowing sustainable use, poverty alleviation by provision of facilities for the enhancement of livelihoods, social upliftment through various community-based training programmes and improvement of water quality and waste management. A further 27 sites have been proposed using the same criteria and are identified as high priority areas. These SAM sites are managed under the aegis of the Coast Conservation Department and the Coast Conservation Act of No. 57 of 1981 and its amendments.

Listed after this was the district, location and name of SAM and proposed SAM sites.

Marine Protected Areas (MPAs): (A map showed locations of these sites.)
Marine Protected Areas (MPAs) are marine areas of outstanding national significance, conserved by law under the jurisdiction of the Department of Wildlife Conservation, to provide protection of their valuable natural resources. MPAs fulfil a number of functions, including the conservation of biodiversity, sustainable management of natural resources for livelihoods, protection of endangered species and habitats, as well as their contribution to the tourist industry.

Four MPAs have been declared under the Fauna and Flora Protection Ordinance (FFPO) in 1993a. The district and names of these MPAs were listed.

Ramsar Sites: (A map showed locations of these sites.)
In addition to these SAM sites and MPAs there are three declared Ramsar sites, i.e., wetlands of international importance, both for the conservation of migratory waterfowl and for the sustenance of local livelihoods. Coastal areas in two of these declared sites - Bundala National Park, and Maduganga estuary (a SAM site and also a proposed sanctuary) - were affected by the tsunami.

The issues:
There is a risk that reconstruction activities in areas close to SAM and Ramsar sites, and MPAs may not be carried out with due environmental consideration. This could mean that these sites that provide vital livelihood and environmental functions may be affected adversely.

- Improperly planned reconstruction may cause pollution, both during reconstruction and also in the long term as a result of poor design, thus damaging SAM and Ramsar sites, and MPAs.
- Continuation of illegal activities such as mining for lime, sand mining in rivers (which interrupts the natural deposition of sand to beaches) and blast fishing will have a huge negative impact on SAMs, Ramsar sites, and MPAs.

The impacts:

- SAM sites are noted for the economic and livelihoods value of the resources they hold, and the effective management of natural resources in these areas are important for sustainable livelihoods and local economies. Destruction of valuable natural resources in these areas will have a severe impact on communities with high levels of dependence on these resources for their livelihoods.
- SAMs, Ramsar sites and MPAs can help protect low lying coastal areas from extreme weather events such as tropical storms and tsunamis and need to be maintained for the future security of coastal communities. These sites also act as buffers, protecting coastal areas from erosion. Damage sustained to these during the reconstruction effort may increase the vulnerability of coastal populations to extreme weather events and lead to severe coastal erosion, which may adversely affect current and planned coastal developments.
- Marine ecosystems are three-dimensional - the water column supports different species from that of the seabed – and many marine species rely heavily on water currents for the dispersal of larvae and seed. MPAs provide a vital function in serving as sources from which seed and larvae can disperse naturally to other marine areas. Thus, proper conservation and management of existing MPAs is critical for natural regeneration of marine ecosystems beyond the boundaries of the MPAs themselves.
- Many fish stocks are already seriously depleted due to over fishing. SAM sites and MPAs provide a refuge for many species, and healthy populations within SAM sites and MPAs can spill over to non-managed areas, replenishing stocks of fish that are targeted by fishermen. SAM sites and MPAs therefore assist in maintaining

populations of commercially significant marine species and are important to the sustainable management of coastal fisheries. Damage to SAM sites and MPAs due to reconstruction activities, mining, increased water pollution and unsustainable resource use practices may endanger the future sustainability of populations thereby negatively affecting communities that are dependent on fisheries for their livelihoods.

- SAMs, Ramsar sites and MPAs serve as valuable tourist attractions. Sound management is therefore important for the revival of coastal tourism and the much-needed revenue this brings.
- These have acted as important reserves of biodiversity, in the recent past providing many models for novel bio-resources. The preservation of these resources will provide greater options for resource management in the future and provide models for scientific and industrial innovation. Severe damage incurred to these sites will threaten the preservation of key biodiversity resources that may not currently be perceived as being important economically but have enormous monetary potential in the future.

The need:
Reconstruction activities must be carried out in a way that does not adversely affect these sites. This is essential because of their immense value in natural replenishment, protection of coastal areas, support for livelihoods and conservation of biodiversity, all of which are particularly important in a post-tsunami context.

Guiding principles (adapted from the 12 Guiding Principles for rehabilitation and reconstruction of the coastal zone in the tsunami-affected countries):

- Ensure that existing laws and regulations relevant to the coastal zone are upheld.
- Enhance public awareness on existing laws and regulations relevant to the coastal zone.
- Manage existing SAM and Ramsar sites and MPAs effectively so that the ability of natural systems to protect the coastline from extreme weather events is enhanced.
- Manage existing SAM and Ramsar sites and MPAs support sustainable livelihoods.
- Involve all stakeholders in the effort to protect these sites. This is effected easily for SAM sites as a participatory approach is an integral part of the SAM planning process.
- Develop tools to monitor and communicate the impacts of the reconstruction process.

Key steps:

- Consult the Coast Conservation Department and the Department of Wildlife Conservation in order to ensure that reconstruction and rehabilitation are carried out within the existing framework of planning such as the SAM process.
- Consult the CEA prior to carrying out any developmental activities to ensure that environmental impact assessments are carried out if necessary. (See also After the tsunami: knowing about environmental laws and policies, Information Paper 9.)
- Consult the relevant Regional Offices of the Department of Wildlife Conservation (DWC) (see Box 1 for contact details) if the proposed development is within one kilometre of any MPA. (See also After the tsunami: where to rebuild environmental concerns, Information Paper 1.)
- Consult the Department of Wildlife Conservation to ensure that reconstruction and rehabilitation does not adversely affect Ramsar Sites.
- Prevent the dumping of waste – in any form (an illegal activity) - on beaches and in the sea. (See also ‘After the tsunami: knowing about environmental laws and policies, Information Paper 9.)
- Prevent the sourcing of building materials (such as sand and lime) from the coastal zone. These activities are prohibited. (See also After the tsunami: materials for reconstruction, Information paper no.13; After the tsunami: knowing about environmental laws and policies, Information Paper 9.)
- Prevent the use of illegal fishing practices such as blast fishing and coral mining. (See also ‘After the tsunami: knowing about environmental laws and policies, Information Paper 9.)
- Prevent the removal of natural resources from MPAs. Extraction of any resources from designated protected areas is prohibited under the Fauna and Flora Protection Ordinance No. 2 of 1937 as amended. (See also ‘After the tsunami: knowing about environmental laws and policies, Information Paper 9.)

Box 1 listed the regional offices of the Department of Wildlife Conservation responsible for specific MPAs, and contact details for officers-in-charge.

Box 2 listed relevant organisations and contact details for focal personnel.

Community-based Disaster Risk Management

(Sourced directly from http://www.adpc.net/v2007/Programs/CBDRM/Default.asp and ADPC, 2004[21])

'Communities are at the frontline of disasters. Over the last two decades it has become apparent that top-down approaches to disaster risk management alone fail to address the specific local needs of vulnerable communities, often ignoring the local capacities and resources. At times, this approach further increases the vulnerability of the community. In response to the limitations of this top-down methodology, the community-based disaster risk management (CBDRM) emerged as an alternative approach, during the decades of 1980s and 1990s' (http://www.adpc.net/v2007/Programs/CBDRM/Default.asp).

'Community-based disaster risk management (CBDRM) is a process of disaster risk management at which communities at risk are engaged actively in the identification, analysis, treatment, monitoring and evaluation of disaster risks in order to reduce their vulnerabilities and enhance capabilities. Communities at risk therefore, are at the heart of decision making and implementation of disaster risk management activities. The involvement of the most vulnerable is paramount and the support of the least vulnerable is necessary (ADPC-CBDRM-11, 2003, in ADPC, 2004).

'The CBDRM process has seven sequential stages, which can be executed before a disaster or after to reduce risk. Each stage grows out of the preceding one. Together, these steps build up a planning and implementation system, which can become a powerful disaster risk management tool.

Step 1. Selecting the community (choosing the most vulnerable community based on a set of given criteria).

Step 2. Rapport building and understanding the community (building the relationship and trust with the selected community).

Step 3. Participatory Disaster Risk Assessment (PDRA), a diagnostic process to identify the risks that the community faces and how people overcome those risks. This process involves hazard, vulnerability and capacity assessment.

Step 4. Participatory Disaster Risk Management Planning follows after the analysis of the PDRA. The community themselves identifies risk reduction measures to reduce vulnerabilities and enhance capabilities.

Step 5. Building and Training a Community Disaster Risk Management Organisation (CDRMO). Such organisations will ensure that risks are reduced through the implementation of the above plan.

Step 6. Community-managed implementation. This is the CDRMO led implementation of the plan.

