Tools to map, assess and evaluate ES

Ecosystem services and site management: from science into practice

May 7-8th, Kees Hendriks
Guidelines for ES assessment - OPPLA

Ecosystem Services Assessment Support Tool

Use this tool to break down the ecosystem service assessment process into a logical sequence of steps.

Each step provides you with the objective, the expected outcome as well as resources, illustrative real-world cases and tools & methods.

Step 1
Setting the scene

Outcomes of this stage
- Define the decision context
- Identify key stakeholders
- Structure the problem

Explanation
The purposes of ecosystem service assessment

Ecosystem service assessment can be carried out for several reasons. It can raise awareness of the importance of ecosystem services for human well-being (see examples). It can help setting policy or management targets and priorities e.g. in land and water use; it can facilitate ecosystem service accounting, or it can look forward in describing alternative futures. For each assessment aim, there are different methods that are fit for purpose.

Stakeholder involvement

Ecosystem services are services only to an extent that people actually benefit from them. Therefore, it is important to engage the beneficiaries as well as stakeholders that are negatively affected by the loss of services early on in the assessment process. Stakeholder involvement is important also for increasing the credibility, relevance and legitimacy of the assessment results and for making use of local, place-based knowledge.
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Step 2
Identification of ecosystem services

Outcomes of this stage
- Identify ecosystem services and related benefits for people
- Link the services to ecosystem structures and processes

Explanation
What are ecosystem services?
All human beings depend on ecosystems for their economic and social well-being. These contributions that people derive from ecosystems are called ecosystem services. They are usually classified as provisioning services (e.g., food and drinking water), regulating services (e.g., carbon sequestration, water purification) and cultural services (e.g., recreation and aesthetic experiences).

Various definitions of ecosystem services
The Common International Classification of Ecosystem Services (CICES) provides a standard typology of ecosystem services. The CICES categories are also used in Mapping and Assessment of Ecosystems and their Services (MAES) and are translatable to the ones used in the Millennium Ecosystem Assessment (MEA) and the United Nations study on The Economics of Ecosystem Services and Biodiversity (TEEB). For valuation purposes, it is important to distinguish between intermediate and final ecosystem services to avoid double counting. The latter are ecosystem services such as nutrient retention which give rise to final ecosystem services such as drinking water.

Relevant resources
- Simple Matrix Approach
- Quickscan
- Greenframe
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Step 3
Biophysical assessment

Outcomes of this stage:
- Identify the important components of the ecosystem relevant to your ES
- Identify and collect the appropriate data you would need
- Identify the most appropriate biophysical assessment approach

Explanation
What are the links between the ecosystem and the services it provides?

Ecosystem services are produced by multiple components of the natural environment such as species, freshwater, land, soil, and ecosystem processes such as nutrient uptake. To manage ecosystem services effectively, it is often important to understand the relationships between these components. For example, the area of a forest is important for flood protection, whilst species abundance and functional diversity are important for pollination. It is also important to foresee the thresholds, or tipping points, at which an ecological system experiences a major and possibly irreversible change.

Approaches to biophysical assessment

There are a wide range of methods for assessing ecosystem service provision. Which is most appropriate for your case will depend on several factors such as the decision context (e.g., do you need to understand the underlying biophysical processes or test alternative scenarios), data availability, time resources, and types of outputs (e.g., single site or model). Each step in the process, such tasks, can be useful if you are interested in comparing the spatial

Relevant resources

Methods
- Guidance: Biophysical methods
- ESTIMAP
- State and Transition Models
- Bayesian Belief Networks
- Quicksim
- INVEST

Documents
Scientific publications
Case studies
Guidelines for ES assessment

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Step 4: Valuation

Outcomes of this stage
- Identify and understand plural values
- Identify valuation methods to capture plural values
- Integrate value information into management and policy-making

Explanations
Identify plural values

Values refer to a principle associated with a given worldview or cultural context, a preference someone has for a particular state of the world, and/or the importance of something for itself or for others. These different types of values are often interlinked. For example, ethical principles can lead one to assign importance to different ecosystem services and consequently to have a preference for a specific course of action. It is important to incorporate all types of values into land and water management, also the non-tangible ones.

