> Indicators for Ecosystem Goods and Services

Framework, methodology and recommendations for a welfare-related environmental reporting

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Extended summary of the publication «Indikatoren für Ökosystemleistungen»
www.umwelt-schweiz.ch/uw-1102-d

Published by the Federal Office for the Environment FOEN
Bern, 2011

Impressum

Issued by
Federal Office for the Environment (FOEN)
The FOEN is an office of the Federal Department of Environment, Transport, Energy and Communications (DETEC).

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Suggested form of citation
Staub C., Ott W. et al. 2011: Indicators for Ecosystem Goods and Services: Framework, methodology and recommendations for a welfare-related environmental reporting. Federal Office for the Environment, Bern. Environmental studies no. 1102: 17 S.

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Cover picture
Bumble-bee on plum blossom (Kaspar Ruoff)

Link to PDF file
www.environment-switzerland.ch/uw-1102-e
(no printed version available)

> Summary

Initial position, aim and procedure

Initial position

In order to make environmental and resources policies serve economic welfare and show their contributions to this goal, the services that the environment provides must be made measurable and so communicable. To this end the feasibility study "Welfare-significant environmental indicators" (Ott/Staub 2009) tested a new approach for measuring ecosystem services in physical units. Building on this the FOEN, with the help of numerous internal and external experts, has drawn up a list of relevant ecosystem goods and services that forms the starting point for the "Inventory of Final Ecosystem Goods and Services".

Aim

The aim of the present study is to revise and further develop the inventory. The result should be a consolidated inventory with concrete proposals for operationalization (indicators). The indicators should help to specify and implement the aims of environmental policy and to simplify the communication of resources policy to the various target groups.

Procedure

Within the context of this study a methodology has been developed for reviewing and further developing the inventory (validation) and also for creating indicators (operationalization). The initial FOEN inventory was checked for consistency, completeness and relevance. This was carried out in connection with existing classification and indicator systems. A method of operationalizing the individual services was also developed. Finally, concrete proposals for the operationalization of the individual ecosystem goods and services were developed and their use was discussed.

Consultations

Alongside the theoretical, literature-based development of the systems for validation and operationalization, consultations with experts were carried out. As part of the validation process for the inventory scientists who carry out research in this and related areas were consulted. The usability of the inventory was also discussed with representatives of two sectors (tourism and nature protection). In order to clarify the availability of base data for the operationalization of the individual ecosystem services, numerous discussions with technical experts were also carried out relating to the individual indicators. The study received active support from the German Federal Agency for Nature Conservation (BfN), the Austrian Environment Agency (U) and the European Environment Agency (EEA).

Results

The result is an inventory of 23 ecosystem services relevant to Switzerland as well as proposals for indicators for the individual services. The methods developed can be used to further develop the indicators and also for similar studies in other countries.

Limits

It is important to note that the concept of ecosystem services corresponds to an anthropocentric perspective. It concentrates on those aspects of ecosystems that have a recognisable connection to (human) welfare, that is, are used or valued in some form or other

by the human population (cf. e.g. MA 2005b, 53, Fisher et al. 2008, 2051, Plieninger et al. 2010, 192). In addition, only those services can be considered that have a benefit recognisable by today's state of knowledge.

Complement to, not replacement of other environmental indicators

The indicators discussed here are thus a selection chosen according to the criterion "direct connection to welfare". This selection is necessary to show the contribution that the ecosystems make to welfare. It is in no way a claim that the complexity of the ecosystems and their services has been completely recorded. The welfare-significant environmental indicators are conceived not as a replacement but as a meaningful complement to the existing environmental indicators.

System of the inventory

Final ecosystem services in focus

The inventory deals as a matter of principle with only **final** ecosystem goods and services. The latter are ecosystem goods and services that are directly enjoyed, consumed or used by humans (Final Ecosystem Goods and Services, FEGS) and so make a direct contribution to welfare.[1] The concentration on final services (in contrast to **intermediary** services which contribute to the final services) serves to avoid double counting.