Step 7. Participatory Monitoring and Evaluation is a communication system in which information flows amongst all people involved in the project – the community, the implementing staff and the support agency as well as government agencies and donors ' (ADPC, 2004).

The Asian Disaster Preparedness Center (ADPC) believes that community action for disaster risk management is a crucial element in promoting a 'culture of prevention' and creating safer communities (http://www.adpc.net/v2007/Programs/CBDRM/Default.asp).

[21] ADPC (2004). Community-based disaster management field practitioners' handbook. Bangkok: ADPC

Annotated guiding principles for post-tsunami rehabilitation and reconstruction (Cairo Principles)[22]

Introduction:

The global problem and the need for principles:
The recent tragedy of the tsunami in the Indian Ocean has generated an unprecedented amount of relief and support from the donor community and private organisations, and extraordinary generosity from neighbouring communities adjacent to those devastated. Because of the scale of the impact and the immediate humanitarian needs, actions were initially focused on emergency needs for shelter, food, and medical care. Another priority has been to begin immediately to design and build a warning system for such disasters. The biggest and most protracted challenge will be to rebuild and rehabilitate hundreds of kilometers of devastated coastline, and re-establish livelihoods for over a million displaced people.

This is a huge challenge since many of the affected shorelines are densely populated - in most cases by poor people. Before the rebuilding begins we must commit to avoid needlessly repeating the mistakes of the past – for example, forms of coastal development that pushed the poor into the most unhealthy and hazardous corners of the coast and produced patterns of construction that are inefficient, inequitable, and unsustainable.

To guide the massive coastal reconstruction effort, the United Nations Environment Programme (UNEP) Tsunami Disaster Task Force in cooperation with the UNEP Coordination Office of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (UNEP/GPA), convened a meeting on February 17th, 2005 in Cairo to discuss coastal zone rehabilitation and management in the tsunami-affected region. Attendees from the affected nations and supporting international institutions endorsed twelve key principles (hereafter referred to as the Guiding Principles) consistent with an advance to more sustainable forms of coastal development and the United Nations Millennium Development Goals.

If adopted and applied throughout the affected region, the guiding principles will:
- Allow those involved to sequence their actions following a common set of priorities;
- Strengthen our collective commitment to rehabilitate and protect coastal communities and increase the efficiency of our actions;
- Provide the basis for regional workshops and discussions to pinpoint local needs and priorities;
- Facilitate the exchange of experience and the rapid dissemination of emerging good practices.

The guiding principles:

Over-arching 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 zoning and planning process to:
2. Promote early resettlement with provision for safe housing; debris clearance; potable water, sanitation and drainage services; and access to sustainable livelihood options.
3. Enhance the ability of the natural system to act as a bio-shield 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.
4. Promote design that is cost-effective, appropriate and consistent with best practice and placement of infrastructure away from hazard and resource areas, favouring innovative and soft engineering solutions to coastal erosion control.
5. Respect traditional public access and uses of the shoreline, and protect religious and cultural sites.
6. Adopt ecosystem based management measures; promote sustainable fisheries management in over-fished areas, and encourage low impact aquaculture.
7. Promote sustainable tourism that respects setback lines and carrying capacity, benefits local communities and applies adequate management practices.

[22] Drafted by UNEP/GPA in cooperation with Stephen Bloye Olsen, et al, University of Rhode Island, USA. The entire draft is reproduced here. http://www.cobsea.org/Cairo%20Guiding%20Principles.pdf

How things are done is as important, sometimes more important, than what is done. Local knowledge and insights are critically important to successful planning and decision-making, and local citizens must be engaged in the rehabilitation and reconstruction process at every stage. It is essential that the application of the construction set back line and the boundaries of bio-shields are defined in consultation with the local communities coastal reach by coastal reach.

8. Secure commitments from governments and international organisations to abide by these Principles and build on and strengthen existing institutional arrangements where possible.
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.
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.
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.
12. Widely disseminate good practices and lessons learned as they emerge.

Applying the Principles place by place:
A feature critical to the successful practice of coastal management is the ability to tailor principles such as those adopted in Cairo to the unique needs and conditions present in a specific locale. For example, on low lying shores like those in Bangladesh and the Maldives, a construction setback may not be effective in reducing the vulnerability of people to rising sea level, waves and flooding. In such places, focusing on building cyclone shelters and community-based emergency plans is the best approach. However, in other situations relocating damaged roads, railroads and dwellings to higher ground is both feasible and sensible. Setbacks, greenbelts and no-build zones have been repeatedly shown to be effective in reducing hazards and enhancing environmental qualities in a wide diversity of settings within the region affected by the tsunami and elsewhere. In all cases, protecting and restoring coral reefs, dunes, estuaries and seagrass beds makes coastal systems more resilient and capable of sustaining a diversity of livelihoods and a flow of benefits to the people of the place.

It has been learned repeatedly that successful implementation of a set of principles and a plan of action rests on the active and sustained participation, support and understanding of the affected communities. Without such support, investments in planning and implementation are likely to be ignored or resisted and will not generate a sustained flow of benefits. In this booklet, we use the term ‘coastal reach by coastal reach’ and ‘reach by reach’ to describe a process of planning and decision making that addresses stretches of coastline with similar characteristics and of an appropriate size to make the engagement of local people practical and possible. A coastal reach typically extends between headlands or demarcates a length of shoreline with similar rural or urban characteristics typically extending five to 20 kilometers. For the purposes of coastal management, reaches often need to be smaller for intensely utilised coasts where a diversity of activities are competing for space. Thus, while it is the responsibility of national governments to set the policies and procedures that require setbacks, bio-shields, priorities for settlement and re-establishing livelihoods, the details of how such policies will be applied in a specific locale must make provision for local consultations and tailoring to existing conditions and needs. The precise delineation of a construction setback and identification of additional no-build areas within bio-shields requires soliciting local knowledge and responding to local needs and local conditions.

The principles adopted in Cairo and the more detailed guidance offered in this booklet are divided into two groups. Principles 1 though 7 focus on the priority technical measures. These address what must be done in order to better prepare shorefront communities for future change and to design and implement a rehabilitation and reconstruction process that, where possible, creates conditions superior to those that were present before the tsunami struck. They draw on the scientific knowledge that has evolved in recent decades as coastal processes and their interaction with human activities have been analysed. The lessons learned from the reconstruction and rehabilitation following other natural disasters form the substance of the first seven principles.

In any emergency, the order in which actions are taken is important. The delineation of construction setbacks and improving the long-term conditions of the poor are top priorities and are, therefore, addressed first in both the Cairo Principles and the guidance offered in this booklet.

Principles 8 through 12 deal with how to apply the principles. These principles draw upon the experience in dozens of nations over the past forty years in the evolution of what has come to be called ‘integrated coastal management’ (ICM). These principles address the processes of public participation, the usefulness of setting unambiguous goals at both national and local scales, the evaluation of results, and the dissemination of experience and new knowledge.

I. Priority technical measures:

Principle 1 (Over-arching principle):

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.'

It is not possible to sustain any development in coastal areas if the huge energy and natural dynamics of coastal systems are ignored. Many of the adverse social and economic impacts of the tsunami have occurred because people have been made more vulnerable to natural hazards through poor planning and the ineffective management of coastal development. The technical difficulties and financial costs of opposing the natural dynamics of coastal systems far outweigh the long-term benefits that can be gained by working with the natural processes that create and maintain healthy ecosystems and a flow of social and economic benefits to humankind.

At a time when human populations are becoming increasingly concentrated along coastlines, sea level is rising and long established weather patterns are changing. We therefore know that hazards created by storms, the reshaping of coastlines by processes of erosion and accretion, instabilities produced by new patterns of land use as well as such relatively rare occurrences as tsunami will together make shorelines increasingly hazard-prone.

The nations of the region and several international organisations are working together to develop an effective tsunami early warning system that will reach the entire regional community, particularly the most vulnerable groups.

- What is known about past and future coastal change can be applied to define a reference line showing where the shoreline is anticipated to be, for example, by 2050. Detailed aerial photographs could be prepared reach by reach for all of the region's shoreline, showing conditions as they were before and after the tsunami. A reference line could be drawn on such photographs showing the mean high water mark anticipated by the 2050 median projection for a sea level rise of 30cm made by the Intergovernmental Panel on Climate Change (IPCC). This reference line should be modified by other tectonic and coastal data affecting anticipated coastal change in specific areas. Where information is available, data on the anticipated effect of historical trends in erosion and accretion to 2050 and the inland extent of flooding in past storms should also be integrated into estimates of the future position of shorelines.
- A recommended construction setback line should be established by each government as a set distance and/or elevation inland of the reference line. The area seaward of the setback line should be designated as a strictly enforced 'no-build' zone. It is essential that such setbacks are incorporated into the existing regulatory system and are applied equitably to the wealthy and the poor.
- On low-lying shorelines with little topographical relief, practical disaster preparedness plans should be developed and tested that feature speedy evacuation of people to protected shelters.
- The width of the no-build zone determined by the setback should be greater in as-yet-undeveloped shores than in already urbanised areas.
- Designate setback lines with permanent on-site markers and enforce them uniformly as a regulatory measure.
- Exceptions for building structures seaward of the setback line should be granted only where required to support such water-dependent activities as fishing and navigation (not tourist facilities or permanent settlements). Where such exceptions are granted, structures should be temporary or built to withstand flooding by strengthened structural members and elevated first floors that permit flood waters to flow through unimpeded. Attention should be given to the impact of such structures on adjacent coastal areas, and mitigation actions taken.
- The granting of such exceptions for construction seaward of the setback line should be based on clear and uniform criteria and applied through a highly transparent process with opportunities for comment by the local community.