Valuation methods

A wide range of socio-cultural and monetary valuation methods are available to capture plural values. Socio-cultural valuation methods explore ways of representing cognitive, emotional, and ethical responses to nature. Approaches include preference assessments within multi-criteria analysis and time use methods, photo elicitation, photogrid analysis, narrative methods, participatory mapping of ecosystem services, scenario planning, and deliberative methods. Socio-cultural valuation methods cover a wide range of contexts, but are particularly suited for exploring
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Outcomes of this stage
- Incorporating ecosystem services in decision-making
- Instruments for sustaining ecosystem services
- Nature based solutions

Explanation
Ecosystem service information in decision-making
Information about ecosystem services and their values can be integrated in decisions on land and water management options, or policy decisions, by using decision-support tools such as cost-benefit analysis, multi-criteria decision analysis (MCDA) and environmental impact assessment (EIA). These tools structure information on management and policy options and their consequences and highlight trade-offs between ecosystem services (e.g. recreation vs. timber production). Facilitation, mediation and dispute resolution methods are helpful in highly conflictual trade-off situations. Overall, ecosystem service knowledge is most effective when decision-makers and key stakeholders have been closely involved in the assessment process to ensure that they find the information relevant and reliable, and are ready act upon it.

Response options for sustaining ecosystem services
Several policy instruments can be used to sustain and enhance the provision of ecosystem services:
Guidelines for ES assessment

- Guidelines for mapping, assessing and evaluation
InVest

- Invest: Integrated Valuation of Ecosystem Services and tradeoffs
- Stanford University, University of Minnesota, The Nature Conservancy, World Wildlife Fund
- Emphasis on stakeholder engagement
- Strong spatial component; Maps as output
- Terrestrial, freshwater, Marine ecosystems
- Scale flexible from local to global
- GIS data and CSV tables as input
- Tools for scenario analysis
Invest - Tool

https://www.naturalcapitalproject.org/invest/
Invest – Users guide

Invest – Introduction course

About this course

People depend on nature to sustain and fulfill human life, yet the values of nature are typically ignored in decisions. Mapping and modeling ecosystem services can help highlight the diverse benefits provided to people by nature (what and where) and explore how these benefits might change under different management options—thus bringing information about nature’s values into decisions in practical ways. With these approaches, we can improve the state of biodiversity and human well-being by motivating greater and more cost-effective investments in both.

This course introduces the Natural Capital Project’s (NatCap) approach to using ecosystem service information to inform decisions. It uses specific examples to illustrate how the approach has worked in each case and highlights key methods and tools used in implementation.
Invest – Training program

https://www.naturalcapitalproject.org/training-program/
INVEST – Ecosystem Service

- Habitat Quality
- Habitat Risk Assessment
- Crop Pollination
- Climate Regulation: Carbon Storage and Sequestration
- Water Yield: Reservoir Hydropower Production
- Nutrient Delivery
- Sediment Delivery
- Scenic Quality Provision
- Recreation and Tourism
- Wave Energy Production
- Offshore Wind Energy Production
- Marine Finfish Aquacultural Production
- Fisheries
- Crop Production
- Seasonal Water Yield Model
InVest

- Selection of most relevant ES possible
- Spatially-explicit; Maps as information source and outputs
  - Biophysical terms (e.g. tons C sequestered)
- Spatial resolution flexible (local, regional, global)
- Use of production functions defining change in ES for change in structure and function of Ecosystems
- Run Independent, or as script tool in GIS environment
- Somewhat limited by local data access and quality
- Well-developed Economic Valuation
- Tools on Cultural ES need further development
- Focus on supply side, beneficiaries bit underexposed
Invest – example
Conwy catchment in North Wales, UK

Sharps et al. 2017
Natural Capital Project - INVEST

- https://www.naturalcapitalproject.org/
- https://www.youtube.com/watch?v=i1OTQvNV1lo
- https://www.naturalcapitalproject.org/training-program/
- Library: https://www.naturalcapitalproject.org/library/
Co$ting Nature

- Web based tool for natural capital accounting and analysing ES provided by the natural environment, identifying beneficiaries, and assessing impacts of interventions

- Kings College London, Ambio TEK, UNEP-WCMC

- Target audience: Conservation NGO’s, Policy analysts, Agriculture, Industry, Education and Research

- Resolution 1x1 km / 1 ha

- Data on global scale available, own data can be used

- GIS tools helpful but not necessary

- For some uses to simple

- Economic valuation (no pricing but opportunity costs)
Co$ting Nature – Ecosystem Services

- Rural Ecosystems only (no Urban)
- Conservation priority
- Biodiversity
- Water Quantity
- Water Quality
- Water Provisioning Services
- Carbon Services
- Recreation
- Hazards mitigation services
- Beneficiaries (Local/Global)
- Opportunity Costs
Co$ttingNature – Model documentation

This section describes the science, equations and assumptions behind the modules and submodules used and builds upon the Co$ttingNature version 1 documentation, which should also be consulted.