Types of goods and services

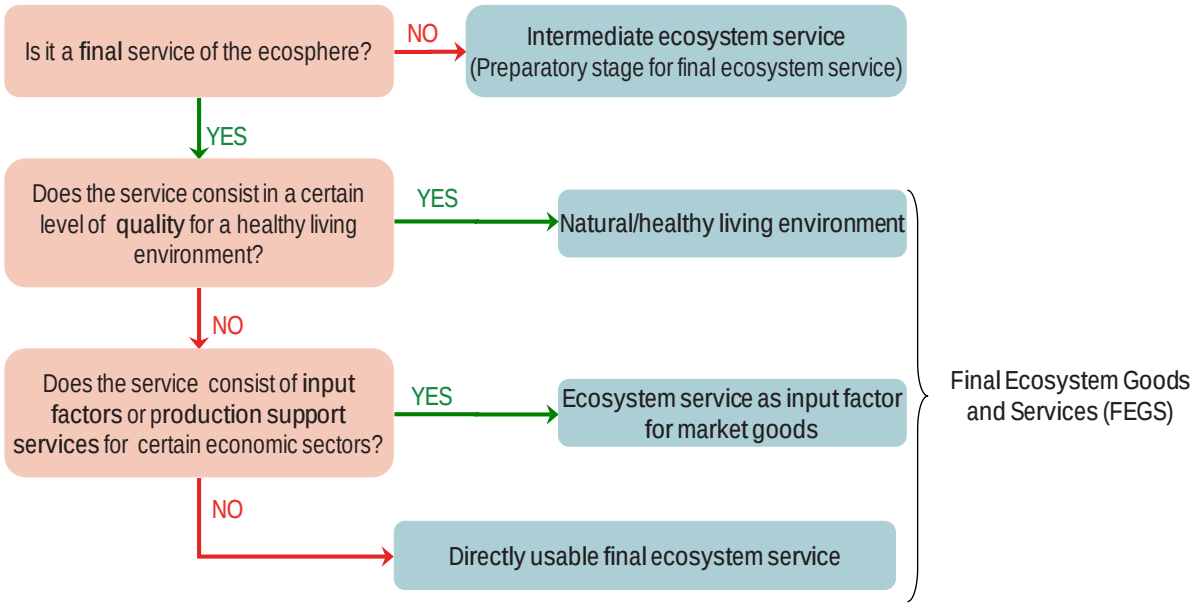
In order to make the inventory more precise, additional characteristics of the FEGS are defined. These characteristics make it possible to use different definitions of ecosystem goods and services and at the same time make the differences transparent. The following types of goods and services have been distinguished:

> **Directly usable final ecosystem goods and services** are used directly by the human population (e.g. recreational or protective services, foodstuffs and feed production, timber yield, contribution to renewable energy).
> Ecosystem services can also be **input factors for market goods** and are thus not directly consumed (e.g. pollination as an agricultural input).
> Under **natural/healthy living environment** qualities of health-related environmental media are summarised (e.g. air quality).
> **Intermediate ecosystem goods and services** are services that offer humans no direct benefit. Intermediate ecosystem goods and services are not normally covered here in order to avoid double counting. The only exception in the present inventory is CO_2 storage as an input to climate stability. The reasoning here is that the resulting final ecosystem service only emerges after a considerable time delay.

The following figure shows a system developed for this project which divides the FEGS into these four types of goods and services.

[1] «Final» is paraphrased by Boyd and Banzhaf (2007, 619) with «directly enjoyed, consumed, or used to yield human well-being».

Fig. 1 > System for dividing the FEGS into the four types of goods and services



Source: econcept and FOEN, economics section

Catégories de bénéfices et bénéfice

For every FEGS the benefit it generates for the population is also formulated. These benefits indicate the contribution to welfare, that is to recreation, prevention, etc. In order to achieve a link to the product groups used in the FOEN, the benefits are assigned to the categories Health, Security, Natural diversity and Production factors.

The current inventory

The resulting inventory of final ecosystem services is summarised in Tab. 1. Altogether it includes 23 FEGS in the benefit categories Health, Security, Natural diversity and Production factors. The FEGS are described and classified into the different types of goods and services and their benefits are listed. The respective indicators listed in the Appendix.

Tab. 1 > Inventory of Final Ecosystem Services

Nr.	Final Ecosystem Goods and Services (FEGS)	Type of good or service	Benefit	Service type according to MA (2005)
Health/wellbeing				
H1	Recreational services based on hunting, collecting and observation of species living in the wild	Directly usable final ecosystem service	Recreation	Cultural services
H2	Recreational services based on urban green areas and open spaces as well as recreational areas both near to the place of residence and further away	Directly usable final ecosystem service	Recreation	Cultural services
H3	Recreational services based on recreational spaces in the residential environment (gardens etc.)	Directly usable final ecosystem service	Recreation	Cultural services
H4	The chance to develop a sense of place through attractive and characteristic landscapes (natural and cultural heritage)	Directly usable final ecosystem service	Wellbeing	Cultural services
H5	Local microclimate regulation service through ecosystems	Directly usable final ecosystem service	Wellbeing	Regulating services
H6	Healthy air	Natural/healthy living conditions	Prevention	Not included in this form (possibly regulating service)
H7	Quietness	Natural/healthy living conditions	Prevention	Not included in this form (possibly regulating service)
H8	A level of non-ionising radiation compatible with human health	Natural/healthy living conditions	Prevention	Not included in this form (possibly regulating service)
Security				
S1	Protection from avalanches, rock falls and debris flows through vegetation on steep slopes	Directly usable final ecosystem service	Protection of humans, animals and material assets	Regulating services
S2	Protective service offered by areas that can be flooded or can retain water	Directly usable final ecosystem service	Protection of humans, animals and material assets	Regulating services
S3	Carbon sequestration	Intermediary ecosystem service	Protection of humans, animals and material assets	Regulating services
Natural Diversity				
D1	Existence of natural diversity at the level of species, genes, ecosystems and landscapes	Directly usable final ecosystem service	Existence of natural diversity (over and above its signifi-cance for all ecosystem services)	Only partially covered: cultural services
Production factors				
P1	Natural supply of ground and surface water usable as drinking and process water	Directly usable final ecosystem service	Water supply	Provisioning services
P2	Natural supply of production support services: pollination and biological pest control	Ecosystem service as input factor	Contribution to agriculture and forestry / food industry	Regulating services
P3	Fertile soil for agricultural and forestry use	Ecosystem service as input factor	Contribution to agriculture and forestry / food industry	Basic services
P4	Forage crops and organic fertilisers for agricultural use	Ecosystem service as input factor	Contribution to agriculture / food industry	Provisioning services
P5	Timber increment for forestry use	Ecosystem service as input factor	Contribution to forestry	Provisioning services
P6	Wild animals and fish for commercial use	Ecosystem services as input factor	Contribution to fishing and hunting economy	Provisioning services
P7	Supply of valuable natural and cultivated landscapes for commercial use in tourism	Ecosystem service as input factor	Contribution to value creation in tourism	Provisioning services

