

# ELD CAMPUS

## Module: Identification and selection of ecosystem services



## In this module you will learn about:

- *Ecosystem services: The theory behind it*
- *Understanding regulating and supporting services: water, nutrient and soil organic cycles*
- *Special characteristics of ecosystem services*
- *Identification and assessment of ecosystem services*
- *Priorities matter - selecting ecosystem services for assessment*

If you want to deepen your know-how on the identification, selection and assessment of ecosystem services, further information is provided in the script of this module and links are provided at the end of this presentation.

## Link with the ELD 6+1 approach

- In this module we will refer to the first three steps of the ELD approach, with emphasis on step 3

***1. Inception***

***2. Geographical characteristics***

***3. Types of ecosystem services***

***4. Role of ecosystem services and economic valuation***

***5. Patterns and pressures***

***6. Cost-benefit analysis and decision-making***

***+1 step: Take action!***

## Definitions: ecosystem and ecosystem services

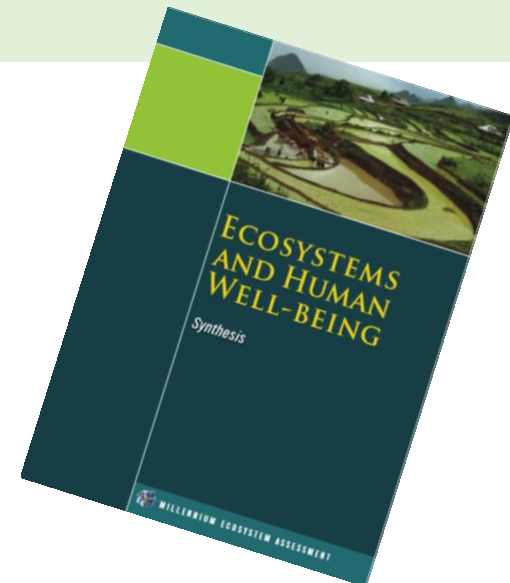
- **What is an ecosystem?**

A dynamic complex of plant, animal, and microorganism communities and their non-living environment interacting as a functional unit (MA 2005).

- **What is an ecosystem service?**

The direct and indirect contributions of ecosystems to human well-being (TEEB 2010).

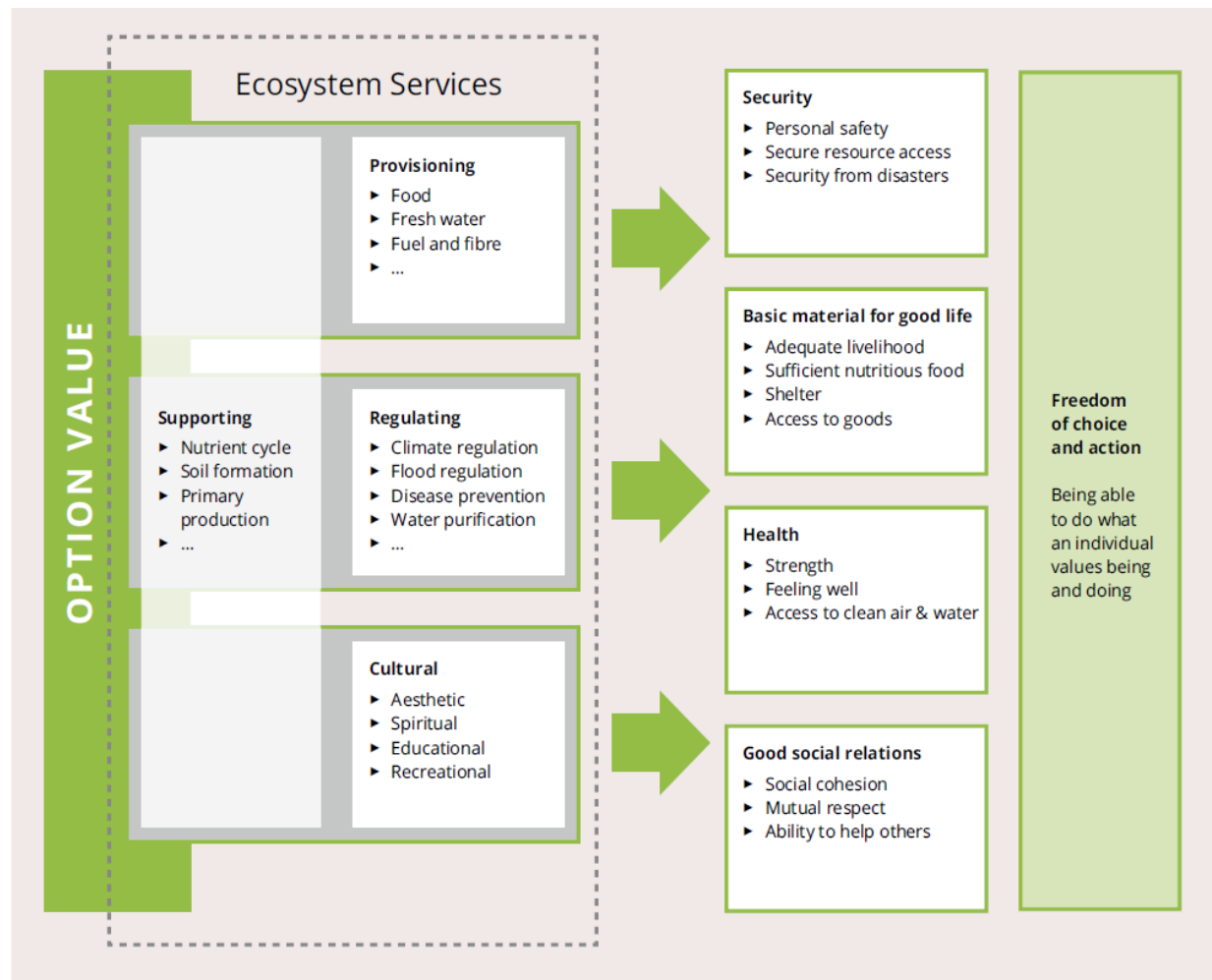
Ecosystem services have been for the first time assessed worldwide by the Millennium Ecosystem Assessment between 2001 and 2005.



