Section C4a

Terrestrial Environments: Assessment of Disaster Impacts

Objectives

- ❑ Review goods and services provided by terrestrial environment
- ❑ Identify components of the natural terrestrial environment at risk to natural hazards (Resilience and Vulnerability)
- ❑ Decide which resources to assess for impact and damage
- ❑ Measuring impacts and damages

Resources and Ecosystems providing goods and services

Goods and services provided by terrestrial resources and ecosystems are generally known. However, their economic and social value is quite often not understood or appreciated. Difficulties in arriving at reliable or acceptable economic values for such resources make direct damage assessment and costing difficult. Table 13 summarizes the goods and services provided by selected resources and ecosystems and notes sectors sharing the primary benefits.

Terrestrial Environment

Table 13

Summary of goods and services provided by selected resources/ecosystems

Resource/Ecosystem	Socio-economic value		Sectors that enjoy primary benefits
	Goods	**Services**	
Forest/watershed	❑ Timber ❑ Fuelwood ❑ Food ❑ Other forest products	❑ Habitat ❑ Water catchment ❑ Ecotourism ❑	❑ Forestry ❑ Tourism
Rivers/Lakes	❑ Fresh water ❑ Food ❑ Hydro-electricity	❑ Habitat ❑ Recreation ❑ Water flow	❑ Housing ❑ Tourism ❑ Agriculture
Aquifers	❑ Ground water	❑ Ground water storage	❑ Housing ❑ Tourism ❑ Agriculture
Wetlands	❑	❑ Flood control ❑ Ground water recharge	❑ Tourism ❑ Housing ❑ Agriculture
Scenic landscape	❑ Photographs ❑ Postcards	❑ Visual pleasure ❑ Spiritual upliftment ❑ Education	❑ Tourism
Wildlife	❑ Food ❑	❑ Viewing ❑	❑ Tourism
Medicinal and wild plants	❑ Drugs ❑ Herbal applications ❑ Cosmetics	❑ Spiritual	❑ Health ❑ Tourism
Soils	❑ Food	❑ Nutrient recycling	❑ Agriculture

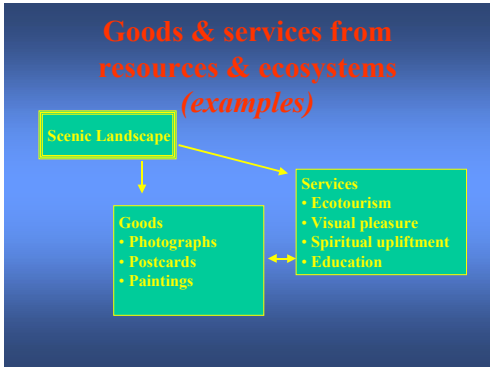


Figure 15
Goods and services from resources and ecosystems

Resilience and Vulnerability

Terrestrial systems are naturally resilient but take considerable time to recover in some cases. Economies highly dependent on environmental goods and services are vulnerable because of potential disruption to production flows and services, e.g:

- Forest and watershed damage from volcanoes or hurricanes can affect run-off and recharge and hence the supply of surface and/or ground water;
- Timber producing species buried, burnt or broken from lava flows from a volcano or damaged by wind from a hurricane will result in temporary or permanent disruption of timber producing cycles;
- Scenic landscapes and natural habitats may temporarily lose their tourism appeal;
- Wildlife damage or loss can affect critical sources of protein and food supply to local populations and adversely affect the eco-tourism appeal of affected areas.

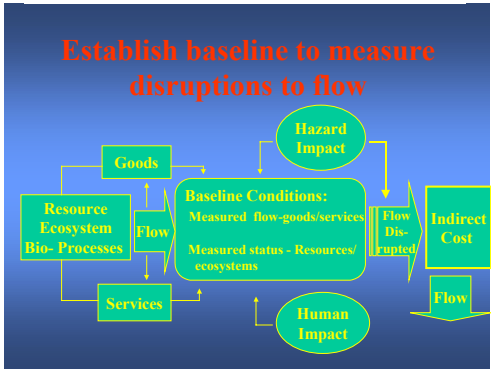
Deciding which Resources/Ecosystems or Environmental Services to Assess for Damages and Impacts

- Primary focus should be on resources, ecosystems, or environmental services of known economic or social value;
- Time and resource limitations may require selecting ecosystems, habitats, wildlife species or resources considered to be of primary importance for economic purposes, bio-diversity or other reasons;
- In this respect, managed areas or resources provide a good starting point because for the most part their socio-economic and cultural value to the country has been determined;
- Examples of managed areas are:
  - Forest Reserves
  - National Parks
  - Wildlife Sanctuaries
  - Archaeological Sites
  - Protected Landscapes

❖ Why Assess Managed Areas?