Nr.	Final Ecosystem Goods and Services (FEGS)	Type of good or service	Benefit	Service type according to MA (2005)
P8	Renewable energy sources: water power, wind power, biomass, solar energy, geothermics	Ecosystem service as input factor	Contribution to energy economy	Only partly covered: provisioning services
P9	Cooling effects as natural production support services	Ecosystem service as input factor	Cooling effects for various sectors	Regulating services
P10	Genetic resources and biochemicals	Ecosystem service as input factor	Contribution to the pharmaceutical industry, agriculture and other industries	Provisioning services
P11	Decomposition or storage of residual materials	Ecosystem service as input factor	Contribution to the waste water and waste disposal industry	Regulating services

Integration in international classification systems

The FEGS that were developed here can be integrated with their respective indicators into the international classification systems of the Millennium Ecosystem Assessment (MA 2005) and the Common International Classification of Ecosystem Goods and Services (CICES, Haines-Young and Potschin 2010).

The **Millennium Ecosystem Assessment (MA)** divides the ecosystem services into four different classes: (1) Provisioning Services include, among other things, food, drinking water and timber. (2) Regulating Services cover services such as flood protection and air pollution control. (3) Cultural Services bring together recreational services with spiritual, religious and cultural services. (4) Supporting Services are all the processes that ensure the necessary conditions for the existence of all ecosystems, such as the nutrient cycle. The Supporting Services are by definition *intermediate* ecosystem services and for that reason they do not belong in an inventory of *final* ecosystem services. According to the MA the effects of the ecosystem services on human welfare can be analyzed into the constituents security, health, basic material for a good life, good social relations and freedom of choice and action.

The **Common International Classification of Ecosystem Goods and Services (CICES)** is promoted by the European Environment Agency EEA. CICES aims to develop a new classification system based on the MA that is compatible with the already established accounts of the System of National Accounts (SNA).[2] The classification developed within the framework of CICES for coding the ecosystem services and the system used by MA overlap to a large extent. One important difference is that CICES does not contain Supporting Services so as to avoid double counting.[3] As in the present FOEN Inventory, only those services are included which benefit people directly. In addition CICES is formulated in a relatively open way and allows some leeway for country-specific circumstances when implemented at a national level.

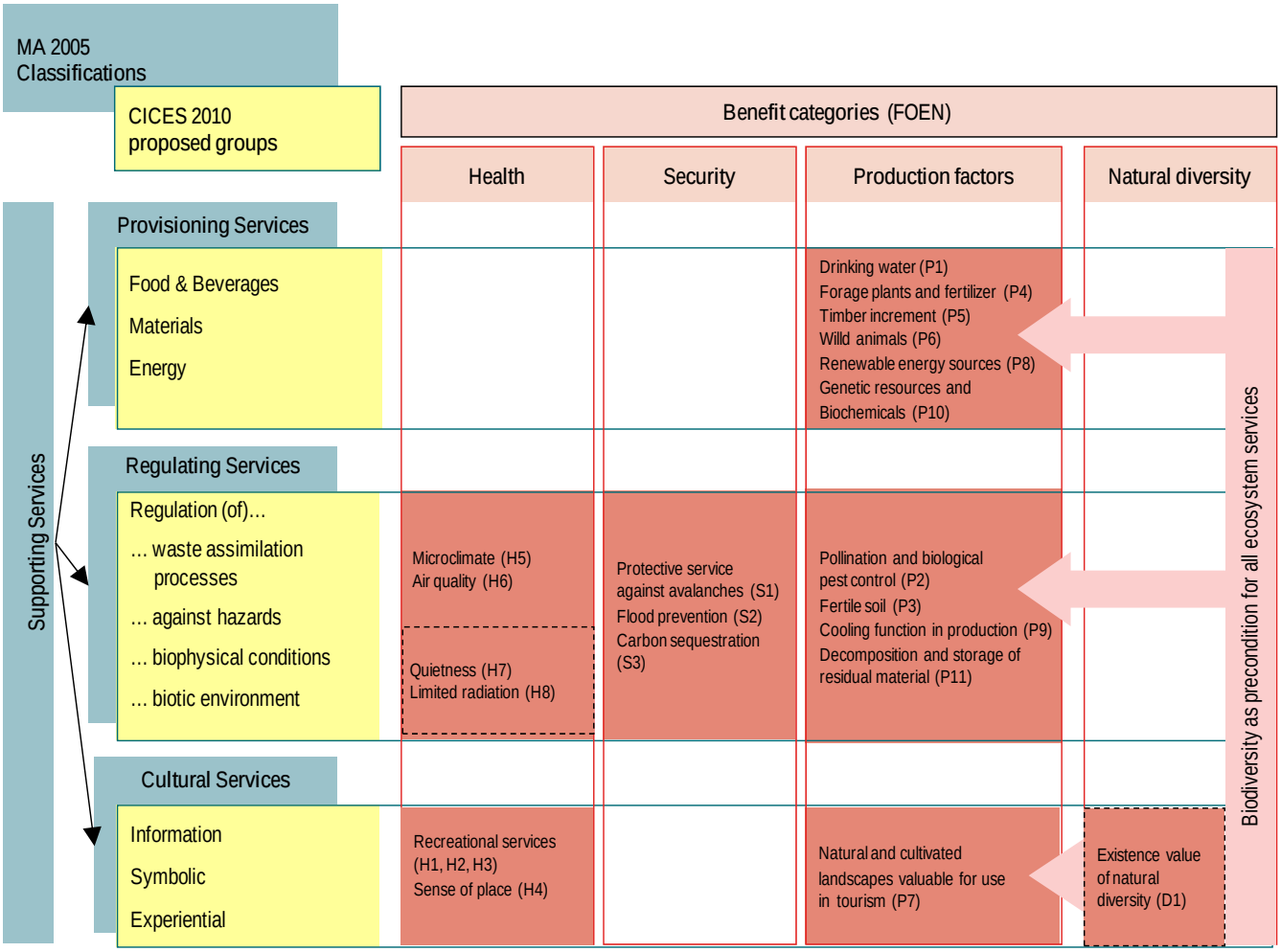
[2] The SNA is extended by environmentally relevant satellite accounts (System of Economic and Environmental Accounts, SEEA). In future this system will also contain accounts for ecosystem services. For this reason CICES is being further developed so as to achieve compatibility with accounts that are already available.