## Classification of ecosystem services and link with human well-being

### 4 categories of services:

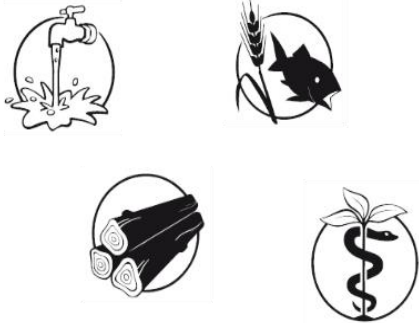
- Provisioning
- Regulating
- Cultural
- Supporting



## Ecosystem services categories

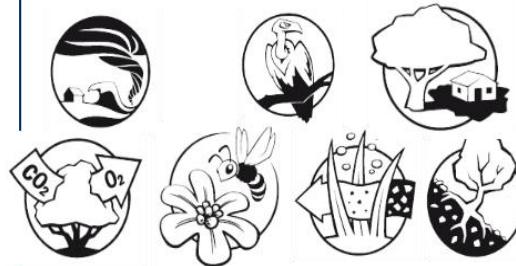
### Provisioning services

food, raw materials, fresh water, medicinal resources



### Regulating services

e.g. pollination, moderation of extreme events, carbon sequestration and storage, waste-water treatment, erosion prevention and maintenance of soil fertility,...



### Cultural services

e.g. recreation and mental and physical health; aesthetic appreciation and inspiration for culture, art and design; spiritual experience and sense of place,...



### Habitat or supporting services













habitats for species, maintenance of genetic diversity



© ValuES, adapted from TEEB 2010

*Other classification systems exist! Have a look in the script!*

## Effects of land degradation on ecosystem services

		<b>Soil erosion by water</b> (e.g. gully erosion, mass movements/ landslides, loss of topsoil/ surface erosion)
		<b>Soil erosion by wind</b> (e.g. loss of topsoil, deflation and deposition)
		<b>Chemical soil deterioration</b> (e.g. fertility decline and reduced soil organic matter, soil pollution, salinization)
		<b>Physical soil deterioration</b> (e.g. compaction, sealing, waterlogging)
		<b>Biological degradation</b> (e.g. reduction of vegetation cover, loss of habitats, increase of pests/ diseases)
		<b>Water degradation</b> (e.g. change in quantity of surface water, decline of surface water quality)

© Harari et al. 2017

*Remember the different categories of land degradation!*

## Effects of land degradation on ecosystem services

Depending on the extent of the phenomena, these processes lead to a decline or loss of different ecosystem services:

- **Soil fertility decline**, and consequently a decline in provisioning ecosystem services like crops, fruits, fibre, timber, fuelwood and medicines;
- **Loss of topsoil**; soil erosion eventually causes damages further upstream;
- **Reduced flood regulation functions**;
- **Soil and/or (ground-)water contamination**;
- **Reduced water storing capacities**, sinking groundwater levels;
- **Reduced carbon sequestration** and climate regulation functions;
- **Reduced biodiversity** (soil microorganisms as well as flora, fauna, habitats above-ground).

