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The "DACH" – Approach for Ecosystem Services Accounting – Recommendations for Integrating ES in National Accounting – [*])

1. Policy aims of the DACH – Approach

DACH is the name of a co-operation between the German Federal Agency for Nature Conservation (D), the Environment Agency Austria (A) and the Swiss Federal Office for the Environment (CH). One issue of this cooperation is the development of a system of indicators for the monitoring of ecosystem services. Switzerland started the first initiative with a study that proposed a set of indicators for ecosystem goods and services (Staub et al. 2011)[1], followed by Austria with Report 0355 of the Umweltbundesamt on "Ökosystemleistungen in der Landwirtschaft – Erstellung eines Inventars für Österreich" (Ecosystem services and Agriculture – Compilation of an Inventory for Austria, Umweltbundesamt 2011). The German approach is prepared by an ongoing research project of IFUPLAN (Munich) in cooperation with the ETH-Zurich und the University of Bayreuth. The systems of Austria and Germany are based (resp. will be based) on the Swiss approach with some adaptations to the three countries due to differences in the importance of ecological problems as well as in the availability of necessary information for the calculation of concrete indicator values.

The monitoring is done using physical indicators. Approaches for monetary evaluation are being developed in parallel but, for now, exclusively for special aspects. The development of approaches for a full monetization of all services certainly will take some more time, but will surely be intensified in the future in order to fulfil action 5 of the EU Biodiversity Strategy (see below).

The overall objective of the three approaches is to raise public awareness and to build up a more profound basis for policy advice on the state, the development and on maintenance options for ecosystems and their services:

[*]) The information and views set out in this article are those of the authors and do not necessarily reflect the official opinion of the respective agencies

[1] The study was based on a feasibility study (Ott, Staub 2009)

Questions that shall be answered more substantially with the help of the indicator systems are for example:

1) What is the development of the different ecosystem services (positive or negative)?
2) What is the rate of decline of the current flow or stock?
   ⇨ In which domain is there an immediate need for policy intervention or policy change?
3) Do, and if so, where do data show trade-offs between intensive use of some ecosystem services (esp. provisioning services) and the decline of other services (esp. regulating and cultural services)?

Example for trade-offs:		
- crop yield - animal production	◄ versus ►	- recreation - water purification - soil fertility and soil formation - carbon sequestration - diversity of genetic resources - habitat protection

4) Where are the main chances and what are the respective capacities for integrated, multi service approaches for the protection and re-development of services?

Examples for integrated approaches:		
Maintenance of sustainability in agriculture	⇨	- carbon storage / mitigation of greenhouse gas emissions - habitat and landscape protection - diversity of species and genetic resources
rewetting and land use change on agricultural used former peatlands	⇨	- carbon storage / mitigation of greenhouse gas emissions - gene-pool and habitat protection - water purification
restoration of alluvial floodplains	⇨	- flood protection - recreation - diversity of genetic resources - habitat protection - water purification

5) Where are regional hot-spots of service decline?
6) Where are regional “hot-spots” best suited for integrated mitigation and re-development approaches?

A national inventory contributes to a large extend to answering questions 1 and 2. In order to receive proper answers to questions 3 to 6, a regionalization of data would be helpful. The current approaches in Switzerland and Austria consist of national inventories. The ongoing German study will include an additional mapping of selected ecosystem services according to objective 2, action 5 of the European Biodiversity Strategy:[2]

“Member States, with the assistance of the Commission, will

- **map and assess the state of ecosystems and their services in their national territory by 2014,**
- **assess the economic value of such services, and promote the integration of these values into accounting and reporting systems at EU and national level by 2020.”**

2. Categories of National Accounting addressed by the DACH – Approach

The basic Swiss study started with the idea of accounting for final ecosystem services[3] but ended up with an approach that is somehow more pragmatic and seems to be more comprehensive, too. Often final ecosystem services (not to mix up with final demand) in the sense of Boyd and Banzhaf cannot be easily defined. If they are defined – more ore less precise – on a national level, normally there is a lack of information on their use and the intensity of use (respectively demand). Therefore in the DACH – approach indicators for final ecosystem services are sometimes substituted and sometimes complemented by indicators that show the use of or the demand for the respective service (for example: number of visits of recreation sites, crop production in t/a).

