

Part II Session: Guidance on developing decision-support tools

“Developing Approaches for Assessing and Optimising the Value of Ecosystem Services” - Christian Fled

Terminology

- ▶ *Expertsystem.com*: A Decision Support Tool (DST) is a software developed to support analysts and decision makers in making better decisions, faster.
- ▶ *Wikipedia.com*: A Decision Support System (DSS) is an information system that supports business or organisational decision-making activities.
- ▶ For the matter of ease: DST = DSS

Structure

- ▶ Four questions
- ▶ Examples
- ▶ Typology (some thoughts)
- ▶ Guidance



Structure

- ▶ Four questions
- ▶ Examples
- ▶ Typology (some thoughts)
- ▶ Guidance



4 Questions towards DSTs

1. What decisions are to be informed or aided?
2. What kind of support is required therefore?
3. Who are the tool's end users?
4. How to implement the support as a tool?

It's going to get complicated...



I What decisions?

- ▶ ESS assessment: How to assess?
- ▶ ESS valuation: How to value? How to incorporate non-monetary ESS?
- ▶ ESS management: How to prioritise ESS (hierarchy)? How to derive appropriate management options?
- ▶ ...



2 What kind of support?

- ▶ Aid communication between stakeholders
- ▶ Provide access to data for modelling (databases)
- ▶ Provide access to documents (search tools)
- ▶ Provide access to (structured and aggregated) knowledge (wiki system)
- ▶ Provide access to models
- ▶ ...



3 Who are the end users?

- ▶ Ecosystem managers
- ▶ Scientists
- ▶ Restorationists
- ▶ Water boards
- ▶ Politicians
- ▶ People at the policy-science interface
- ▶ ...



4 How to implement a DST?

- ▶ Documents
- ▶ Knowledge tables
- ▶ Standalone models

- ▶ Wiki systems
- ▶ Online models
- ▶ Interactive queries

To be clarified:

- ▶ Data requirements
- ▶ Data availability



Complication

- ▶ Specific requirements are likely to limit generalisation!



Structure

- ▶ Four questions
- ▶ **Examples**
- ▶ Typology (some thoughts)
- ▶ Guidance





Contents lists available at ScienceDirect

Ecosystem Services

journal homepage: www.elsevier.com/locate/ecoser



A comparative assessment of decision-support tools for ecosystem services quantification and valuation



Kenneth J. Bagstad^{a,*}, Darius J. Semmens^a, Sissel Waage^b, Robert Winthrop^c

^a U.S. Geological Survey, Geosciences & Environmental Change Science Center, Denver, CO, USA

^b BSR, San Francisco, CA, USA

^c Socioeconomics Program, USDI–Bureau of Land Management, Washington, DC, USA

- ▶ Review of 17 DSTs against 8 criteria
 - ▶ Uncertainty quantified
 - ▶ Time required for application
 - ▶ Free availability
 - ▶ Level of development and documentation
 - ▶ Spatial scalability
 - ▶ Generalisability across ecosystems / regions
 - ▶ Coverage of non-monetary ESS
 - ▶ Integration with other tools