Principle 2:

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

Putting people first in rehabilitation requires moving quickly to resettle those displaced by the tsunami in a manner that provides the poor with living conditions and services that are better than those that existed before the disaster. Those that have lost property and cannot rebuild because their properties are within the no-build zone must be compensated adequately.

- Where practicable, identify sites beyond the 'no build zone' for permanent housing for those displaced by the tsunami, and for reconstruction of essential infrastructure, such as access to roads, water supply and sanitation, waste water treatment and solid waste disposal.
- Avoid or minimise involuntary resettlement - in accordance with the Guiding Principles on Internal Displacement presented to the UN Commission on Human Rights and the General Assembly. A 'no build zone' applied to a settled coastline may have severe consequences for those deprived of land tenure or 120 rights of residence. Where relocation is judged to be in the best long-term interest of those affected, provide adequate compensation for land and property. Also, establish channels for grievance resolution at the appropriate levels of government.
- Adopt appropriate building codes for all structures, including seismic codes in earthquake prone areas.
- Provide potable water, sewage collection and treatment, and adequate drainage systems in all new and reconstructed communities.
- Favour standardised, modular systems with interchangeable components to achieve cost savings and reduce future maintenance costs.
- Encourage the use of local labor in all phases of the reconstruction process thereby generating employment and enhancing the marketable skills of the poor.

Principle 3:

Enhance the ability of the natural system to act as a bio-shield to protect people and their livelihoods by conserving, managing and restoring wetlands, mangroves, spawning areas, seagrass beds and coral reefs; and by seeking alternatives.

Natural barriers to flooding and coastal erosion, such as coral reefs, near-shore rock outcrops, sandbars, and sand dunes should be protected from construction activity and uses that compromise their structural integrity. They reduce, absorb and redirect waves and floodwaters. Wetlands, lagoons, river estuaries, and reefs are essential to sustaining fisheries, public health and the many livelihoods that support coastal populations. They contribute to a healthy and aesthetically pleasing environment for a seaside holiday. A portion of the funds for rehabilitation should therefore be assigned to protect and restore these habitats.

Reconstruction will require thousands of cubic meters of sand for cement and for fill, and building materials of every description. Traditionally, many of these materials have been taken from the coast itself. When sand is mined from beaches, dunes and coastal rivers, mangroves are cut for timber, and wetlands filled as building sites coastal settlements become more vulnerable to hazards of every description.

- Conduct rapid assessments that involve local people in the identification of natural areas important to fisheries production, the recycling of wastes, shoreline stabilisation and scenic quality, including coastal wetlands and mangroves, seagrass beds, and coral reefs. The aerial photographs and maps used for establishing setback lines can be used in this process of identifying critical areas.
- Incorporate these natural features and habitats into a designated coastal bio-shield that maximises the protection from coastal hazards and the associated benefits provided by these natural features. Adopt measures to protect bio-shields from activities that compromise their natural qualities. Protect them from future disturbance and, where feasible, restore them.
- Where feasible, plant trees seaward of the setback line to form a greenbelt that buffers the shore from waves, floods and erosion.
- Prohibit the mining of sand, coral and stone from coastal waters within the 20m depth contour.
- Regulate sand mining from rivers.
- Declare wetlands and mangroves as off limits for harvest of wood.
- Prohibit the filling of wetlands and estuaries.

Principle 4:

Promote design that is cost-effective, appropriate and consistent with best practice and placement of infrastructure away from hazard and resource areas, and favouring innovative and soft engineering solutions to coastal erosion control.

The reconstruction is an unprecedented opportunity to relocate communities away from hazardous and unhealthy areas, rectify badly designed infrastructure and services, and reduce previous inequities in their availability and distribution.

- Place arterial roads, railroads and other transportation infrastructure well inside the setback line, and site access-ways perpendicular to the coast.

- Limit investments in erosion control to those situations where pre-existing infrastructure or settlements make it cost-effective, and where it is considered environmentally justifiable; favour soft solutions (placement of sand, planting vegetation) over hard solutions (breakwaters, groynes, shoreline armouring).
- Identify natural barriers to flooding and coastal erosion, specifically coral reefs, near-shore rock outcrops, sand bars, and sand dunes; protect them from construction activity and uses that compromise their structural integrity.

Principle 5:

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

- Identify with permanent on-site markers and preserve public rights of way to the shore. All coastal development initiatives should respect the customary rights of local communities to the coastline, and recognise these areas as public domain.
- Assure that landing sites for local fishers and associated facilities for cleaning catches and storing fishing gear are restored or relocated to an equivalent or better nearby location.
- Identify with permanent on-site markers and preserve religious or cultural sites valued by local residents. Coastal development should keep these special coastal features accessible and protect their visual integrity.

Principle 6:

Adopt ecosystem based management measures; promote sustainable fisheries management in over-fished areas, and encourage low impact aquaculture.

The rehabilitation of hundreds of kilometers of shoreline should generate many opportunities for more diversified and more sustainable livelihoods. A primary concern must be the future prospects of communities dependent upon fishing. These same communities contain a high proportion of the region's poorest people. A recent statement prepared by WorldFish points out that coastal fisheries in Asia were depleted severely and over-fished before the tsunami. Too many boats taking too many fish had in some areas reduced fish stocks to less than 10% of their original levels and destroyed or degraded the habitats upon which these potentially renewable resources depend. A trend toward the use of damaging gear and the use of increasingly destructive fishing methods -such as small mesh nets that take juveniles - has made the situation progressively worse. The tsunami has only added to the problem.

- While assisting fishers by replacing equipment and rebuilding boats, ensure that less destructive and more sustainable fishing practices are adopted.
- Assist fishers who do not wish to return to fishing by developing alternative livelihoods. This will contribute to reducing fishing effort and restoring natural resources.
- Promote employment-intensive fisheries operations that contribute directly to poverty alleviation and food security.
- Implement integrated coastal fisheries management (ICFM). This approach is centered on the development of management plans that incorporate social, economic and biological objectives.
- Develop investments, training and infrastructure that reduce post-harvest losses. In rebuilding destroyed infrastructure and processing facilities and creating new ones, make investments to minimise postharvest losses and add value to catches. This will also provide additional livelihoods, particularly for women, when it emphasises the use of employment-intensive, low-cost, hygienic technologies.
- Encourage investment in community-based aquaculture and other livelihoods that bring benefits to local populations and do not degrade coastal ecosystems. Rehabilitated aquaculture must adopt environmentally sound management practices that do not pollute, damage habitats or cause long-term harm, including use of feed that is taken from sustainable sources and seeds that are raised in environmentally sound hatcheries or taken from sustainable fisheries.
- Modify the placement and density of shrimp aquaculture operations to reduce environmental degradation and adverse impacts on other coastal activities. In particular, subject shrimp ponds to siting criteria that protect natural systems and coastal water quality, and limit the intensity and extent of operations in each coastal reach.
- Avoid the 'privatisation' of inshore waters and the consequent disruption of fishing operations and livelihoods.

Principle 7:

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

- Identify vulnerable sectors of the population and develop strategies (for example, training, micro-enterprise development) to redirect these to such income generating activities as value-added processing, eco-tourism and cottage industries that reduce pressure on ecosystem services.
- Ensure that tourism planning is responsive to the needs of the local community and seeks to ensure community benefits. Local communities should be involved in the tourism planning process and development of associated recreational activities. This will help ensure that economic benefits are adequately distributed.
- In coastal tourism development, use appropriate siting, improved engineering designs and appropriate construction management practices that respect the dynamic nature of the coastal areas and ecosystem function. Such measures help control the negative impacts that can come with coastal tourism, including the loss of habitat and landscape, degradation of water quality, erosion of beaches and loss of beach access and income by traditional resource users. Such siting and design also helps minimises risks from storms, hurricanes, tsunamis and erosion and will reduce the need for prohibitively costly restoration and rehabilitation measures. Construction setbacks are one of the most appropriate proactive means of reducing risk of natural hazards. National and local authorities must support the industry through public sector planning, development control and provision of construction standards.

