

MARS fact sheet #01

Multiple stresses and freshwater ecosystem service provision: the MARS 'cookbook' methodology

The MARS project assesses the impacts of multiple stressors on the provision of ecosystem services from freshwater ecosystems, under different climatic and land-use scenarios. The European Union FP7 funded project has developed an innovative new assessment methodology – termed a 'cookbook' – to allow scientists, environmental managers and policy makers to quantify the relationships between multiple stresses and ecosystem service provision and value. The cookbook provides an invaluable tool to support the implementation of the Water Framework Directive in Europe.

Ecosystem Services and MARS

Ecosystem services are the benefits that people obtain from ecosystems, which contribute both directly and indirectly to human well-being. Their designation helps highlight and value the key roles that biodiversity and ecosystem functions play in providing multiple benefits to humans, such as food, clean water and sanitation. This in turn, helps support, legitimate and strengthen environmental policy and conservation.

The MARS cookbook is a new integrated assessment methodology that allows users to assess how the impacts of multiple stresses affects the services that freshwater ecosystems can provide. Increasingly complex 'cocktails' of multiple stresses such as nutrient pollution, water abstraction and flooding affect Europe's freshwater ecosystems. Such multiple stressors can interact in an ecosystem to potentially intensify or weaken their individual, additive effects, posing new challenges for environmental management. In collaboration with a number of other European Union projects, MARS is undertaking experimental and modelling analyses to better understand the effects of multiple stressors on freshwaters, particularly in terms of the ecosystem services that they provide.

Service capacity, flow and benefits

Building on the expertise of project partners and insights from wider scientific and economic research, the MARS cookbook uses a cascade

model methodology that links the structure and function of an ecosystem to its service provision. This methodology includes the *capacity* of an ecosystem to provide a service (assessed using biophysical data), the actual *flow* of the services used by humans (assessed using socio-economic data), and finally the *benefits* that ecosystem services provide.

By assessing both the capacity of an ecosystem to provide services, and the actual use of these services, the MARS cookbook methodology allows assessments on the *sustainability* of ecosystem use to be made. The unsustainable use of ecosystem services may become an additional stressor of the ecosystem's health and status.

The MARS service cookbook

The MARS cookbook methodology is split into four steps. The first is *scoping*, the process by which the aquatic ecosystem and ecosystem services of interest are selected and mapped, and the spatial and temporal scale of analysis are defined. The second step is to develop the *assessment framework*, through which multiple stressors and ecosystem services are linked in a stressor-ecological status-ecosystem service series. A key step here is to check whether the ecological indicators used (e.g. biodiversity, ecological status) capture the effects of the stressors, and can be linked to the ecosystem services of interest.

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The third step is *assessment*, where biophysical indicators are organised according to the ecosystem's capacity to deliver a service, its actual use, and the resulting human benefits provided. Indicators are organised in three categories: capacity (e.g. biomass of commercial fish species); flow (e.g. fish catch); and sustainability (e.g. % of catch within sustainable limits). Their ability to indicate ecosystem stress and / or service provision is quantified through the computer modelling of existing ecological data.

The fourth step is *valuation*, to identify the benefits provided by ecosystem services and aggregate them at three scales: water body, catchment and

European continent. The valuations are undertaken at appropriate scales to support decision making in River Basin Management Planning. In the valuation process, the ecosystem service, benefit and value are separated, because a service (e.g. water purification) can provide numerous societal benefits depending on the location (e.g. drinking water; swimming areas). The economic value of the ecosystem services provided can then be valued through revealed and stated preference methodologies, and cost-based and benefit transfer approaches.

Further reading

Grizzetti B., Lanzanova D., Liqueste C., Reynaud A. (2015) Cook-book for ecosystem service assessment and valuation. JRC Science and Policy Report EUR 27141 EN. Luxembourg Publication Office of the European Union. 136 pp.