Different tools for different purposes

K.J. Bagstad et al. / Ecosystem Services 5 (2013) e27–e39

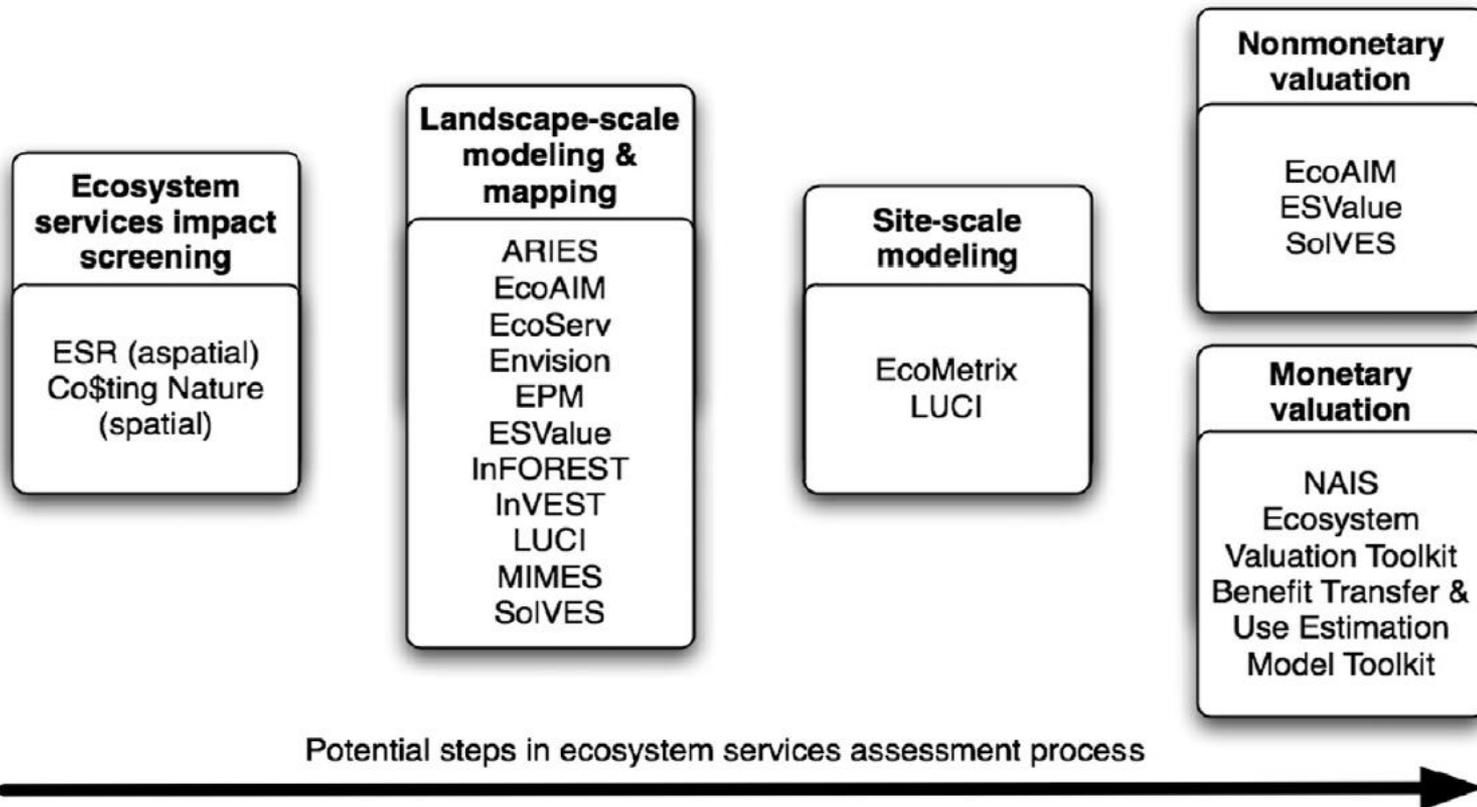


Fig. 1. Potential steps in ecosystem services assessment process.

Bagstad et al. (2013): Key criterion

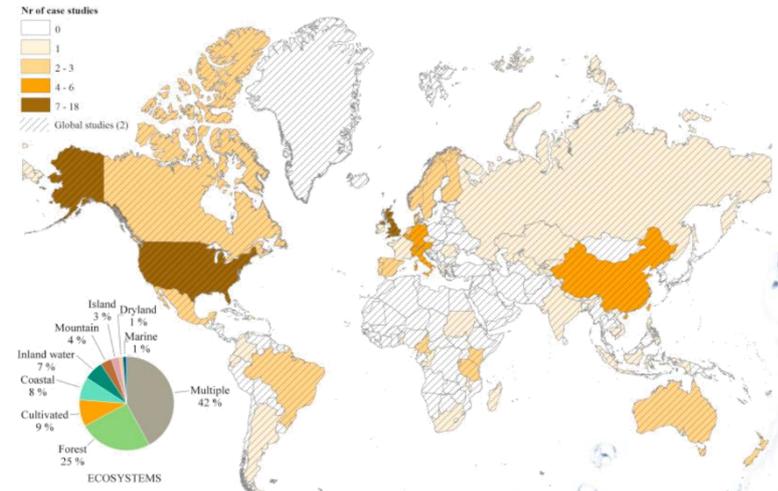
- ▶ Cost-benefit balance determines tool utility