II. Process measures:

Principle 8:

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

- Mobilise rapid or immediate endorsement of these principles and enunciate their implications for all reconstruction activities. The adoption of the principles need not add time to the reconstruction process and, if unequivocally endorsed by the highest levels, will reduce uncertainty.
- Set specific measurable goals (for example, to double the number of people with potable water over pre-tsunami levels) for the reconstruction by each participating nation and its partner organisations. This will help focus the effort and provide a basis for measuring successful implementation of the principles.
- Use the opportunities created by the intense activity brought by the reconstruction process to strengthen the relationships among these institutions and to address weaknesses in the current coastal management system. Responsibility for coastal planning and decision-making - including the necessary enforcement powers - are invariably distributed among a number of governmental agencies at the national and sub-national levels. In some nations non-governmental organisations also play major roles in coastal management.
- Embrace opportunities to strengthen each nation's coastal management system and encourage investments in associated training and institution building.

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.

- First, consult with local people to review conditions as they existed before the tsunami to identify potentially significant habitats, rights of way to the shore and significant cultural or religious sites. The provision of detailed before and after aerial photographs and maps showing the reference line will assist in this process. It is essential that representatives of the poorer segments of the community are present and participate actively and that traditional leadership such as village leaders and religious leaders provide guidance and assist in the mediation of disputes.
- Second, envision the conditions and specific features of the coastal reach in question that would be seen as meeting local needs and local goals. This will address the specifics of marking the setback line and engaging in a rapid planning and zoning process. These discussions are likely to reveal competing views and conflicts. Therefore, it is important that decisions be guided by the precise demarcation of the setback line and that the boundaries of bio-shields be based on pre-defined and unambiguous criteria and that these be applied in a transparent manner.
- Adapt strategies for applying these principles as appropriate. It will be important to learn and adjust as the reconstruction and rehabilitation efforts unfold. Local knowledge combined with technical expertise and guided by national goals is the recipe for success.

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.

- Tailor coastal management principles to the unique conditions present in every coastal reach. This favors a decentralised approach and a co-management structure in which local institutions assume significant roles in planning and decision making.
- Assist the governmental and non-governmental institutions with coastal management responsibilities to refine their abilities to identify threats and their root causes, to negotiate goals and strategies with a diversity of stakeholders, to practice conflict resolution and to prioritise their actions.
- Promote the use of economic assessment tools that help set priorities for investments, define and meet financing needs and sequence investments so as to maximise inter-sectoral collaboration and the advance towards sustainable development.
- Encourage the application of the Precautionary Principle and to its use in impact assessments that should be used to evaluate proposals for major construction projects.

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.

- Set clear goals for the desired outcomes of the reconstruction and rehabilitation process reach by reach and subsequently use these as a reference point for assessing progress and the practice of adaptive management.
- Define and monitor simple, practical indicators for assessing progress towards goals and monitoring the coastal reconstruction and rehabilitation process.
- Report periodically on the results of the reconstruction processes and the lessons that emerge from the application of the principles; document failures as well as successes.
- Make it easy for the print, radio and television media to stay involved in the reporting process by establishing and updating a website and registering it with the main search engines.

Principle 12:

Widely disseminate good practices and lessons learned as they emerge.

- Annually invite experts and leaders from the region and elsewhere to review progress and widely disseminate throughout the region the emerging good practices.
- Celebrate success. Create incentives to, and publicly recognise successes - particularly when they result from local initiatives and local creativity in problem solving.

Conclusion:

Formulating principles to guide the rehabilitation and reconstruction is but one first step in the arduous reconstruction process. Those engaged in the process will need to work hard to create conditions that are better than those that existed before the tsunami and make coastal communities - particularly the poor - less vulnerable that they were before. There will be major pressures to simply put things back as they were before and to take advantage of the emergency to further individual interests rather than the common good. These pressures must be resisted. The implementation of these twelve Cairo Principles will help grasp the opportunities generated by such a calamity and thereby create conditions that are more sustainable and more equitable than those that were present before.

Appendix:

Selected literature and references are provided below. Documents accessible through websites have been emphasised due to their easy access worldwide.

General guidance:

- Additional guidance on post-tsunami reconstruction is provided in an IUCN information paper, dated February 2005, entitled 'Guidance for Ecosystem Rehabilitation incorporating Livelihood concerns'. It is available on the web at: http://www.iucn.org/tsunami/docs/tsunamiguidance-info.pdf#search=' %EF%82%B7%20IUCN%20information%20paper%20%28February%202005%29%20Guidance%20 for%20 Ecosystem%20Rehabilitation%20incorporating%20Livelihood%20concerns.' and :http://www.iucn.org/tsunami/docs/tsunami- guidance-info.pdf
- Asian Wetland Symposium of February 9th 2005 on tsunami and coastal wetlands had recommendations for action: http://www.wetlands.org/news&/docs/AWS_Tsunami.pdf

Reducing vulnerability:

- UNESCO has produced a document entitled 'A proposal for building capacity to generate coastal bathymetry: a critical element in protecting lives, livelihoods and sustainable development in areas prone to ocean-based extreme events.' The IOC/UNESCO website is at: http://ioc.unesco.org/iocweb/index.php
- Information on the Indian Ocean Tsunami Warning System is gathered at: http://ioc.unesco.org/indotsunami

Debris clearance:

- Guidelines on debris disposal are available at several sites including http://www.un.org/esa/sustdev/documents/agenda21/english/agenda21chapter21.htm

Promoting access to sustainable livelihoods:

- The International Tropical Timbers Organization's 1996 paper by C. Field, entitled 'Restoration of mangrove ecosystems' contains ideas about reforestation to assist sustainable livelihoods.
- The UN department of economic and social affairs has publications relating to sustainable development at: http://www.un.org/esa/sustdev/mgroups/success/SARD-6.htm

Conserving, managing and restoring natural systems:

- Links to useful literature on the restoration of near-shore marine ecosystems are provided by http://restoration.nos.noaa.gov/htmls/resources/habitat_pubs.html
- The Florida seagrass restoration project has information that could be adapted to other areas: http://www.fws.gov/CEP/FLGulf.fs.rev.pdf#search='sea%20grass%20restoration'
- The site http://w1.mangrove.org:880/video/rem.html has links to methodology on mangrove restoration. Methodology on mangrove restoration is described in an article at: http://www.tautai.com/Pubs/Mangrove%20Restoration%20Ambio.pdf#search='mangrove%20restoration'
- Links to other information on mangroves can also be obtained at: http://www.ncl.ac.uk/tcmweb/tcm/mglinks.htm
- Dr. Jurgen Primavera and Dr. Anitra Thorhaug have published several peer-reviewed journal articles on restoration of mangroves and seagrasses, respectively
- The National Oceanic and Atmospheric Administration (NOAA) has two websites with useful links to information on coral reefs, their restoration and remediation:
  http://www.coris.noaa.gov/library/other_sites.html and
  http://www.nodc.noaa.gov/col/projects/coral/corallinks/Coral_linkmain.html
- The Intergovernmental Oceanic Commission/United National Educational, Scientific and Cultural Organization (IOC/UNESCO) has also advised about coral reef restoration and remediation at: http://ioc.unesco.org/coralbleaching/gef.htm

Sources of building materials:

- Some ideas on the sourcing of certified timber and other raw materials and strategies on the sound use of wood are presented by the World Wildlife Fund (WWF) at: http://www.unece.org/trade/timber/docs/sem-1/papers/r36Rainey.pdf#search='sourcing%20of%20certified%20timber'

Soft engineering solutions:

- An electronic bibliography on the use of constructed wetlands to improve water is available at http://www.nal.usda.gov/wqic/Bibliographies/eb9701.html
- General links to information on constructed wetlands (including for wastewater treatment) are at http://www.epa.gov/owow/wetlands/watersheds/cwetlands.html

Setting up protected areas:

- Lessons learned from setting up marine protected area designations in the United States that may be adapted and applied to other nations are provided at http://mpa.gov/information_tools/lessons_learned_ table.html

Sustainable fisheries and low-impact aquaculture:

- WorldFish center has produced a briefing paper entitled 'Building a better future for coastal communities affected by the tsunamis.' This contains key recommendations from the project on 'Sustainable management of coastal fish stocks in Asia' documented in Silvestre et al., 2003; In Silvestre et al., (eds): Assessment, management and future directions for coastal fisheries in Asian countries. South and Southeast Asian Coastal Fisheries: Their status and directions for improved management. WorldFish Center Conference Proceedings 67, 1120 pp. This publication is available at: http://www.worldfishcenter. org/trawl/publications/publications.asp