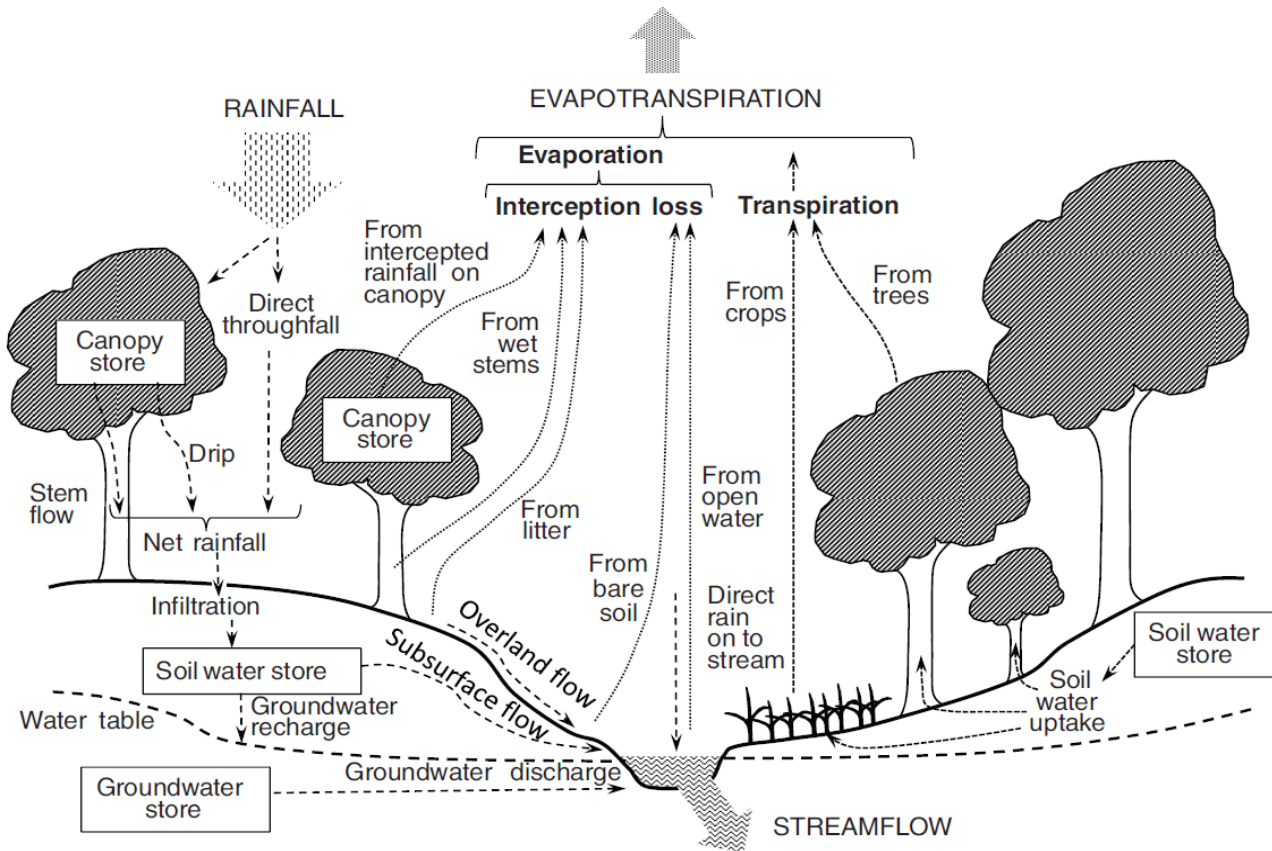


## Effects of sustainable land management practices

On the contrary, SLM measures (agronomic, vegetative, structural and/or management measures) **maintain ecological resilience and the stability of ecosystem services**. They help to:

- **increase the organic matter content and therefore maintain or improve soil fertility** and the availability of provisioning ecosystem services;
- **enrich and stabilise the topsoil and reduce soil erosion**, preventing sedimentation and reducing risks for flooding;
- **keep and/or enhance soil health and water purification mechanisms**;
- **maintain or enhance water storing capacities** and thereby to maintain or increase groundwater levels;
- **foster carbon sequestration** and climate regulation functions;
- **maintain or increase biodiversity**; and
- **improve the resilience**.

