FACTSHEET

Moderation of extreme events

In a nutshell

Ecosystems and living organisms create buffers against natural disasters. They reduce damage from natural hazards including floods, storms, tsunamis, avalanches, landslides and droughts.

1. Role for human well-being

Vegetation coverage and plant root systems stabilize slopes, which can prevent or decrease the intensity of avalanches and landslides and thereby protect people from potential disaster. Coral reefs and mangroves in coastal ecosystems help protect coastlines from storm damage caused by hurricanes or large waves. The importance of this ecosystem service is growing especially due to climate change effects such as sea level rise and heavy rainfall. Its benefits are widespread among populations living in vulnerable areas. These can range from protection from physical harm to cost savings on man-made protection measures and damage costs. In 2013, flooding in Central Europe – especially in Germany and Austria – caused more than 12 billion euros ($15.5 billion) of damage, according to Munich Re, the world's biggest reinsurer. Unseasonably heavy rainfall caused the Vltava, Danube and Elbe rivers and their tributaries to burst dams and breach their banks.

2. Typical threats

Due to population growth and infrastructure development the beneficial impacts of this service are decreasing. People's vulnerability to natural hazards is increasing worldwide. This is due partly to an increased use of 'high-risk' areas that are exposed to extreme events and partly to the conversion of ecosystems that otherwise serve to prevent or moderate extreme events. Conversion or structural changes in natural ecosystems are leading directly to a decline of this service, for instance in mountainous regions (landslides), in watershed areas and along rivers (floods and droughts) or coastal regions (storms). Moreover, depositions of man-made waste products (such as chemicals) in ecosystems diminish the ability of ecosystems to provide protection against natural disasters over the long term. Ecosystems crucial to the moderation of extreme events have thresholds. If so called tipping points are passed, they collapse and lose their ecological capacity to deliver the service. Restoring ecosystems or devising and implementing man-made alternatives require substantial investments. People often recognise their dependence on properly functioning ecosystems only when a natural disaster has already occurred and the loss of this service becomes obvious. In the Philippines, the 2004 tsunami contributed to a wider understanding and appreciation of the value of mangroves for disaster risk reduction and not just for shrimp farming. It is difficult to predict when an extreme event will happen. However, climate change models indicate that in many regions the frequency of extreme events is likely to increase.

3. Example indicators

- The social value of this ecosystem service can be assessed by the number of households at risk or the population protected by natural ecosystems (households/ha).
- Avoided damages in terms of property or health and avoided costs of man-made alternatives (e.g. for dams) are other socio-economic metrics.

- The frequency of extreme events (e.g. abundance/50 years) and their extent (e.g. hectares flooded) can be measured by gathering existing local or regional data. This can indicate the vulnerability of communities to natural hazards and shows the socio-economic importance of natural habitats in protecting communities.
- The capacity of ecosystems to store water (in m^3/ha or biomass/ha) and the spatial extent of riparian zones available for retention (in hectares) can show the importance of an area for flood protection.
- Land cover/land use maps or aerial views are helpful: Information on the extent of current land cover can indicate the state of protection against extreme events. One example is the indicator 'extent of marine habitats'. This indicator assesses global trends in mangroves, seagrass beds and coral reefs, which in many coastal areas are linked with the moderation of extreme events.
- For protection against landslides, the total size of deforested slopes in ha and the share of area required to protect human communities can serve as an indicator.

Global available sources for national data:

- The website PreventionWeb provides disaster and risk profiles for different hazards and regions/countries.
- FAO's Global Land Cover Network (GLCN) and the USGS provide extensive databases relating to different remote sensing land cover issues.

4. Example methods

For **assessing the value** of this ecosystem service:

- Contingent valuation
- Cost based methods such as : Avoided damage costs and replacement costs
- Surveys and questionnaires asking local communities about the effects of extreme events on their livelihoods.
- The TESSA toolkit (p.210) provides brief explanations of the following economic valuation approaches related to flood protection in wetlands:
  - Damage costs avoided (direct costs)
  - Defensive expenditures
  - Current expenditures on flood protection measures
  - Replacement costs

For **assessing the condition** of this ecosystem service:

- Assessing various forms of vulnerability
- The TESSA toolkit, p.199 provides a set of methods to assess flood protection services. These methods are based on stakeholder meetings and are focused on wetland sites. Different methods can be used depending on access to hydrological data. See also the related ValuES Method Profile
- In addition, the TESSA toolkit, p.213 gives examples of possible alternative state contexts for assessing flood prevention in order to give some idea of how hydrographs are likely to change in the future.
- The description of essential climate variables provides a good overview of how to measure land cover changes.

5. Managing this service

Typical instruments for managing this service include:

Land planning and zoning

- Assigning watershed status, protecting forest areas in sensitive areas (e.g. mountains) and other land planning measures can be used to maintain or improve the contribution of ecosystems to moderate extreme events. For case studies and guidance, see for example: RCC Guideline 3.2 - Promoting Use of Disaster Risk Information.

Sustainable management of agricultural and forest land based on ecological conditions

- For practical steps aimed at integrating ecosystem management into disaster risk reduction strategies at the local and national levels, please see the guide: Environmental Guidance - Note for Disaster Risk Reduction - Healthy Ecosystems for Human Security.
- Ecosystem based adaptation on climate change can be a powerful way to develop a pro-active response to reduce natural hazards. See for example: The response of mangrove soil surface elevation to sea level rise.

Restoration of ecosystems with high potential to moderate extreme events

- The area surrounding Thornton Creek, USA experiences storm water-related flooding more often than other areas. The results of a cost-benefit analysis, which incorporated ecosystem services values, showed that reducing peak flows and providing habitat restoration is the best option for dealing with the floods.
- Since two hurricanes struck the region around San Crisanto, Mexico in 1995, the San Crisanto Foundation has focused on mangrove restoration to reduce the impact of future floods. Combined with other measures, this has also had a positive effect on the diversity of species and abundance of fish. Moreover, local socio-economic conditions have improved significantly due to alternative sources of income and increased income.
- The website Mangrove Restoration provides a 5 step guide to the successful ecological restoration of mangroves.

For guidance documents, training material and further useful information related to the moderation of extreme events, please see the site PreventionWeb.

UNDP's Bureau for Crisis Prevention and Recovery aims to build in-country capacity to analyze, prevent and manage risks related to climate variability and change, and define risk management solutions. See for example the Climate Risk Management approach.

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