Maes J., Hauck J., Paracchini M., Ratamäki O., Hutchins M., Termansen M., Furman E., Pérez-Soba M., Braat L., Bidoglio G. (2013) Mainstreaming ecosystem services into EU policy. *Current Opinion in Environmental Sustainability*, 5, 128–134.

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Figures

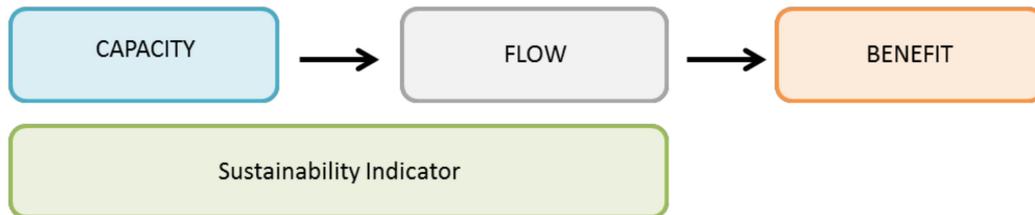


Figure 1: The cascade model - quantifying the capacity, flow and benefits of ecosystem services

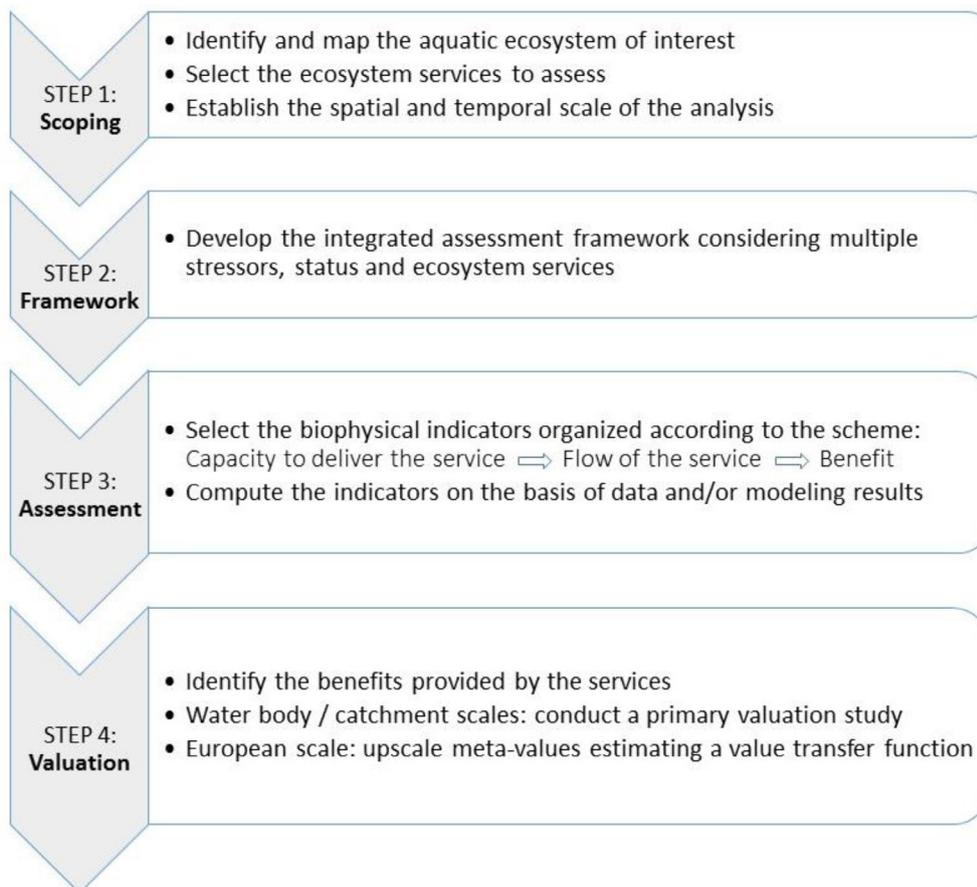


Figure 2: The four steps of the MARS 'cookbook' methodology