## Understanding regulating and supporting services- the water cycle



© Coates et al. 2013

*More information on the water cycle is provided in the script!*

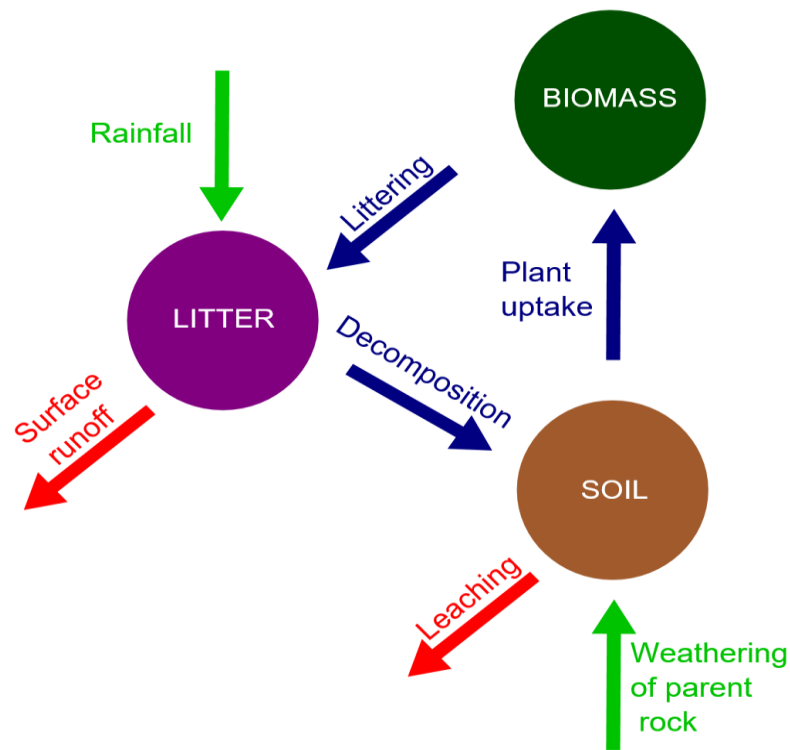
## Understanding regulating and supporting services- the water cycle

- In soils, water retention is fundamental to provide enough water for plant growth. For instance, desertification is essentially due to water loss from soils;
- Vegetation, and more generally land cover, are major components of the water cycle;
- Ecosystems can be considered as “natural water infrastructure”.



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## Understanding regulating and supporting services- the nutrient cycle



© Wikipedia 2019

*More information on the nutrient cycle is provided in the script!*

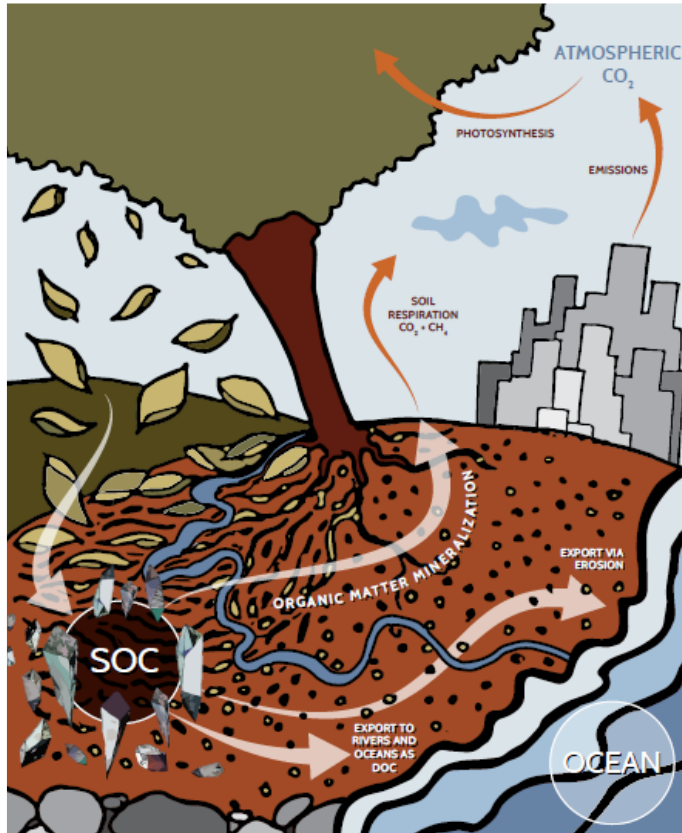
## Understanding regulating and supporting services- the nutrient cycle

- Soil conservation measures improve natural soil fertility and natural nutrient cycles, for instance by using crop rotations with legumes, green- and animal manures, cover crops in combination with reduced- or no-tillage, limited herbicide use and agroforestry;
- The nutrient use efficiency is optimised by applying context-adapted soil amendments such as compost or liming agents;
- Application of fertilisers should promote a balanced crop nutrient uptake and be based on soil and plant analyses.