- The specific objectives for management of such areas are indicative of their national importance re biodiversity, education, economy, etc.
- Baseline information critical to assessment of impacts is more likely to be available for such areas.

Figure 16
Sources of baseline and post event data



Sources of Baseline and Post Event Data

- Protected Area Managers
- Wildlife Managers
- Management Agencies

- NGOs
- State of the Environment Reports/National Environmental Profiles/Other Reports
- International Organizations

Two Major Categories of Data/information
- Physical/ecological data
- Socio-economic

a) Physical/ecological Data
- Size (acreage)
- Critical wildlife or plant species
- Estimates of species populations
- Status of species (threatened, endangered, other)
- Dimensions, layout of archaeological sites
- Other

b) Socio-economic Data
- # Employees
- Concessions
- Related community enterprises (outside of area boundaries)
- Community uses within managed areas
- Visitor trips
- Visitor revenues
- Other

Refernces/sources In Analysis Of Baseline Conditions
- Wildlife population studies
- Forest surveys
- Flora and Fauna inventories
- Vegetation/life zones classifications

- Resource inventories
- Archaeological surveys

Damage Impact Surveys
- Secondary sources
- Vehicle reconnaissance
- Aerial photos
- Remote imagery

The Watershed Example

The conventional watershed is a geographic unit with hydrological characteristics determined by geology, topography, soils and vegetation. The "megawatershed" is a new concept developed in relation to the use of fresh water taken from bedrock aquifers in contrast to alluvial aquifers. Recharge to both is determined by the following formula:

Recharge = Precipitation – evaporation – runoff.

Lower than normal precipitation (as in droughts) reduce recharge to the aquifer. Human practices and natural hazards that increase runoff will also reduce recharge. Damages to watershed from hurricanes or volcanoes that can disrupt water supplies include:
- Damage to vegetation, causing an increase in runoff, a reduction in water infiltration into soil and a reduction in recharge to the aquifer;
- Damage to streams and rivers, which can divert natural flow away from critical recharge areas;
- Siltation of rivers and streams resulting in increase costs for water treatment;
- Lowering of generation capacity at hydroelectric plants.

Photo 19:
Flood damage to vegetation

Such adverse effects can reduce fresh water production from well fields, which can be determined by monitoring pumping levels at wells in association with rainfall and established recharge rates.

While it may be impractical or inadvisable to repair damages to watersheds in the majority of cases, the calculation of water loss resulting from such damages can inform strategies seeking to find alternate water sources, temporary or otherwise, to mitigate water shortage effects on households, tourism, agriculture and other sectors.

Several factors should be considered when seeking to determine damages and costs, namely:

- Damages and costs for major river stream bank repairs would most likely be calculated in the infrastructure sector, because ironically this type of re-construction is not considered a form of repair to a natural system;
- Damages to water production and treatment facilities and transmission lines are more obvious but watershed damages and impacts resulting in the disruption of water supply or impairment of water quality should be given due consideration in relation to loss of an environmental good or service;
- Confirmation of links between watershed damage and reduction in water supply requires time and adequate monitoring and so costing may not be possible soon after a hazard event;
- With respect to costing of damages, the focus should be on indirect costs, e.g:

    - Loss of earnings to water authority;
    - Increase cost of water treatment due to turbidity;
    - Relatively higher costs of water from alternative sources, e.g., desalination

Wildlife Species and Habitats Example

- Foremost attention in damage or impact assessment should be given to species or habitats well known for either their visitor attraction and economic value, value to communities either as source of food, livelihood or jobs, national or global biodiversity importance or in some cases scientific value;

Photo 20
Wildlife species and habitat

- Damage and impact assessment can be done efficiently where:
  - Species habitats are well defined, such as the nesting habitat for the Magnificent Frigate Bird, Barbuda in Antigua and Barbuda
  - Estimates of species populations prior to a hazard event are available, such as the Amazona Parrot species of the Windward Islands, Howler Monkeys in parts of Belize
  - Socio-economic data on visitor levels to wildlife parks or sanctuaries, income to service providers and jobs are available
  - Where optimal ecological conditions are well enough understood to determine adverse effects on habitat requirements, including diets, shelter and range;

Photo 21
Assessment strategy