In the current versions the indicators of the Swiss and the Austrian inventory and the concept for Germany give information on the following categories that are relevant for national accounting:

[2] Similarly, but less ambitiously, the Swiss government declared in 25.04.2012, as part of its biodiversity strategy, the following objective: "By 2020, ecosystem goods and services will be quantitatively monitored, which allows to consider them in the form of indicators that are complemental to GDP within a [comprehensive] welfare measurement as well as in regulatory impact assessments" (translation by the authors). Switzerland is not part of the European Union.

[3] Inspired much by the work of Boyd and Banzhaf (2007)

Categories relevant for national accounting:		Indicator examples from: Swiss Inventory / *Austrian inventory* / *German concept* :
● final demand (as a category of national accounting, not to mix up with final ecosystem services in the sense of Boyd and Banzhaf)	flows	- recreation (measured as number of visits and/or through measures of accessibility) - water supply from springs and groundwater (in m^3/a)
● intermediate goods (as a category of national accounting, not to mix up with ecological processes interpreted as intermediate goods with regard to final services by Boyd and Banzhaf)		- forage crops (in t/a) - *crop production (in t/a)*
● production factors ◦ facilitating production and/or ◦ influencing production cost	stocks incl. depreciation investment	- land used for agricultural production -- *loss of fertile soils* density of bees - species and habitat richness indicators
● damage prevention ● reduction of health care cost (and the like)		- protected values through "Forest protection against landslides" - alteration in carbon storage due to land use change - *agricultural land in alluvial floodplains that can serve for water retention* - *filtering capacity of urban green on particulate matter*

Those ecosystem services that help to prevent damages or reduce health care costs are usually influencing current as well as future costs. The monetary value of these assets could be calculated in analogy to private assets as the net present value of future benefits, in this case: future cost decreases.

Species and habitat diversity is not only a factor for future production and therefore an asset but also an entity that is relevant for current wellbeing. Therefore biodiversity could be addressed, in addition to its productive value, for its direct use and non-use benefits, valued – for example – by willingness to pay for nature conservation.

Many regulation services of species and habitat diversity are already captured in other indicators like the "filtering effect of urban green" or the "area of active alluvial floodplains". Thus there is an overlap with indicators for resilience based on species and habitat patterns.

Some of the current indicators address the capacity to produce flows (of ecosystem services) and sometimes the real use of flows (and assets). Information on both sides is valuable for decision making: capacity and stocks regarding long term sustainability and the actual use regarding short to medium-term optimization. Unfortunately, however, there often is a lack of information available permitting a detailed insight to both sides. Therefore the change of capacities or stocks has sometimes to be taken as an indicator for the changes of flows and the other way round.

3. Information provided by the DACH – Indicators beyond National Accounting and Environmental-Economic Accounting

The present indicator systems still have some gaps. Nevertheless, they already provide valuable information on natural assets and ecosystem services to decision makers that go beyond traditional national accounting and also beyond environmental economic accounting. Additional questions that can be answered are:

Additional information made available	Examples
What kind of final demand is served by ecosystem services and is neglected by the current accounting systems?	- recreation - water taken directly from springs - willingness to pay for nature conservation
Which domains of the economy depend on natural capital? Is natural capital shrinking or expanding?	- crop production - soil loss - arable land converted to sealed land
What kind of present and future changes in production are caused and will be caused by changes of natural capital or its use?	- rise of production costs or production loss by soil degradation - decrease of fresh water supply costs by enlarging the area of grasslands above ground water reserves
What kind of “repair costs” – that are presently accounted as final demand – are (and could additionally be) avoided by ecosystem services?	- avalanche protection - flood protection - regulation of urban climate
What is the actual and potential contribution of natural capital and ecosystem services to climate change adaption and mitigation?	- carbon sequestered in organic soils - soil carbon loss due to land use change

4. Information Requirements – Use of Models

In order to provide sufficient information to answer the questions above in a useful way for policy making, the indicators should:

- be detailed and concrete,
- build on reliable information and models,
- include all information on the relevant physical, social and economic conditions of ecosystems and the services they are delivering to people and economy.

Policy relevance means that the additional information should help to solve well defined problems. Examples for such political problems are climate change, climate adaption, health care, prevention of flood risks, securing food production, securing water supply etc.