- Guidance on the restoration of small scale fisheries is available at: http://www.idrc.ca/es/ev-28137-201-1-DO_TOPIC.html
- Codes of conduct for sustainable aquaculture are discussed in the following FAO document: http://www.fao.org/documents/show_cdr.asp?url_file=/DOCREP/003/AB412E/ab412e34.htm
- The marine finfish aquaculture network refers to cooperation in sustainable finfish aquaculture: http://www.enaca.org/modules/news/index.php?storytopic=10&storynum=10
- Information on fisheries assessments may be downloaded at: http://earthwatch.unep.net/oceans/oceanfisheries.php and http://www.nefsc.noaa.gov/nefsc/publications/tm/tm184/

Land management/infrastructure issues:

- Ideas that could be adapted to the current situation can be found within the 2003 'Final report on the water quality coalition for reef protection project' by the Rainforest Alliance/National Fish and Wildlife Foundation: http://www.eco-index.org/search/pdfs/707report_1.pdf

Tools for rapid social and environmental assessment:

- The World Bank's community-driven development is described at: http://lnweb18.worldbank.org/ESSD/sdvext.nsf/09ByDocName/CommunityDrivenDevelopment
- Tools and methods of social assessment are evaluated at: http://www.worldbank.org/socialanalysis sourcebook/socialassess5.htm
- More information on using social assessment and rapid participatory rural appraisal may be found at: http://www.fao.org/docrep/W5830E/w5830e08.htm and http://www.unu.edu/unupress/food2/UIN08E/uin08e0u.htm
- OECS 2003. Technical Manual for Post-Disaster Rapid Environmental Assessment. Volume 1 and 2.
- Organization of Eastern Caribbean Countries, Environment and Sustainable Development Unit. http://www.oecs.org/esdu/
- UN-ECLAC 2003. Handbook for estimating the socio-economic and environmental effects of disasters. United Nations Economic Commission for Latin America and the Caribbean. http://www.proventionconsortium.org/toolkit.htm
- Wetlands International 2005. Assessment of field protocol for rapid wetland and coastal assessment – a guide for staff: http://www.wetlands.org/Tsunami/Tsunamidata.htm

Methods for broader environmental impact assessments:

- Biswas AK and SBC Agarwal (eds.). 1992. Environmental impact assessment for developing countries. Oxford; Butterworth Heinman.
- Lohani BN. 1997. Environmental impact assessment for developing countries in Asia. Asian development bank. Manila.
- Barrow CJ. 2000. Social impact assessment: An introduction. London: Arnold.
- International association for impact analysis provides information at: http://www.iaia.org/Non_Members/Pubs_Ref_Material/pubs_ref_material_index.htm
- DigitalGlobe, a commercial satellite operation has made a donation for post-tsunami reconstruction. Imagery donated and downloadable free of charge at www.landcover.org may aid environmental impact assessments.

Ensuring public participation:

- Guidance on ensuring stakeholder participation, especially the participation of women, is given in the document 'Biodiversity in development': http://www.wcmc.org.uk/biodev/index2.html
- Additional guidance on stakeholder participation is presented in 'Diversity makes the difference.' http://www.generoyambiente.org/ES/publicaciones_uicn/biodiversity/modulebiodiversity.htm
- FAO has a website dealing with the issue of gender equity in public participation: http://www.fao.org/worldfoodsummit/english/fsheets/women.pdf

Strengthen institutional arrangements:

- UNEP's '10 keys for local and national action on municipal wastewater' discusses the interactions of the different players in a locality – ranging from the communities themselves to NGOs, local governments and the tourist industry, for example. Ideas in this list could be adapted to fit the current context. http://www.gdrc.org/uem/water/10-keys.html
- More ideas that could be adapted to coastal areas are presented by the Bonn Keys at: http://www.gdrc.org/uem/water/bonn-keys.html

The Hyogo Framework of Action

(Extracted directly from www.unisdr.org/hfa)

The Hyogo Framework for Action (HFA) is the key instrument for implementing disaster risk reduction, adopted by the Member States of the United Nations. Its over-arching goal is to build resilience of nations and communities to disasters, by achieving substantive reduction of disaster losses by 2015 - in lives, and in the social, economic, and environmental assets of communities and countries. The HFA offers five areas of priorities for action, guiding principles and practical means for achieving disaster resilience for vulnerable communities in the context of sustainable development. Since the adoption of the HFA, many global, regional, national and local efforts have addressed disaster risk reduction more systematically, much however, remains to be done. The United Nations General Assembly has called for the implementation of HFA, reconfirmed the multi-stakeholder ISDR System and the Global Platform for Disaster Risk Reduction to support and promote it. The General Assembly has encouraged member states to establish multi-sectoral national platforms to coordinate disaster risk reduction in countries. Many regional bodies have formulated strategies at regional scale for disaster risk reduction in line with the HFA, in the Andean region, Central America, the Caribbean, Asia, Pacific, Africa and Europe. More than 100 governments have designated official focal points for the follow-up and the implementation of the HFA (March 2007). Some have taken actions to mobilise political commitment and establish centres to promote regional cooperation in disaster risk reduction.

Priorities for action:

Principle1: Make disaster risk reduction a priority:

Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation.

Strong national and local commitment is required to save lives and livelihoods threatened by natural hazards. Natural hazards must be taken into account in public and private sector decision-making in the same way that environmental and social impact assessments are currently required. Countries must therefore develop or modify policies, laws, and organizational arrangements, as well as plans, programmes, and projects, to integrate disaster risk reduction. They must also allocate sufficient resources to support and maintain them. This includes:

- Creating effective, multi-sector national platforms to provide policy guidance and to coordinate activities;
- Integrating disaster risk reduction into development policies and planning, such as Poverty Reduction Strategies; and
- Ensuring community participation, so that local needs are met.

Principle 2: Know the risks and take action:

Identify, assess, and monitor disaster risks - and enhance early warning.

To reduce their vulnerability to natural hazards, countries and communities must know the risks that they face, and take actions based on that knowledge. Understanding risk requires investment in scientific, technical, and institutional capabilities to observe, record, research, analyse, forecast, model and map natural hazards. Tools need to be developed and disseminated: statistical information about disaster events, risk maps, disaster vulnerability and risk indicators are essential.

Most importantly, countries need to use this knowledge to develop effective early warning systems, appropriately adapted to the unique circumstances of the people at risk. Early warning is widely accepted as a crucial component of disaster risk reduction. When effective early warning systems provide information about a hazard to a vulnerable population, and plans are in place to take action, thousands of lives can be saved.

Principle 3: Build Understanding and Awareness:

Use knowledge, innovation, and education to build a culture of safety and resilience at all levels.

Disasters can be reduced substantially if people are well informed about measures they can take to reduce vulnerability - and if they are motivated to act. Key activities to increase awareness of disaster prevention include:

- Providing relevant information on disaster risks and means of protection, especially for citizens in high-risk areas;

- Strengthening networks and promoting dialogue and cooperation among disaster experts, technical and scientific specialists, planners and other stakeholders;
- Including disaster risk reduction subject matter in formal, non-formal, and informal education and training activities;
- Developing or strengthening community- based disaster risk management programmes; and
- Working with the media in disaster risk reduction awareness activities.

Strategic Goals:

- The integration of disaster risk reduction into sustainable development policies and planning;
- Development and strengthening of institutions, mechanisms and capacities to build resilience to hazards;
- The systematic incorporation of risk reduction approaches into the implementation of emergency preparedness, response and recovery programmes.

Principle 4: Reduce risk:

Reduce the underlying risk factors.

Vulnerability to natural hazards is increased in many ways, for example:

- Locating communities in hazard-prone areas, such as flood plains;
- Destroying forests and wetlands, thereby harming the capacity of the environment to withstand hazards;
- Building public facilities and housing unable to withstand the impacts of hazards; Not having social and financial safety mechanisms in place.

Countries can build resilience to disasters by investing in simple, well-known measures to reduce risk and vulnerability. Disasters can be reduced by applying relevant building standards to protect critical infrastructure, such as schools, hospitals and homes. Vulnerable buildings can be retrofitted to a higher degree of safety. Protecting precious ecosystems, such as coral reefs and mangrove forests, allow them to act as natural storm barriers. Effective insurance and micro-finance initiatives can help to transfer risks and provide additional resources.

Principle 5: Be prepared and ready to act:

Strengthen disaster preparedness for effective response at all levels.

Being prepared, including conducting risk assessments, before investing in development at all levels of society will enable people to become more resilient to natural hazards.

Preparedness involves many types of activities, including:

- The development and regular testing of contingency plans;
- The establishment of emergency funds to support preparedness, response and recovery activities;
- The development of coordinated regional approaches for effective disaster response;
- Continuous dialogue between response agencies, planners and policy-makers, and development organisations.

Regular disaster preparedness exercises, including evacuation drills, also are key to ensuring rapid and effective disaster response.

Effective preparedness plans and organisation also help to cope with the many small and medium-sized disasters that repeatedly occur in so many communities. Natural hazards cannot be prevented, but it is possible to reduce their impacts by reducing the vulnerability of people and their livelihoods.