„...a key trait that will enhance or limit its widespread adoption is the time required to apply it relative to the depth and quality of information it adds to the decision-making process...“

Review of decision support tools to operationalize the ecosystem services concept

Adrienne Grêt-Regamey  , Elina Sirén, Sibyl Hanna Brunner, Bettina Weibel

- ▶ Review of 68 ES-based tools
- ▶ Poor coverage of cultural services



MARS Tools (www.freshwaterplatform.eu)

Freshwater
Information
Platform

The Network for freshwater research
Data, tools and resources for science and policy support

MARS FRESHWATER
INFORMATION SYSTEM - FIS



Find background information on the effects of multiple stressors and options to mitigate them as well as example case studies in all kinds of freshwater ecosystems

MARS
DIAGNOSTIC TOOLS - DAT



Identify and diagnose multiple stressors and their effects on waterbodies with an interactive tool, which also suggests potential management measures

MARS
SCENARIO ANALYSIS TOOL - SAT



Provide a catchment-scale perspective of the multiple stressor situation and estimate the effects of changing multiple stressor combinations due to changes

COLLECTION OF OTHER USEFUL
TOOLS



Find here a variety of other useful tools for your research, including modelling tools, assessment tools or GIS and R tools

Freshwater Information System

Drivers

Pressures

States

Impacts

Responses

What are drivers?

The term *driver* describes how social, economic and political systems trigger environmental pressures, both directly and indirectly. Driver categories help us understand the ways in which human activities can impact the natural world.

Drivers form a key element of the driver-pressure-state-impact-response (DPSIR) framework used to design ecosystem-based assessments. The DPSIR is based on cause and effect relationships. Drivers induce environmental pressures, which can lead to a change in the state (or health) of an environment, which can in turn trigger societal responses. As a result, drivers may then be mitigated as a result of political and social debate and scientific evidence.

The drivers according to the WFD Reporting Guidance 2016 (Annex 1C) (EC 2015) are listed below. The pressures, geographical distributions and potential mitigation options for each driver are outlined below.

AGRICULTURE



CLIMATE CHANGE



ENERGY



FLOOD PROTECTION



A tool to support the decision about river management options by knowledge and evidence following the Driver-Pressure-State-Impact-Response framework

MARS Diagnostic Tool (Feld et al. 2020)

The screenshot displays the MARS Diagnostic Tool interface. On the left, there is a form for inputting biological metrics. The main content area is divided into two sections: a diagnostic plot and a radar chart.

Diagnostic plot: The plot is titled "Benthic invertebrates in mid-sized sand-bottom lowland rivers of Central Europe". It provides instructions on how to use the tool and explains the significance of the radar chart. The text states: "By choosing the appropriate metric states of your water body, you can diagnose potential causes of deterioration. Chose 'Unknown', if a particular metric status is not available. Based on your selection, the radar plot to the right displays the probabilities of the seven candidate causes, of being causal for your metric states. Klick on each cause to get more details of the probability distribution. To increase visibility, you can change the plot's scaling by sliding the scale bar to the right or left. The index card 'Causal hierarchy' provides you with a tabular output of the causes, in decreasing order of their probability. Select the index card 'Read more' for more information and useful links."

Radar chart: The radar chart is titled "You are in the diagnostic analysis Potential causes of deterioration". It shows the probabilities of seven candidate causes. The causes and their relative probabilities are:

- Urban land use
- Fine sediment pollution
- Lack of large wood (logs)
- Bank reinforcement
- Flow reduction/impounding
- Riparian degradation
- Arable land use

The chart shows that "Lack of large wood (logs)" and "Riparian degradation" are the most probable causes, with "Lack of large wood (logs)" being the most prominent.

A tool to support the decision about river management options conditional on the biological symptoms of a water body.