[3] This definitely does not mean that these services are any less important. On the contrary, they are the basis for other services and often make them possible in the first place. One argument for not taking them into account is that these services are contained as inputs in the products and services that are founded on them and are later consumed by people and therefore are already accounted for in an evaluation of the end products (cf. Potschin and Haines-Young, et. al 2010).

In the following figure the MA classes of ecosystem services are listed on the left side and their relation to the CICES classes is shown. Various ecosystem services, ordered according to the four benefit categories of the FOEN, are then divided amongst the classes of MA and CICES.

Fig. 2 > Integration of the Inventory into the MA and CICES Classifications

Interpretation assistance: for example, the FEGS "Natural supply of ground and service water usable as drinking and process water" (P1), which is assigned in the FOEN Inventory (red) to the "Factors of production", is coded in the MA class (blue) "Provisioning services". This class is also found in the CICES (yellow), although in a slightly altered form, with the subgroups food and drinking water, materials and energy. The FEGS P1 can also be assigned to this CICES class.



Source: econcept und FOEN, based on MA, CICES classifications, the name of each FEGS is abbreviated (see tab. 1)

Systems for the formation of indicators

Key questions for the creation of indicators

The formulation of the FEGS is deliberately kept general. It thus does not give a direct description of the entities that are to be recorded by the indicators. After the Inventory had been validated a system of operationalization or creation of FEGS indicators was developed.

Operationalisation aims to define measurable units. The entities to be measured or recorded must be made concrete and specific. With this aim in mind, an indicator profile has been drawn up for every FEGS. The following figure (fig. 3) shows which key questions must be answered when compiling indicators.

1. Basis for goods or services?

The essential key question is to find out the basis for the service, i.e. those components of nature that generate the goods or services: one example is the recreational spaces for recreational services; another would be protective forests for protection from avalanches, debris flows, rock falls etc. As an element of nature the basis for the service is material and so essentially measurable. Usually several such service providers can be identified per FEGS.

2. Demand vs. supply?
3. Connection to welfare?

Secondly, there is the question of whether the use (demand side) or the supply of the service should be measured. Here it must be noted that a supply that is not used does not produce an economic benefit. Thirdly, when the indicator profile is drawn up it is important to check that there is a connection to welfare.