Who is responsible for implementing disaster risk reduction and the Hyogo Framework?

Collaboration and cooperation are crucial to disaster risk reduction: states, regional organisations and institutions, and international organisations all have a role to play. Civil society, including volunteers and community-based organisations, the scientific community, the media, and the private sector, are all vital stakeholders. Following is an indication of the variety and diversity of actors and their core responsibilities.

States are responsible for:

- Developing national coordination mechanisms;
- Conducting baseline assessments on the status of disaster risk reduction;

- Publishing and updating summaries of national programmes;
- Reviewing national progress towards achieving the objectives and priorities of the Hyogo Framework;
- Working to implement relevant international legal instruments; and
- Integrating disaster risk reduction with climate change strategies.

Regional organisations are responsible for:
- Promoting regional programmes for disaster risk reduction;
- Undertaking and publishing regional and sub-regional baseline assessments;
- Coordinating reviews on progress toward implementing the Hyogo Framework in the region;
- Establishing regional collaborative centres; and
- Supporting the development of regional early warning mechanisms.

International organisations are responsible for:
- Encouraging the integration of disaster risk reduction into humanitarian and sustainable development programmes and frameworks;
- Strengthening the capacity of the United Nations system to assist disaster-prone developing countries with disaster risk reduction initiatives;
- Supporting data collection and forecasting, information exchange, and early warning systems;
- Supporting States' own efforts with coordinated international assistance; and
- Strengthening disaster management training and capacity building.

The International Strategy for Disaster Reduction (ISDR) system is responsible for:
- Developing a matrix of roles and initiatives related to the Hyogo Framework;
- Facilitating the coordination of actions at the international and regional levels;
- Developing indicators of progress to assist States in tracking their progress towards implementation of the Hyogo Framework;
- Supporting national platforms and coordination mechanisms;
- Stimulating the exchange of best practices and lessons learned; and
- Preparing reviews on progress toward achieving the Hyogo Framework objectives.

The International Strategy for Disaster Reduction

The International Strategy for Disaster Reduction was adopted as a follow-up of the International Decade on Natural Disaster Reduction (IDNDR) 1990-1999 by the Member States of the United Nations in 2000. This strategy aims to achieve substantive reduction of disaster losses and build resilient communities and nations, as an essential condition for sustainable development.

The ISDR System comprises numerous organisations - both states and civil society worldwide working together to reduce disaster losses. All countries are encouraged to establish National Platforms for Disaster Risk Reduction or other coordination mechanisms. At regional level, information sharing and coordination among existing bodies are promoted by the UN/ISDR secretariat and partners as Regional Platforms for Disaster Risk Reduction. The international elements of the ISDR System are the Global Platform for Disaster Risk Reaction and the UN/ISDR secretariat.

The Global Platform for Disaster Risk Reduction is the main global forum for governments, United Nations agencies, international financial institutions, regional bodies, civil society, the private sector, the scientific, and academic communities. It is responsible for raising awareness and reiterates commitments, for sharing experience on implementation among stakeholders and governments, addressing gaps, and for providing strategic guidance and coherence for implementing the Hyogo Framework. Thematic clusters, groups and platforms work on specific topics of the disaster risk reduction agenda, such as: climate change adaptation, education, urban risk, early warning, recovery and capacity development. The Global Platform will appoint a committee to advise on programmatic priorities and direction to the Global Platform.

The UN/ISDR secretariat, accountable to the UN USG, serves as a broker, catalyst, and focal point for disaster risk reduction within the United Nations and among the members of the ISDR System. It advocates for commitment to disaster risk reduction and the implementation of the Hyogo Framework, and reports on progress.

The full text of the Hyogo Framework for Action can be downloaded at http://www.unisdr.org/eng/hfa/hfa.htm.

Asian Disaster Preparedness Center (ADPC)

(Extracted directly from its website http://www.adpc.net/v2007/.)

The Asian Disaster Preparedness Center (ADPC) is a non-profit organization supporting the advancement of safer communities and sustainable development, through implementing programmes and projects that reduce the impact of disasters upon countries and communities in Asia and the Pacific, by:

- developing and enhancing sustainable institutional disaster risk management capacities, frameworks and mechanisms, and supporting the development and implementation of government policies;
- facilitating the dissemination and exchange of disaster risk management expertise, experience and information; and
- raising awareness and enhancing disaster risk management knowledge and skills.

At the recommendation of UN Disaster Relief Organisation (UNDRO) - now known as UN Office for the Coordination of Humanitarian Affairs (UN-OCHA) - ADPC was established in 1986 as an outreach activity of the Asian Institute of Technology in Bangkok , Thailand , with the aim of strengthening the national disaster risk management systems in the region. In 1999, ADPC became an independent entity.

ADPC's Vision:

Safer communities and sustainable development through disaster risk reduction

ADPC's mission:

ADPC's mission is to reduce the impact of disasters on communities and countries in Asia and the Pacific by:

- raising awareness and enhancing knowledge;
- developing and strengthening sustainable institutional mechanisms;
- facilitating exchange of information, experience and expertise; and
- developing and demonstrating innovative disaster reduction practices.

ADPC's goals are to:

- mainstream disaster reduction in development;
- build and strengthen capacity;
- facilitate partnerships and exchange of experiences;
- be recognised as a proactive and responsive regional resource; and
- achieve quality service through a team approach.

Future priorities:

For future activities, ADPC has identified a number of disaster risk management priorities that the countries in the Asia region must address in their attainment of sustainable development. These include:

- mainstreaming of disaster risk management into national development policies and processes (for example, planning, staffing, budgeting, etc.);
- assisting provincial and district governments in developing disaster risk management plans and supporting national governments in developing their national disaster risk management information systems;
- encouraging appropriate legislation and policies for enforcing the incorporation of disaster risk management into development strategies and programs;
- developing financing mechanisms to support the financial sustainability of disaster risk management outcomes and activities;
- reducing vulnerabilities of urban population in Asia projected to increase from 30% to 45% of the population by 2015, increasingly putting urban centers at risk;
- developing and supporting implementation of regional programs on disaster risk management, specifically, ASEAN and SAARC;
- encouraging and developing increased community participation in mine risk education activities and providing greater support to victims assistance; and
- converting vulnerable communities into a resource for undertaking disaster management intervention.

Environmental Personnel Network and Disaster Environment Working Group for Asia

Emergency Personnel Network

The Emergency Personnel Network (EPN) is a network of humanitarian organisers – professionals and operational managers who meet once a year to discuss best practices, benchmark standards, hear case studies, review new methodologies, examine problems, present solutions and plan for the future (http://www.epn.peopleinaid.org/aboutnetwork.aspx).

Through an online facility, EPN members can share ideas and experience, seek assistance and share information to improve the performance of their organisations.

About 180 organisations, including American, Australian and British Red Cross, Oxfam, CARE, UN Habitat, UNHCR are part of this network.

More information about EPN can be obtained at http://www.epn.peopleinaid.org/aboutnetwork.aspx.