Are criteria of Bagstad et al. (2013) met by the MARS Diagnostic Tool?

Criterion	Fulfilled
Uncertainty quantified	+++
Time required for application	+++
Free availability	+++
Level of development and documentation	++
Spatial scalability	+
Generalisability across ecosystems / regions	---
Coverage of non-monetary ESS	n. a.
Integration with other tools	---

EcoServ (ecosystemsknowledge.net/ecoserv-gis)

Ecosystems
Knowledge
Network

Enter search terms



About us Join Resources Events News Forums

Home > Resources > Tools > Tool Assessor

EcoServ-GIS

▼ Overview

Description:

EcoServ-GIS is a Geographic Information System (GIS) toolkit for mapping ecosystem services at a county or regional scale. It uses input GIS/map data to generate fine-scale maps that illustrate human need or demand for ecosystem services as well as the capacity of the natural environment to provide them.



Input:

Freely available GIS datasets and OS MasterMap Topography data.

Output:

Maps

Scale:

Local scale
Landscape scale
Regional scale

Cost of the tool (and guidance):

Open access (free)

Context:

A range of land uses.

Resource requirement (software):

ArcGIS Desktop (10.2.2 onwards) with the Spatial Analyst Extension (Advanced Licence).

Level of technical expertise required:

Basic – intermediate GIS skills
Technical / GIS / modelling skills (training advised)

Types of ecosystem service included:

Regulating
Cultural

A toolkit for mapping ecosystem services
at a country or regional scale.

Resources by theme

Tool Assessor
List of Tools
ARIES
BeST
Co\$ting Nature
EcoServ-GIS
GI Valuation Toolkit
i-Tree Eco
InVEST
Natural Capital
Planning Tool
ORVal
Participatory GIS
SENCE
TESSA
Viridian
Search
Tool Assessor -
Reference List
Eco-metric
Natural Capital
Assessment Gateway
Blog Library
Partnerships for
People, Place &
Environment
Quick Start Guides
Network Publications
Biodiversity and
Ecosystem Services
Sustainability
Programme
Nottingham Trent
Basin: Sustainable
Waterside Living

Structure

- ▶ Four questions
- ▶ Examples
- ▶ **Typology (some thoughts)**
- ▶ Guidance



FRESHWATER METADATA
JOURNAL & METADATABASE



Databases

Collect and save information about your freshwater dataset, then make it visible to the world by publishing it

FRESHWATER BIODIVERSITY
DATA PORTAL



Databases

Find freshwater data and publish your own research data on the web

GLOBAL FRESHWATER
BIODIVERSITY ATLAS



Maps

Publish your scientific results as a map in the atlas and make it visible to a wide audience

FRESHWATER SPECIES
TRAITS DATABASE



Databases

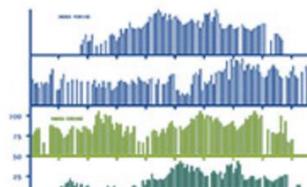
Find unified, standardised and codified information about the ecological preferences of more than 20.000 European freshwater organisms

RESEARCH DELIVERABLES



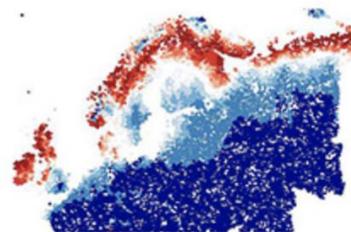
Knowledge
related research projects

FRESHWATER TOOLS



**Interactive
DS Tools**

FRESHWATER RESOURCES



Find a collection of resources, training and education material that will help you deepen your engagement with freshwater science

FRESHWATER POLICIES



Knowledge
policy drivers

FRESHWATER
INFORMATION SYSTEMS



Find other useful information systems that may support your freshwater related research

FRESHWATER
NETWORKS & PROJECTS



Knowledge

Find an overview of global and European research initiatives and links to past and ongoing research projects

FRESHWATER BLOG



Read the unique freshwater blog and gain information on freshwater life and related

Communication

84% of global freshwater species populations lost since 1970: can we 'bend the curve' of this trend?