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## Understanding regulating and supporting services- the carbon cycle



© FAO 2017

As for the nutrient cycles of nitrogen and phosphorus, soil organic carbon can be increased through SLM measures

*More information  
on the carbon  
cycle is provided  
in the script!*

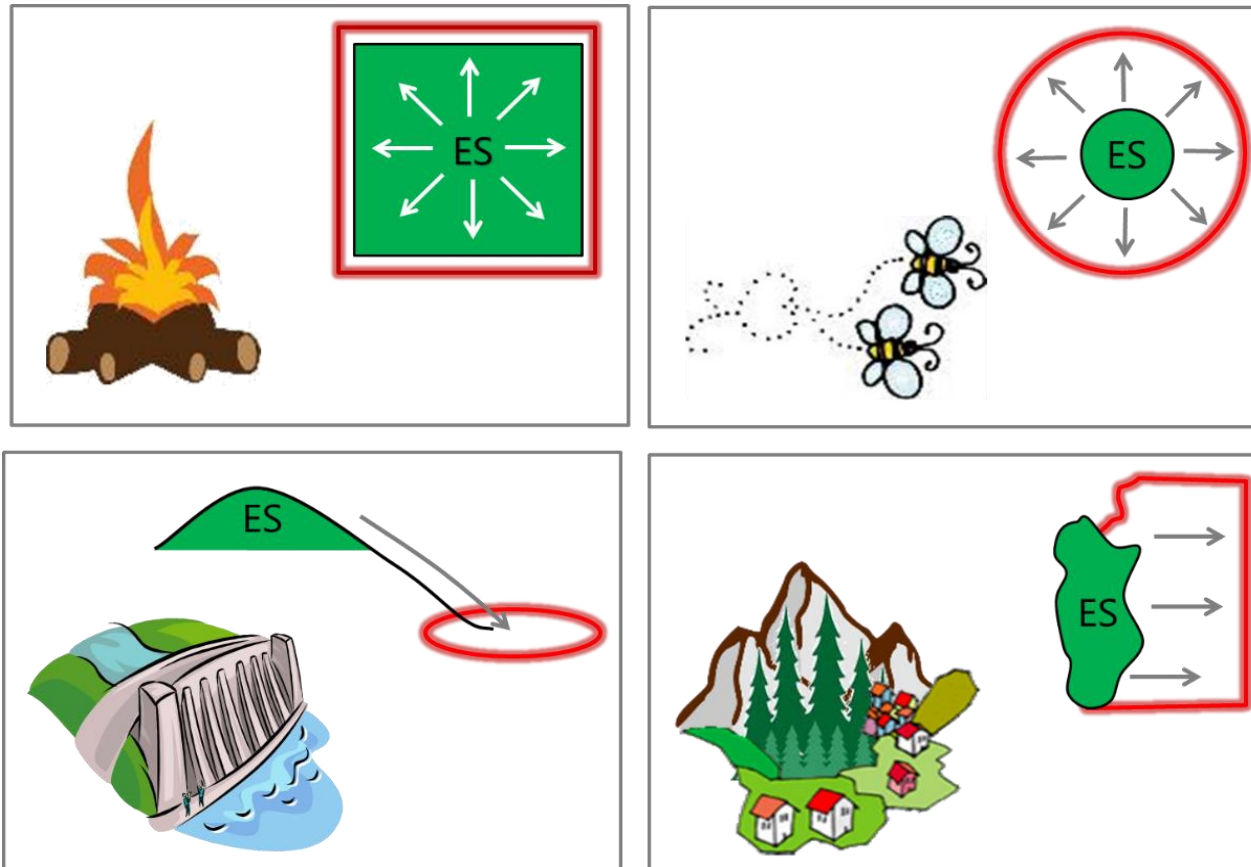
## Special characteristics of ecosystem services

Ecosystem services are difficult to assess, to quantify and to value because of spatial and temporal dynamics, their connectivity and complexity as well as trade-offs and synergies within ecosystem services

- Spatial dynamics
- Temporal dynamics
- Connectivity and complexity
- Trade offs and synergies

## Spatial dynamics

- There might be differences in where an ecosystem service is produced and where the benefits are experienced!