Disaster Environment Working Group for Asia

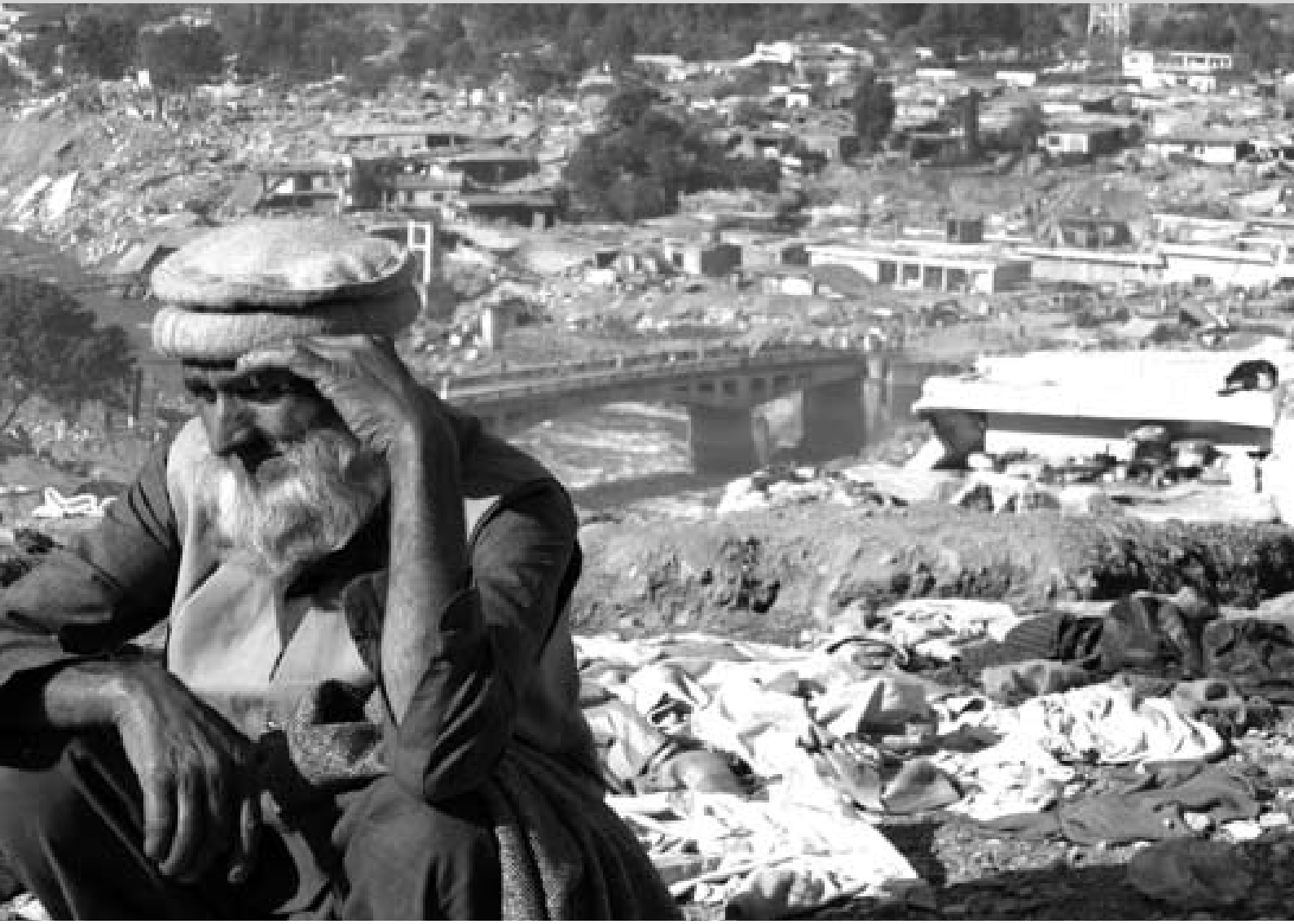
The Disaster Environment Working Group for Asia (DEWGA) was established in 2007. It acts as a small, semi-formal, open-ended, regional, action-oriented, cross-sectoral partnership to explore avenues through which the partners can work with each other to minimise long term environmental impacts and degradation, as a key disaster risk reduction measure.

DEWGA aims to create a multi-disciplinary community of practitioners in the Asia Pacific region that is concerned with closing the gap among sectors with a view to increasing effectiveness of risk reduction – presuming that environmental sustainability is a key success factor – whether specific interventions on the ground or long-term strategies. It is envisaged that this will be achieved through the following objectives.

i) Serve as a collective body to advocate and promote linkages between disaster risk reduction and environmental management.
ii) Create a space in which the partners can identify and undertake bilateral or joint programmes of work.
iii) Exchange information on new and upcoming initiatives (for example, events, programmes, research and publications) that provide structured opportunities to strengthen these linkages.
iv) Actively promote integration of disaster risk reduction and environmental sustainability into respective work programmes.

DEWGA collaborates with the United National International Strategy for Disaster Reduction (UN-ISDR) and the United Nations Environment Programme (UNEP) and has six founding members: the Asian Disaster Preparedness Centre (ADPC), CARE, the International Environment and Disaster Management, Graduate School of Global Environmental Studies, Kyoto University (IEDM/KU), IUCN – the World Conservation Union, the Stockholm Environment Institute (SEI) and WWF.

Information about DEWGA can be obtained from http://www.sei.se/programmes/risk-livelihoods-a-vulnerability/projects/1472-m-disaster-environment-working-group-for-asia-dewga.html



The Sphere Standards: Humanitarian Charter and Minimum Standards in Disaster Response.

(Quoted directly from (http://www.sphereproject.org/content/view/229/232)

Drawing on international humanitarian law, the Sphere Project is a set of minimum standards, indicators and guidance notes for disaster response, based on a humanitarian charter.

Sphere is based on two core beliefs:

1. That all possible steps should be taken to alleviate human suffering arising out of calamity and conflict, and
2. That those affected by disaster have a right to life with dignity and therefore a right to assistance.

'More than 700 people from 228 relief organisations in 60 countries considered ideas on good practice over three years. The results were published in a handbook in January 2000.

The Sphere handbook contains a humanitarian charter and minimum standards, accompanied by key indicators for five sectors of disaster response:

- Water supply and sanitation,
- Nutrition,
- Food aid,
- Shelter and site management, and
- Health services.

The charter recognises the basic right to assistance of people affected by disasters, enshrined in international law. It highlights the legal responsibility of states to guarantee these rights. The standards are formulated as principles or objectives.The key indicators are quantified indices to measure fulfilment of the standards' (http://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=1121289).

The aim of Sphere:

The aim of Sphere is to improve the quality of assistance to people affected by disaster and improve the accountability of states and humanitarian agencies to their constituents, donors and the affected populations.

Guiding values and principles for the Sphere Project:

The Sphere Project is based on:

- International humanitarian, human rights, and refugee law,
- The code of conduct: principles of conduct for the International Red Cross and Red Crescent Movement and NGOs in disaster response programmes.

Strategic objectives of Sphere:

1. To improve the commitment to and effective use of Sphere by all actors involved in humanitarian action.
2. To strengthen the diversity and regional balance of organisations in the governance and implementation of Sphere.
3. To develop and nurture a cadre of people who are able to use Sphere effectively.
4. To coordinate and interact with other humanitarian initiatives, and work together when that complements Sphere's aim.
5. To understand and increase the impact of Sphere.

More information on the Sphere standards can be obtained from http://www.sphereproject.org/.

The UNHCR Handbook for Emergencies

United Nations High Commissioner for Refugees has developed a Handbook for Emergencies, which was in its third edition in 2007[23] (UNHCR, 2007).

'The United Nations Refugee Organization (UNHCR), is mandated by the United Nations to lead and coordinate international action for the world-wide protection of refugees and the resolution of refugee problems. . . The majority of UNHCR's operations begin as a result of an emergency caused by a sudden influx of refugees and IDPs[24]. . . Much of UNHCR's normal work is, in effect, built upon emergency interventions and responses. There are, however, situations that are clearly exceptional. The UNHCR handbook addresses the needs and requirements for a comprehensive response to such situations.' (UNHCR, 2007).

'The aim of international protection in emergencies is to:

i. Ensure admission and at least temporary asylum;
ii. Prevent forcible return ('refoulement'); and
iii. Ensure refugees are treated according to basic human rights standards.

This comprehensive handbook summarises UNHCR's mandate of international protection and the aim and principles of emergency response; deals with emergency management; covers the vital sectors and problem areas in refugee emergencies, including health, food, sanitation and water, as well as key field activities underpinning the operations such as logistics, community services and registration. The chapters in each section start with a summary so that readers, who might not need the full level of detail in each of these chapters, can understand the basic principles of the subject quickly.

It also gives guidance on the support to field operations, primarily administration and staffing. Also included is a 'toolbox' which gathers, in one location, the standards, indicators and useful references used throughout the handbook' (UNHCR, 2007).

Some selected indicators and standards are listed below.

Table 11. Key emergency indicators
(Source: A Handy Guide to UNHCR Emergency Standards and Indicators, 2007)

	Crude mortality rate	Mortality rate among children under 5yr
Normal rate among a settled population	0.3 to 0.5/10,000/day	1.0/10,000/day
Emergency programme under control	<1/10,000/day	<2.0/10,000/day
Emergency programme in serious trouble	>1/10,000/day	>2.0/10,000/day
Emergency out of control	>2/10,000/day	>4.0/10,000/day
Major catastrophe	>5/10,000/day	

Table 12. Typical infrastructure requirements
(Source: A Handy Guide to UNHCR Emergency Standards and Indicators, 2007)

1 latrine	1 family (6–10 persons
1 water tap	1 community (80–100 persons)
1 health centre	1 camp (of 20,000 persons)
1 hospital	up to 200,000 persons
1 school	1 sector (5,000 persons)
4 commodity distribution sites	1 camp module (20,000 persons
1 market	1 camp module (20,000 persons)
2 refuse drums	1 community (80–100 persons)

[23] Citation: UNHCR, 2007. http://www.unhcr.org/paubl/PUBL/471db4c92.html.
[24] An IDP is an internally displaced person.