Costing Nature is aimed at incorporating ecosystem service provision and benefits information into the conservation prioritisation and planning. It focuses on water, carbon and tourism-related services and on defining the magnitude and geographic pattern of these as potential services and as those realised (used) by local and global beneficiaries. Costing Nature starts by mapping individual services for water, carbon and tourism and then combines them with analysis of current pressure, future threats, biodiversity and conservation priority to produce an assessment of priority areas for conservation and careful management on the basis of all of these factors. This is done first using baseline datasets representative of the current situation. Users may then apply scenarios for climate, land use or land management change (such as for example removal of funding for a conservation area) and examine the impacts – in terms of change in ecosystem services – and implications for beneficiaries. In version 1 all outputs are expressed in relative terms as indices from 0-1 globally. This is to represent priority across the the world and so that very different services and priorities can be combined in aggregate indices to which the user can then apply specific weights.

In all of these maps urban areas are set to zero, as Co$ttingNature does not model many of the services provided by nature in urban environments (air purification, temperature regulation, noise reduction, aesthetic benefits). Co$ttingNature is thus a model of ecosystem services provided by the rural environment, including their benefits to urban beneficiaries.

The model produces a series of summary maps which combine the outputs of many of the modules described below. These maps include:

Relative total realized bundled services is total realised services including water, carbon, nature
Co$ttingNature – Training support

Consult this page for instructions in Spanish
Voir cette page pour les instructions en français

This page is designed for training in person - if you are on a web-based training course click here. Recent basin or country specific training courses have materials here.

SELF-PACED VIDEO TRAINING:
These PSS are easy to use but some introduction is useful in finding your way around them, using them appropriately and interpreting their output. This page links to a series of recordings of our web-based demonstrations including access to specific functions in the system.

PRACTICAL EXERCISES
THEORY:
Model and data documentation can be found here and system (interface and functionality) documentation here
A presentation on the science behind the PSS can be found here (English). [opens in Google docs viewer]. Download: (E1)
A powerpoint demo of the system functionality is here [opens in Google docs viewer]. Download: (E2)
Co$tingNature – Examples

The following are applications of Co$ting Nature by us or by partners. Some take the form of links to reports summarising a significant body of work, others are simple applications of the tool produced within an hour of work.

See example application blog posts by users of this tool [here](#).

1. Madagascar: understanding conservation priority and the impacts of projected land use change on biodiversity and ecosystem service provision (for ESPA).
2. The Amazon: understanding water and environmental security with climate change as a threat multiplier (for CDKN).
3. The Amazon: understanding ecosystem service trade-offs with agriculture within the context of REDD (for GCP).
4. Coello, Colombia: understanding the impact of proposed mining on the suite of ecosystem services (for CGIAR).
5. Impacts of recent large-scale deforestation on conservation priorities and ecosystem services in the Gran Chaco, Paraguay.
6. Conservation trade-offs for Colombia: which are the top priority areas for conservation, now and in the future.
7. Conservation trade-offs and land use change projections for northern Borneo: which are the top priority areas for conservation, now and in the future.
8. Conservation priorities and trade-offs under current and projected land use for western Zambia: which are the top priority areas for conservation, now and in the future.
9. The impacts of progressive deforestation on biodiversity and ecosystem services, the Amazon.
10. The significance of the Yasuni National Park and its future under scenarios of deforestation and conservation associated with Yasuni-ITT.
11. The relationships between biodiversity and ecosystem service provision at sites throughout the world.
12. Biodiversity strategy and action for the UK.

Co$ting Nature

- **Documentation:**
  [https://docs.google.com/document/d/19jje32EeuIBZk_ibRkwT4sAObYsbdViVxp6Vh0sZDGAs/edit](https://docs.google.com/document/d/19jje32EeuIBZk_ibRkwT4sAObYsbdViVxp6Vh0sZDGAs/edit)

- **Examples:**
  [http://www.policysupport.org/costingnature/example-applications](http://www.policysupport.org/costingnature/example-applications)

- **Training:**
  [http://www.policysupport.org/costingnature/training](http://www.policysupport.org/costingnature/training)
Co$ttingNature – Example Yasuni National Park -Ecuador

Current forest cover: Tree cover: 53%

50 years of high forest loss (ineffective protected areas): Tree cover: 32% (40% loss)

50 years of high forest loss (effective protected areas): Tree cover: 37% (30% loss)
Co$ttingNature – Example Yasuni National Park -Ecuador
Co$ttingNature –
Example Yasuni National Park -Ecuador
Co$ting Nature

Total economic value (USD/km²)
Total: 1.44b USD (currently realisable on 2.24b USD [2016] GDP)
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Questions?

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