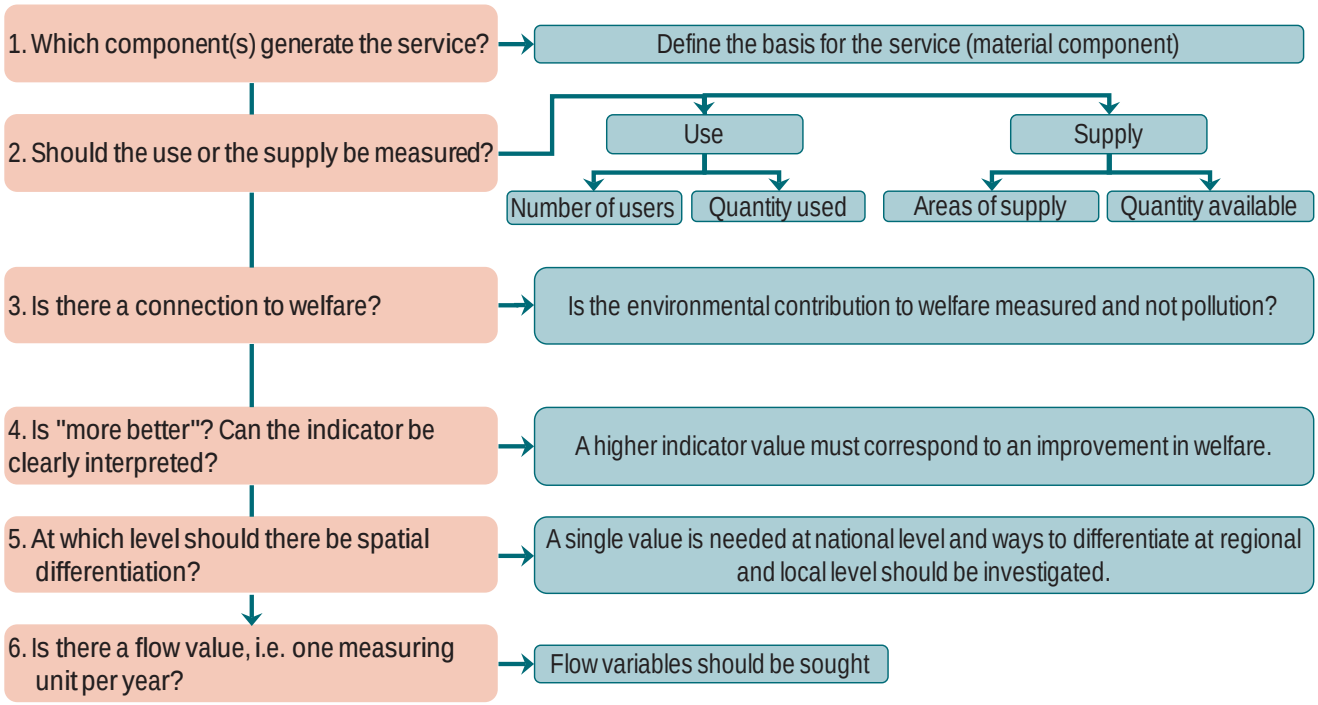
4. Signs of the connection to welfare: “more is better”?

The indicators should be interpretable without ambiguity. They are therefore selected according to the fourth key question on the principle that “more is better”. This means that a higher indicator value signifies an increase of the goods or services provided. In terms of welfare economy this means, all other things being equal, a monotonically increasing (but not necessarily linear) connection between indicator and welfare. The principle “more is better” relates to the individual ecosystem service. An overall view takes into account the increase and decrease of all the ecosystem services. Example: if improved access to an area of natural interest leads to an increase in recreational services then other ecosystem services may come under pressure as a result of the increase in visitors.

5. Spatial differentiation
6. Flow values

The fifth key question concerns the possibilities for spatial differentiation. The sixth question is whether the indicator gives a flow value (benefit contribution per year) rather than a stock value (potential of goods and services).

Fig. 3 > Key questions in drawing up indicator profiles and indicators



Source: econcept

An indicator profile was drawn up for every FEGS on the basis of the key questions explained above which made it possible to derive the indicators. Proposals relating to content were discussed in consultations with experts and, on the basis of the available data record, were made concrete to the extent that indicators could be formulated.

Data availability

The availability of data bases and indicators was also clarified in the consultations. It was shown that at the present time many new indicators are being developed and that for some FEGS improved indicators may be introduced in a few years' time. The indicators proposed here should therefore be further developed on a continuous basis in parallel with their implementation.

Examples of indicators for selected ecosystem goods and services

Indicators for selected ecosystem services will be used as examples in the following table. The individual indicators are derived in Chapter 3. In Appendix there is a complete overview of the operationalized inventory.

Tab. 2 > Indicators for selected ecosystem goods and services

Selection of indicators proposed for the individual Final Ecosystem Goods and Services (FEGS). They are drawn from consultations with representatives of the FOEN and of other federal offices. They must be further specified before application.

FEGS	Indicators	Data base
Santé / Bien-être		
H2: Recreational services based on urban green areas and open spaces as well as recreational areas both near to the place of residence and further away	I1: Availability of green spaces and water courses within 4 km of residential houses in Switzerland	LABES[4] parameter "Landscape quality near the place of residence"
	I2: Accessibility of recreational spaces near to the home for the Swiss resident population	LABES parameter 35 (Areas without infrastructure and quiet areas)
	I3: Accessibility of areas free from infrastructure for the Swiss resident population	LABES parameters 31a/b and 32 (Water bodies easily accessible, access to nearby recreational areas, access to areas without infrastructure, quiet areas)
	I4: Accessibility of quiet areas for the Swiss resident population	
	I5: Effective recreational use of forest areas: proportion of areas with a frequency of at least 100 persons per day on the test area (a circle with a radius of 100m)	Swiss National Forest Inventory
H3: Recreational service through recreational spaces in the residential environment (gardens etc.)	I1: An area that can be used as a private garden or for sitting in, playing in and enjoying	Area statistics
H6: Healthy air	I1: Number of people who are exposed to "good air" (below the emissions limit) or to "bad air" (above the emissions limit) near their place of residence in relation to pollution from fine particulate matter	National Air Pollution Monitoring Network (NABEL). Data on pollution can be linked with geographical population data. Threshold values for emissions are set by the Federal Council.
	I2: Number of people who are exposed to "good air" (below the emissions limit) or to "bad air" (above the emissions limit) close to their place of residence in relation to pollution from nitrogen dioxide	
	I3: Number of people who are exposed to "good air" (below the emissions limit) or to "bad air" (above the emissions limit) close to their place of residence in relation to pollution from ozone levels	
	I4: Number of people who are exposed to "good air" (soot-free air) or "bad air" close to their place of residence in relation to pollution from soot	
H7: Quietness	I1: Number of people who experience a quiet environment during the day (number of people with day-time noise pollution [from roads, railways and airports] Lr ≤ 55dB)	Noise pollution: SonBASE
	I2: Number of people who experience a quiet environment at night (number of people with night-time noise pollution [from roads, railways and airports] Lr ≤ 45dB)	Threshold values: planning values for residential zones
Security		
S1: Protection from avalanches, rock falls and debris flows through vegetation on steep slopes	I1: Protective forests used for avalanche protection as km² or map	Silvaprotect
	I2: Protective forest used for protection against landslides (slope-type debris flows) as km² or map	
	I3: Protective forest used for protection against rock falls or boulder slips as km² or map	
	I4: Protected values through "Forest protection against avalanches" in CHF (enables scenario-defined risk calculation)	
	I5: Protected values through "Forest protection against landslides" in CHF (enables scenario-defined risk calculation)	