Highly aggregated indicators (see e.g. Weber 2011), can play an excellent role for early warning. An interesting example is the paper by Vardon et al. (2011) who propose an index which builds on land cover (ha) asset accounts, condition classes for each spatially defined output area, and a weight for the output areas, which allows aggregation for the index. Such an index has the advantage of tracking overall development of the natural capital. Furthermore, the index is formed in a transparent, straightforward way. On the other hand, there are a number of open methodological questions, some of which are raised by the authors themselves, some which are also worth exploring, such as the question of the criteria for weighting[4], or the interpretation of comparisons between different regions or countries.[5]

More importantly, only concrete information on ecosystem services and natural assets related to addressable problems will improve concrete policy decisions. Overly vague as well as excessively complex indicators will not be understood and thus may have no relevant effect on policy.

Frequently natural assets and ecosystem services cannot be accounted in monetary terms as marketed goods and services can be. They rather have to be assessed on the basis of ecological and ecological-economic models. Examples are soil fertility, soil loss, the appropriateness of landscapes for recreation, the recreational use of “normal” landscapes, microclimatic effects of urban green, water run off, water retention, flood mitigation etc. Often the respective models are not developed well enough to serve as a basis for national assessments. In these cases there are two possibilities:

- First, applying rough models in order to get a first but not very reliable indicator for the desired information (e.g.: a national indicator for recreational benefits).
- Or second, just presenting the relevant input information without or with very moderate modelling and aggregation (e.g. different information on: present recreational use,

[4] Ideally, weights should reflect the potential of an area to produce ecosystem goods and services.
[5] While comparison over time seems straightforward in such an index, is comparison between different countries or regions possible, given the very different original endowment with land cover types of each country?

population density as a demand indicator, landscape composite indices as indicators for appropriateness, etc.).

The second case – just presenting cautiously aggregated basis information - is not very satisfying from a theoretical point of view, but may deliver data which are taken seriously by decision makers. Therefore it should be accepted as a first pragmatic step towards an upcoming more comprehensive approach.

The classification of the final ecosystem goods and services in Switzerland, Austria and Germany are in line with the classes of the Millenium Ecosystem Assessment (MA 2005) and the Common international classification of Ecosystem Goods and Services (CICES Haines-Young and Potschin 2010).

This pragmatic approach should be further underlined by recommendations on sub-indicators in cases where the value of a service depends on additional local conditions (e.g.: natural capacity, capacity taking account of anthropogenic pressures, local demand, accessibility, actual use). This would help to obtain data collections and compilations that are comparable on the international level.

5. Required Data on Ecosystems, Natural Components and Processes and Socio-economic Demand – Recommendations for Targeted Ecosystem Definitions

To fill the “DACH” inventories with all necessary information data are necessary on:

• different components of ecosystems	- topography - soil - water balance - land use	- vegetation - species - …
• man made impairments of ecosystem functions	- pollution - noise	- disturbance - …
• economic and social use and demand indicators.	- number of visitors - population density - water demand	- value of assets exposed to flood or avalanche risk - perception of cultural values - …

This information must be given

- in a composition,
- on a spatial scale and
- within a network of socio-ecological interactions

that are specific to each ecosystem service.

Universal ecosystem definitions can only be appropriate – if at all – for defining some basic statistical units, but they are inadequate as the only basis for the assessment of

ecosystem services. Typically each ecosystem service depends on a specific system of different ecosystems interlinked by exchange of specific ecosystem functions (like species exchange, water run off or the aesthetic composition of different landscape features). The specific composition of ecosystems and interrelations has to be taken into account for a proper assessment of every service.

Many of the ecosystem services so far omitted by traditional and environmental-economic accounting are goods which cannot easily be displaced or substituted like timber or agricultural products. Their importance and value are heavily dependent on the economic and social conditions that determine the local demand for each service. For example, the retardation of water runoff is not as important in a last settlement just before the coastline as it is in an upper river basin area, where the settlements located downstream are heavily exposed to flood events. The enrichment of agricultural landscapes by hedgerows and small bush and wood patches is more valuable to satisfy the demand for recreation if placed near an agglomeration than in a remote area.

Hence, there is not only a need for physical and ecological information, but as well for information on social and economic conditions of demand. This is another reason why some highly aggregated ecosystem composition indicators may fail to support concrete policy decisions.

Highly aggregated indicators can potentially fill important information gaps in environmental-economic accounting, and serve as signals for early warning. But they cannot replace more concrete and spatially explicit information needed for practical policy decisions.

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