## Temporal dynamics

- Ecological conditions and processes can change in a dynamic way
- Societal preferences and needs can also change over time



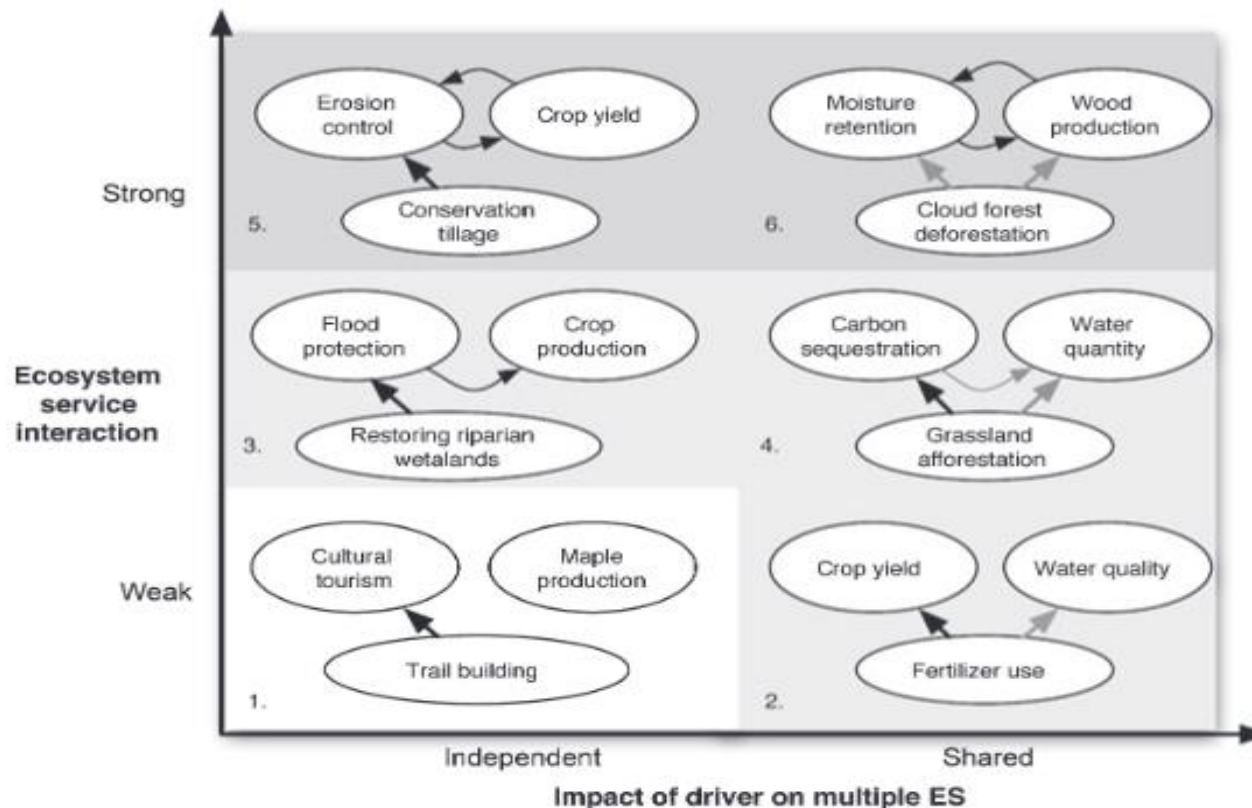
© GIZ



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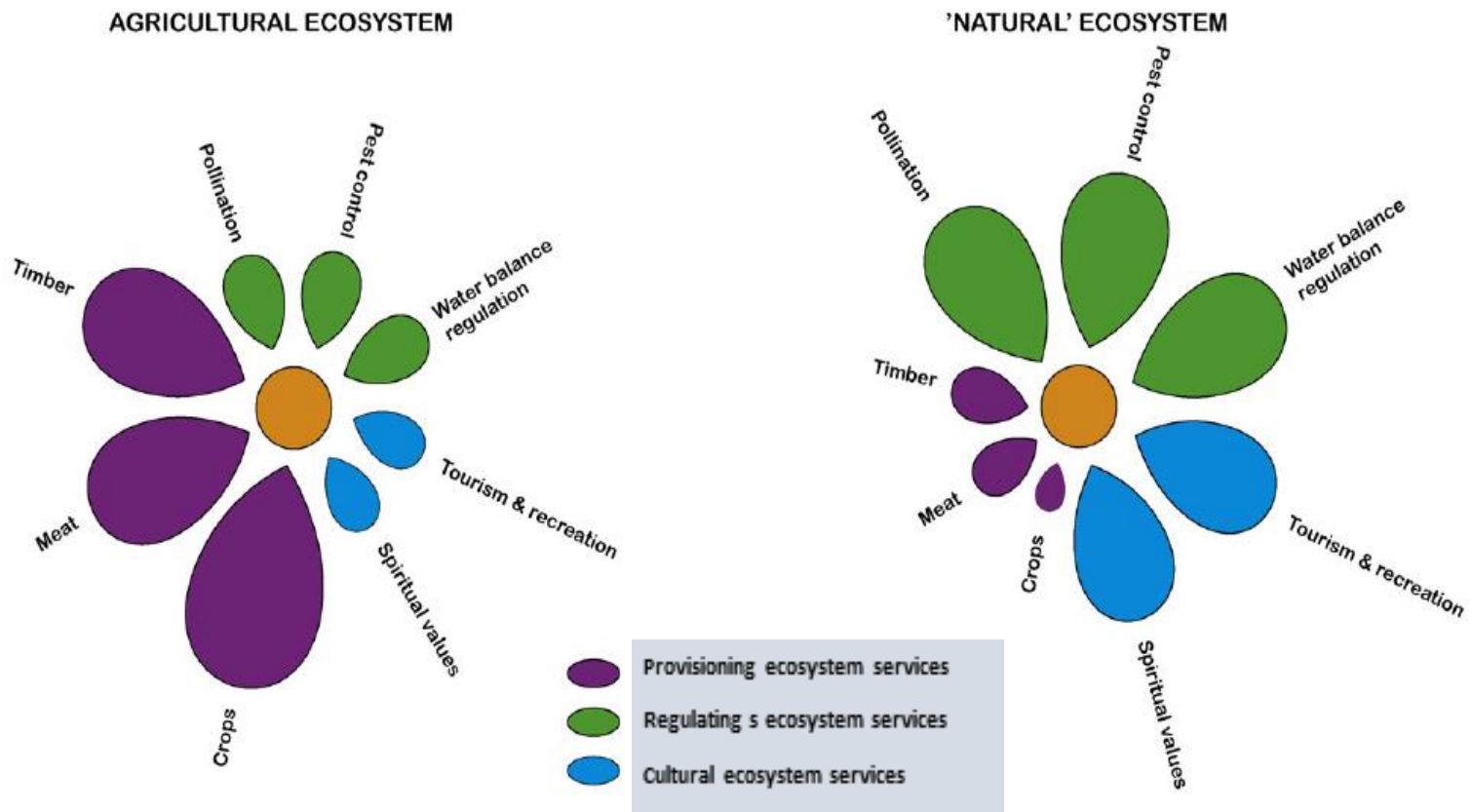
## Connectivity and complexity

- Changes in the ecosystem can affect services