Chemical pollution limits the ecological status of European freshwaters

World Water Week at Home

Indigenous Knowledge offers valuable insights into Arctic freshwater ecology

Half of known freshwater megafauna species threatened with extinction

Tweets by @freshwaterblog

The Freshwater Blog Retweeted



Come and join our new interactive and applied course:

"Aquatic ecosystem science and application (# 812006)"

led by @stefan_schmutz.
[online.boku.ac.at/BOKUonline/ee/...](https://online.boku.ac.at/BOKUonline/ee/)

Communication

Sep 30, 2020

The Freshwater Blog Retweeted



Everywhere you look there are ponds:
newscientist.com/article/225557...



Sep 29, 2020

Embed View on Twitter

MARS PROJECT
RECOMMENDATIONS



Knowledge
project aiming to inform River Basin Managers and stakeholders in other sectors

FACT SHEETS



Knowledge
and read the key messages in a brief and concise style

(Tentative) Typology of tools

- ▶ Communication tools (Blogs, Tweets)
- ▶ Knowledge tools (Wikis, documents)
- ▶ Data provision tools (databases, meta data)
- ▶ Modelling tools (mathematical models)

- ▶ Interactive tools to inform decisions based on user entry
- ▶ Interactive tools to support (e.g. rank) decisions based on user entry

- ▶ ~~Decision taking tools~~

Structure

- ▶ Four questions
- ▶ Examples
- ▶ Typology (some thoughts)
- ▶ **Guidance**



Development in four phases

1. Identify decisions that call for support, including the decision-maker(s)
2. Develop and analyse potential support options
3. Chose appropriate support option
4. Implement decision support tool



Example: MARS Diagnostic Tool

1. Identify decisions that call for support, including the decision-maker(s)
 - ▶ Inform water body managers about (hierarchy of) causes of deterioration → inform management options
2. Develop and analyse potential support options
 - ▶ Data and knowledge (evidence) on cause-and-effect relationships
 - ▶ Diagnose potential causes from biological symptoms (effects)
3. Chose appropriate support option
 - ▶ Bayesian network using conditional probabilities of causes and effects
4. Implement decision support tool
 - ▶ Browser-based online tool using R and Shiny (freeware)

Providing guidance: starting point

1. Identify decisions that call for support, including the decision-maker(s)
2. Develop and analyse potential support options

Questionnaire:

- ▶ What decision(s) to inform?
- ▶ What support to provide?
- ▶ What end user(s) to address?
- ▶ What output to be generated?
- ▶ What knowledge / data is required?
- ▶ Do(es) end user(s) match data requirements?



Providing guidance: follow-up

3. Chose appropriate support option
4. Implement decision support tool

Questionnaire:

- ▶ What outcome is appropriate?
- ▶ How to make outcome accessible?
- ▶ Static or dynamic access?
- ▶ How to implement tool?
- ▶ What level of documentation is required?
- ▶ Technical limitations, IPR, copyright, licensing...



Next steps

- ▶ Let's discuss first...





Thank you for your attention!

Bagstad, K.J., Semmens, D.J., Waage, S., and R. Winthrop (2013) A comparative assessment of decision-support tools for ecosystem services quantification and valuation. *Ecosystem Services*, 5, e27–e39.

Burstein, F. and C. W. Holsapple (2008) *Handbook on Decision Support Systems*. Berlin, Springer.

Feld, C.K., Saeedghalati, M. and D. Hering (2020): A framework to diagnose the causes of river ecosystem deterioration using biological symptoms. *Journal of Applied Ecology*, DOI: 10.1111/1365-2664.13733.

Grêt-Regamey, A., Sirén, E., Brunner, S.H., and B. Weibel (2017) Review of decision support tools to operationalize the ecosystem services concept. *Ecosystem Services* 26, 306–315.

Sprague, R. H. and E. D. Carlson (1982) *Building effective decision support systems*. Englewood Cliffs, N.J., Prentice-Hall.

www.wikipedia.com



Guidance on developing DSTs

- ▶ Addressees
- ▶ Aims
- ▶ Format
- ▶ Content
- ▶ Case studies
- ▶ ...