[4] The abbreviation LABES stands for landscape observation programme in Switzerland. This forms part of the National Environmental Observation of Switzerland.

FEGS	Indicators	Data base
	I6: Protected values through "Forest protection against rock falls and boulder slips" in CHF (enables scenario-defined risk calculation)	
	Cumulative indicator 1: Protective forest for protection against natural hazards as km² or map	
	Cumulative indicator 2: Protected values from protective forest in CHF (enables scenario-defined risk calculation)	
S3: Carbon sequestration	I1: Alteration in the storage of greenhouse gases per year caused by a change in the economic use of forests expressed in tonnes of CO_2	Swiss Greenhouse Gas Inventories: LULUCF
	I2: Alteration in the storage of greenhouse gases per year, through changes in land use, measured in tonnes of CO_2 (negative values = emissions)	
	I3: An index of the CO_2 storage for the individual forms of land use (forest, cultivated land, grass land, wetlands) [Basis: the sum of the index values for all forms of land use is set at 100 for 1990]	
Natural diversity		
D1: Existence of natural diversity at the level of species, genes, ecosystems and landscapes	I1–3: BDM Indicators Z3, Z7 and Z9: species diversity in Switzerland and the regions, species diversity in the countryside, species diversity in natural habitats These proposals should be seen as provisional: there is intensive discussion of indicators in connection with biodiversity strategy. Thus the feasibility of an indicator such as "Changes to the number and extent of existing natural environments in Switzerland" should be tested.	Biodiversity Monitoring Switzerland (BDM); Centre Suisse de Cartographie de la Faune (CSCF); *Centre du Réseau Suisse de Floristique (CRSF);* Swissfungi; Swisslichen and the Swiss Ornithological Institute Sempach
	I4: Indicator of types of landscapes (based on a typology of landscapes in Switzerland / protected area statistics)	
Production factors		
P1: Natural supply of ground and surface water usable as drinking and process water	I1: Water supply from untreated spring and ground water in millions m³ water per year	Annual water statistics of the Swiss Gas and Water Industry Association (SVGW)
	I2: Percentage of untreated spring and ground water in the whole water supply system	
P5: Timber increment for forestry use	I1: Annual timber increment in 1000 m³ per year	National Forest Inventory: LFI 2 and LFI 3 (www.lfi.ch-/resultate_resultateauswahl.php?p=theme)
	I2: Annual net timber increment in 1000 m³ pro Jahr (timber increment minus usage and mortality)	
	I3: Amount of timber used in 1000 m³ per year (annual usage)	
P7: Valuable natural and cultivated landscapes for commercial use in tourism	I1: Number of passenger journeys by the Swiss mountain railways	Association of Swiss Mountain Railways (SBS)
		Association of Public Transport (VöV), Commission for Tourism
	I2: Supplementary indicator 2: number of passenger journeys by post vehicles (in tourist areas) and ships (on Swiss lakes)	Association of Swiss Shipping (VSSU)

Using the Inventory

The expert consultations resulted in a discussion of the possibilities and difficulties that need to be considered in connection with the three basic target groups i.e. the political decision-makers, the politically interested public and the beneficiaries of the ecosystem goods and services.

The possibilities of using the inventory for communications purposes are strongly dependent on the political goals that are being actively pursued. The inventory must be further specified in order to implement political measures. In its present form it can and should be used however as a general means of communication for raising awareness of the usefulness of (and our dependence on) nature and as an informed basis for more specific research. The experts see some potential in the welfare-related perspective, in particular with regard to reaching broader target groups.

Aggregation and overall index

On the basis of the indicators that have now been drawn up it is possible to create theme-relevant indices, thus for instance to draw up an index relating to the quality of a location or an index relating to health. The formation of an overall index would go even further. Such an Ecosystem Services Index (ESI) would have the potential advantage of reducing complexity in communications in that one single measurement value could be presented to the broad political public instead of a multitude of values of different dimensions, as is the case with the Gross Domestic Product (GDP). One overall index would have the disadvantage, however, of losing a large amount of information since many different topics would be mixed together within it.