differently. Changes or impacts on one component may also affect other services. This makes ecosystems be very complex to understand and to assess

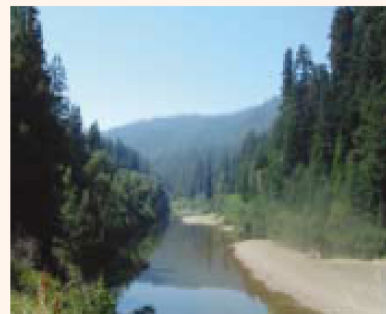
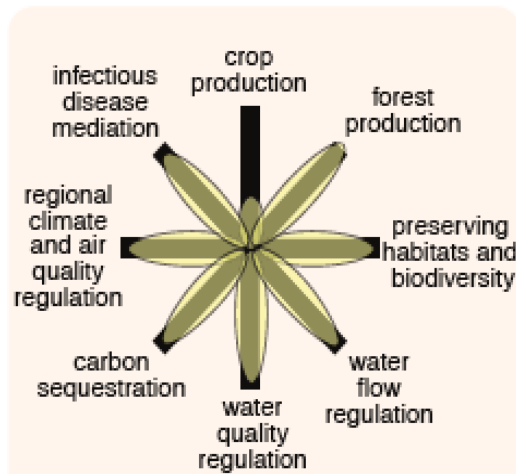


## Trade-offs and synergies

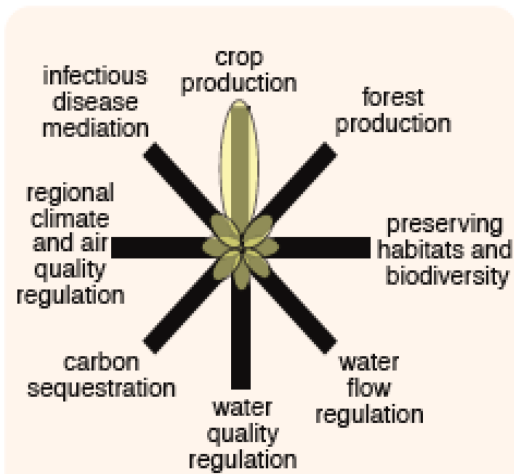
- The reduction of one ES might increase another ES and vice versa