Table 13 Site planning for emergencies

Land	30 – 45m^2 per person.
Shelter space	3.5m^2 per person (tents or other structures).
Fire break space	▪ A clear area between shelters 50m wide should be provided for every 300m of built-up area. ▪ A minimum of 1-1.5m should be provided between guy-ropes of neighbouring tents on all sides.
Roads and walkways	20-25% of entire site.
Open space and public facilities	15-20% of entire site.
Environmental sanitation	▪ 1 latrine seat per 20 people or ideally 1 per family sited not farther than 50m from user accommodations and not nearer than 6m. ▪ 1 x 100 litre refuse bin per 50 people. ▪ 1 wheelbarrow per 500 people.
Water	▪ 15-20 litres per person per day of clean water. ▪ Health centre: 40-60 litres/patient/day. ▪ Feeding centres: 20-30 litres/patient/day.
Tap standards	1 per 200 persons, sited not farther than 100 m from user accommodations.
Warehouse space	For food grains in bags, stacked 6m high, allow 1.2m^2 of floor space per ton.
Food	2,100 kcal/person/day. This will require approximately 36 metric tonnes/10,000 people/week of food assuming the following daily ration: ▪ 350-400g/person/day of staple cereal. ▪ 20-40g/person/day of an energy rich food (oil, fat). ▪ 50g/person/day of a protein rich food (legumes).

This comprehensive handbook also provides a checklist for initial assessment as shown below.

UNHCR checklist for initial assessment (UNHCR, 2007)

Who are the refugees, their number and pattern of arrival?

- Approximately how many refugees are there?
- Where have the refugees come from? Why?
- What is the rate of arrival? Is it likely to increase or decrease?
- What is the total number likely to arrive?
- What is the location of the arrival points and of the sites where people are settling (latitude and longitude)?
- Are the refugees arriving as individuals or in groups? Are these family groups, clans, tribal, ethnic or village groups?
- Are families, village groups and communities intact?
- How are the refugees organized? Are there group or community leaders?
- How are the refugees travelling: on foot, in vehicles? What is the gender ratio of the population?
- What is the age profile of the population? Can a breakdown in age be given – under five's, age 5 to 17 years, 18 years and over?
- How many unaccompanied minors are there? What is their condition?
- What was the social and economic situation of the refugees prior to their flight?
- What are their skills and languages? What is their ethnic and cultural background?
- Are there individuals or groups with special social problems? Are there particular groups made more vulnerable by the situation? (For example, the disabled, separated minors or elderly people in need of support.)
- What are the basic diet, shelter, and sanitation practices of the refugees?
- What is the security situation within the population: is there a need for separation between different groups?
- What is the formal legal status of the refugees?

Characteristics of the location.

- What are the physical characteristics of the area where the refugees are located?
- What is the soil, topography and drainage?
- Is there enough space for those there and those likely to arrive?
- Is there all season accessibility?
- Can the refugees access relief assistance from where they are located?
- What is the vegetation cover?
- Will the refugees need to use wood for fuel and shelter?
- Approximately how many people already live in the local area?
- Who owns (or has usage rights on) the land?
- Is there grazing land and are there potential areas for cultivation?
- What is the actual or likely impact on the local population and what is their attitude and that of the local authorities towards the refugees?
- Are there security problems?
- What environmental factors must be taken into account (for example, fragility of the local environment and extent to which local community relies on it; how rapidly might it be degraded by the refugees, proximity to protected areas)?
- What is the condition of the local population? If assistance is provided to the refugees, should the local population also be assisted?

Health status and basic problems.

- Are there significant numbers of sick or injured persons, is there excess mortality?
- Are there signs of malnutrition?
- Do the refugees have access to sufficient quantities of safe water?
- Do the refugees have food stocks, for how long will they last? Do the refugees have adequate shelter?
- Are adequate sanitary facilities available?
- Do the refugees have basic domestic items?
- Is there sufficient fuel for cooking and heating?

Resources, spontaneous arrangements and assistance being delivered.

- What type and quantity of possessions have the refugees brought with them?
- What arrangements have the refugees already made to meet their most immediate needs?
- What assistance is already being provided by the local population, the government, UN organisations and other organisations, is the assistance adequate, sustainable?
- Is the present assistance likely to increase, continue, decrease?
- What is the government's policy on assistance to the refugees?
- Are there any major constraints likely to affect an assistance operation?
- Has contingency planning for this type of emergency been undertaken?
- What coordination arrangements are required?

Means to deliver protection and assistance.

- Can effective implementing arrangements be made quickly and locally? If not, what are the alternatives?
- Is there already an identified refugee leadership with whom it will be possible to coordinate the delivery of protection and assistance?
- What are the logistical needs and how can they be met?
- Where will the necessary supplies come from?
- How will they reach the refugees?
- What storage is needed, where and how?
- Are there essential items which can only be obtained outside the region and whose early supply will be of critical importance (for example, food, trucks?)
- What are the needs for UNHCR and implementing partner staff and staff support?

The entire handbook can be downloaded at http://www.unhcr.org/publ/PUBL/471db4c92.htm. A summary of the handbook, A Handy Guide to UNHCR Emergency Standards and Indicators can be downloaded at http://www.humanitarianreform.org/humanitarianreform/Portals/1/cluster%20approach%20page/clusters%20pages/CCm/IDP%20Key%20Resources/A%20Handy%20Guide%20to%20UNHCR%20Standards%20and%20Indicators.pdf

Guidelines for gender sensitive disaster management

(quoted directly from APWLD, 2006[25])

'In 2000, the special session of the UN General Assembly, 'Gender equality, development and peace for the twenty-first century' highlighted the inefficiencies and inadequacies of existing approaches and intervention methods in responding to natural disasters and the need for gender perspectives to be incorporated whenever disaster prevention, mitigation and recovery strategies are being developed and implemented. . . However, five years after [these concerns were] expressed, gender blind disaster management recurred in the context of the Indian Ocean tsunami and the earthquake in Paksitan. Survey findings confirmed that women were more vulnerable during disasters [because] women, marginalised and disempowered under normal circumstances, are more at risk because of their lower socio-economic status, barriers to choice and lack of access to resources. . . .There is an urgent need to move from gender blindness to gender sensitivity in helping the victims of natural disasters. Given that disasters will always occur, it is imperative to ensure that a gender perspective is included in all disaster management programmes so that the relief efforts are able to properly address women's needs and prevent violations of women's human rights.

Gender sensitive disaster management must be based on the [following] fundamental principles: 1) Women's rights are human rights, therefore, relief efforts should not only be based on needs, but on ensuring that women's human rights are protected and promoted; 2) Equality of women and men: and 3) Non-discrimination against women' (APWLD, 2006).

The APWLD's guidelines for gender sensitive disaster management include short, medium and long-term guidelines. Each of these guidelines is detailed in the original document, here, only the main guidelines are presented.

Immediate needs:

1. Identifying specific needs of women: Ask the women. Women are the most aware of what family needs are and what immediate responses needed.
2. Ensure that emergency relief supplies include items specially needed by women.
3. Ensure women's access to sufficient and adequate food. Ensure that disaster affected people do not suffer from hunger, thirst and malnutrition.
4. Food distribution should be equitable, transparent and respect human dignity.
5. Aid distribution for women should be handled by women.
6. Ensure that women's menstrual needs are met.
7. Ensure that all disaster affected people have access to adequate shelters.
8. Ensure women's access to adequate toilet and bathing facilities.
9. Ensure women's access to free health care services.
10. Ensure security and safety of women and children.
11. Protect women from violence and abuse.
12. Ensure women's access to psycho-social counselling.

Mid-term responses during the recovery phase:

1. Ensure women's participation in management of camps and temporary shelters.
2. Ensure women's equal access to compensation payments and rehabilitation measures.
3. Eliminate head of household concept.
4. Ensure women's access to information on relief and rehabilitation measures.
5. Ensure children's access to education.

Long-term responses during the reconstruction phase:

1. Ensure women's participation in decision-making processes for rehabilitation and reconstruction.
2. Ensure that reconstruction of houses meets women's and family needs.
3. Enure women's equal ownership rights to land, house and property.
4. Ensure women's equal access to livelihood opportunities.
5. Raise women's awareness of their human rights.
6. Mobilise and empower women to advocate for their human rights.
7. Protect vulnerable and marginalised groups.
8. Protect migrant workers.
9. Reach out to widows and women-headed households, the disabled and elderly.
10. Reach out to low caste people.
11. Ensure stateless people's access to relief support.
12. Protect women – victims of disasters and armed conflict situations.

[25] APWLD, 2006. http://www.apwld.org/pdf/Gender_Sensitive.pdf)

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The IUCN Asia region covers 23 countries, stretching from Pakistan in the West to Japan in the East, Indonesia in the South to Mongolia in the North. IUCN maintains offices in Bangladesh, Cambodia, China, Lao PDR, Nepal, Pakistan, Sri Lanka, Thailand and Viet Nam. The Asia Regional Office is in Bangkok, Thailand.

IUCN's seven regional thematic programmes, known collectively as the Ecosystems and Livelihoods Group (ELG), are based in two clusters: one in Colombo, Sri Lanka (environmental economics, marine and coastal, species conservation), and one in Bangkok, Thailand (environmental law, forests, protected areas, wetlands and water resources).

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