Conclusion

Operationalized inventories of ecosystem goods and services show in a systematic way the contributions of the ecosphere to welfare. This can assist in sensitising the politically interested public to the significance of ecosystems and in giving a suitable weight to environmental considerations within political decision-making. At the same time progress in environmental politics is made more transparent.

In the design of systems for defining and operationalizing (through the formation of indicators) relevant ecosystem goods and services, the present project stands out through its pragmatic approach. It allows the FEGS to be integrated into the European CICES classification system and thus provides a link to the current scientific and political discussion. Above all, it permits ecosystem goods and services to be operationalized for use in the national resources policy.

The inventory as a whole provides a good overview of the ecosystem goods and services that are relevant to Switzerland. The benefit of the environment for the population is brought into focus, which is extremely helpful. This supplements in a meaningful way the monitoring of environmental impacts and allows welfare-related statements about the environment and on topics of environmental policy

Use from the experts' point of view

The consultations with different experts and representatives of stakeholder groups have shown that the chosen approach, the inventory and the indicators have been judged unanimously to be a step in the right direction. They can imagine a direct use for communications purposes of an overall inventory or of an overall index only to a limited extent however. On the other hand, they see great potential in the use of an extract from the FEGS or from the indicators that has been selected according to a specific theme, both for communicating the aims of resources policies and for concrete applications.

International cooperation

In the attempts to create an international standardisation a distinction must be made between the systems and the concrete operationalization. As far as the systems are concerned the link to the CICES classification is a great advantage. As far as operationalization is concerned, it is expected that in the future, too, country-specific indicators will be relevant. In international comparisons, Switzerland stands out for its very good access to data of high quality, which allows the country to make a contribution to international cooperation through its examples of measured indicators.

Recommendation for further action

Aspects of further action

The recommendation for further action is that indicators for ecosystem goods and services should be integrated step by step into the environmental reports. At the same time, the proposals that have so far been drawn up for the operationalization of the individual FEGS should be further substantiated and specified in a target-oriented manner. The strategy for further steps is heavily dependent on the planned use. The authors however see more potential in a target- and theme-related development than in the orientation towards a completely operationalized inventory. In this respect decisions are needed on which FEGS should be further specified, for which target group and with what aim.

> Annex: Proposals of indicators

Tab. 3 > Current list of indicators

The indicators proposed here for the individual Final Ecosystem Goods and Services (FEGS) are drawn from consultations with representatives of the FOEN and other federal offices. They must be understood as a first draft in view of an operationalization of the FEGS and must be further specified before being put to use. Details on the data sources and their availability are listed in the full report in German.

Final Ecosystem Goods and Services (FEGS)	Indicators	International Classification (CICES 2010 / MA 2005)
H: Health		
H1: Recreational services based on hunting, collecting and observation of species living in the wild	I1: Number of people who go hunting in their free time	Cultural services: experiental
	I2: Number of people who go fishing in their free time	
	I3: Index for the development of edible fish populations derived from the yields of anglers	
H2: Recreational services based on urban green areas and open spaces as well as recreational areas both near to the place of residence and further away	I1: Availability of green spaces and water courses within 4 km of residential homes in Switzerland	Cultural services: experiental
	I2: Accessibility of recreational spaces near to the home for the Swiss resident population	
	I3: Accessibility of areas free from infrastructure (such as highways, buildings etc.) for the Swiss resident population	
	I4: Accessibility of quiet areas for the Swiss resident population	
	I5: Effective recreational use of forest areas: proportion of areas with a frequency of at least 100 people per day on the test area (a circle with a radius of 100m)	
H3: Recreational services based on recreational spaces in the residential environment (gardens etc.)	I1: Area that could be used for private gardens or for sitting in, playing in and enjoying	Cultural services: experiental
H4: The chance to develop a sense of place through attractive and characteristic landscapes (natural and cultural heritage)	I1: Identification with the natural world among the Swiss resident population	Cultural services: symbolic
H5: Local microclimate regulation services through ecosystems	I1: At the present time there are no plans to create an indicator.	Regulating services: regulation of biophysical conditions
H6: Healthy air for the population	I1: Number of people who are exposed to “good air” (below the emissions limit) or to “bad air” (above the emissions limit) near their place of residence in relation to pollution from fine particulate matter	Regulating services: regulation of biophysical conditions
	I2: Number of people who are exposed to “good air” (below the emissions limit) or to “bad air” (above the emissions limit) near their place of residence in relation to pollution from nitrogen dioxide	
	I3: Number of people who are exposed to “good air” (below the emissions limit) or “bad air” (above the emissions limit) near their place of residence in relation to pollution from ozone levels	
	I4: Number of people who are exposed to “good air” (soot-free air) or “bad air” near their place of residence in relation to pollution from soot	
H7: Quietness (low noise level)	I1: Number of people who experience a quiet environment during the day. (Number of people with day-time noise pollution from roads, railways and airports: Lr<=55dB)	Regulating services: regulation of biophysical conditions
	I2: Number of people who experience a quiet environment at night. (Number of people with night-time noise pollution from roads, railways and airports: Lr<=45dB)	
H8: A level of non-ionising radiation compatible with human health	I1: There are no plans to create an indicator at the present time because of insufficient data.	Regulating services: regulation of biophysical conditions

Final Ecosystem Goods and Services (FEGS)	Indicators	International Classification (CICES 2010 / MA 2005)
S: Security		
S1: Protection from avalanches, rock falls and debris flows through vegetation on steep slopes	I1: Protective forests used for avalanche protection as km² or map	Regulating services: regulation against hazards
	I2: Protective forests used for protection against landslides as km² or map.	
	I3: Protective forests used for protection against rock falls and boulder slips as km² or map	
	I4: Protected values through "Forest protection against avalanches" in CHF (enables scenario-defined risk calculation)	
	I5: Protected values through "Forest protection against landslides" in CHF (enables scenario-defined risk calculation)	
	I6: Protected values through "Forest protection against rock falls and boulder slips" in CHF (enables scenario-defined risk calculation)	
	Cumulative indicator 1: Protective forest for protection against natural hazards as km² or map	
	Cumulative indicator 2: Protected values from protective forest in CHF (enables scenario-defined risk calculation)	
S2: Protective service offered by areas that can be flooded or can retain water	I1: At the present time there are no plans to create an indicator.	Regulating services: regulation against hazards
S3: Carbon sequestration	I1: Alteration in the storage of greenhouse gases per year caused by a change in the economic use of forests expressed in tonnes of CO_2	Regulating services: regulation of biophysical conditions
	I2: Alteration in the storage of greenhouse gases per year caused by changes in land use, measured in tonnes of CO_2 (negative values = emissions)	
	I3: An index of the CO_2 store for the individual forms of land use (forest, cultivated land, grassland, wetlands). (Basis: the sum of the index values of all forms of land use is set at 100 for 1990)	
D: Natural Diversity		
D1: Existence of natural diversity at the level of species, genes, ecosystems and landscapes	I1: Species diversity in Switzerland and in Swiss regions (Swiss Biodiversity monitoring BDM indicator Z3), Species diversity in the countryside (BDM indicator Z7) and Species diversity in habitats (BDM indicator Z9)	Only partially covered under cultural services: symbolic (existence value)
	I2: Indicator of types of landscapes (based on a typology of landscapes in Switzerland / protected area statistics)	
	Change of the number and extension of natural habitats in Switzerland (suitability and feasibility of this indicator is currently analysed).	
P: Factors of production		
P1: Natural supply of ground and surface water usable as drinking and process water (input factor for water management)	I1: Water supply from untreated spring and ground water in millions m³ of water per year	Provisioning services: food and beverages
	I2: Percentage of untreated spring and ground water in the whole water supply system	
P2: Natural supply of production support services: pollination and biological pest control	I1: Number and quality of pollen and nectar producing plants per monitoring site (according to Hintermann & Weber 2009)	Regulating services: regulation of biotic environment
	I2: Average density of bees in Switzerland [populations per km²]	
P3: Fertile soil for agricultural and forestry use	I1: Land used for agriculture in hectares	Supporting services: regulation of biophysical conditions
	I2: Land used for forestry in hectares	
P4: Forage crops and organic fertilisers for agricultural use	I1: Swiss feed grain used (in 1000s of tonnes per year)	Provisioning services: food and beverages
	I2: Estimation of the amount (in tonnes) of agricultural feed produced from meadows and pastures	
	I3: Estimation of the amount (in tonnes) of organic fertiliser used in agriculture	

Final Ecosystem Goods and Services (FEGS)	Indicators	International Classification (CICES 2010 / MA 2005)
P5: Timber increment for forestry use	I1: Annual timber increment in 1000 m³ per year	Provisioning services: materials
	I2: Annual net timber increment in 1000 m³ per year (timber increment minus usage and mortality)	
	I3: Amount of timber used in 1000 m³ per year (annual usage).	
P6: Wild animals and fish for commercial use	I1: Total annual yield of professional fishing industry in Swiss lakes in tonnes of fish	Only partially covered under provisioning services: food and beverages
	I2: Yield from Swiss professional fishing industry as proportion of total consumption of Swiss fish	
	I3: Total annual yield from hunting (game) in Switzerland in tonnes of meat	
	I4: Game shot in Switzerland as proportion of total game consumption in Switzerland	
P7: Availability of valuable natural and cultivated landscapes for commercial use in tourism	I1: Number of passenger railway journeys by the Swiss mountain railways	Provisioning services: experiental
	I2: Supplementary Indicator 2: number of passenger journeys by post vehicles (in tourist regions) and ships (on Swiss waters)	
P8: Renewable energy sources: water power, wind power, biomass, solar energy	I1: Absolute amount and proportional share of renewable energy sources in final electricity consumption	Provisioning services: energy
	I2: Absolute amount and proportional share of renewable energy sources in final consumption of energy excluding electricity	
P9: Natural production support services: cooling effects	I1: Cooling water requirement of the nuclear power stations in millions of m³ per year	Regulating services: energy
P10: Genetic resources and biochemicals, as well as test and experimental organisms	I1: Number of bacterial isolates for milk production, cheese production and meat production (other categories are also possible),	Provisioning services: materials
P11: Production support services: decomposition or storage of residual materials	I1: At the present moment there are no plans to create an indicator.	Regulating services: regulation of waste and assimilation processes