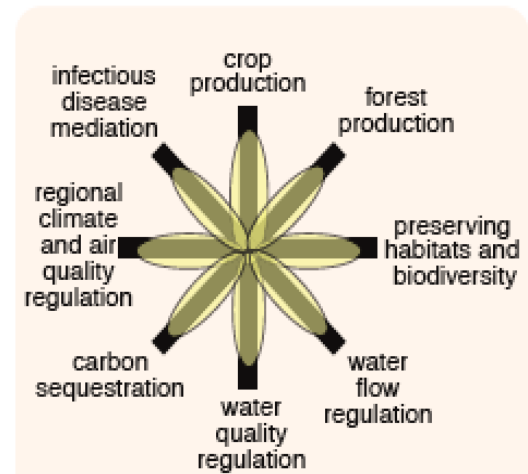
## Trade-offs and synergies



natural ecosystem



intensive cropland



cropland with restored ecosystem services

## Trade-offs and synergies

- Trade-offs have implications for distribution, equity and the interests of different stakeholders
- It is possible to create synergies and thereby win-win situations, where more of one ES creates multiple other ES and benefits!



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## Rivalry and excludability in goods and services

It is important to not only understand the function of the ecosystem dynamics, but also the social systems that interface with the respective goods and services

		<i>Is it possible to prevent consumers from having access to a good or service?</i>	
		<b>Excludable</b>	<b>Non-Excludable</b>
<i>Does the use of a good/service by someone reduce its availability for someone else?</i>	<b>Rival</b>	<b>Private goods:</b> <ul style="list-style-type: none"> <li>• Food</li> <li>• Timber</li> <li>• Coal/ore/iron</li> </ul>	<b>Common use goods:</b> <ul style="list-style-type: none"> <li>• Climate stability</li> <li>• Water</li> <li>• Fish stocks</li> </ul>
	<b>Non-rival</b>	<b>Club goods:</b> <ul style="list-style-type: none"> <li>• National park</li> <li>• EU</li> </ul>	<b>Public goods:</b> <ul style="list-style-type: none"> <li>• Oxygen</li> <li>• Mountains/forests</li> </ul>

© adapted from Emerton et al. 2018

## Identification and assessment of ecosystem services (ES)

The first three steps of an ELD study actually aim at identifying ecosystem services

- In the **inception phase** the scope, focus, spatial scale, and strategic purpose of the study are outlined and agreed upon with stakeholders who will be key in conceiving alternative (SLM) scenarios.
- **The second step** is the identification of **geographical characteristics** and the categorisation of agro-ecological zones.
- Mapping has **high potential to support understanding complex ecological systems and interrelations**. The assessment of the type of ecosystem services (step 3) bases on the identification of the ecological characteristics of different land cover types.

## Identification and assessment of ecosystem services

Important questions regarding the identification of ES are:

- Where are the ecosystems provided?
- Where are the benefits enjoyed?
- Where are administrative limits?
- What are barriers and boundaries?



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## Identification and assessment of ecosystem services

- With the help of maps, “**bundles**” of ecosystems can be identified in relationship to different land cover types
- The step also involves assessing the **type and state of ecosystems services stocks and flows** for each land cover category
- Mapping helps to **visualise and discuss the trade-offs** in terms of the use of ecosystems for different activities, so that environmental problems and conflicts are identified and solutions can be proposed
- ES assessments identify and measure the potential for the provision of ES in a specific political context and for specific beneficiaries.

*More information on the use of maps and on data sources are provided in the script!*

## Steps of an ecosystem service assessment

1. Analysis of key structures and processes of/within ecosystems
2. Understanding of ecosystem functions
3. Identification of service delivery
4. Potential supply of a service through an ecosystem
5. Potential (social) demand for a service

### Guiding questions:

- Which economic, social or cultural activities are relevant for people in the area?
- Which ES do these activities depend on or have an impact on?
- Which are the most relevant ES for the area and why?
- Which stakeholders carry out which activities and how are they dependent on the benefits of key ecosystem services?

## Selection of ecosystem services for assessment

A popular concept when assessing and prioritising ecosystem services is **dependencies and impacts**.

**Dependency** refers to the degree that an (economic or social) activity relies on a certain provided quantity or quality of a service, while **impact** means the degree to which an activity affects an ES negatively or positively or can cause a change in the provision of a given service.

Dependency-impact matrixes can help in the decision, but note that this is a qualitative approach to rank/prioritise services!

ECOSYSTEM SERVICES	DEVELOPMENT OF (ECONOMIC)ACTIVITIES IN AN AREA										SUM
	Meat an Dairy Production		Water Treatment Plant		Communal Tourism		Timber export		Cotton Production		
	Dep*	Imp*	Dep	Imp	Dep	Imp	Dep	Imp	Dep	Imp	
Water Regulation	1*	2	2	0	1	1	0	2	2	1	12
Provision of Raw Materials	0	1	0	0	1	0	2	2	0	1	7
Recreation	0	1	0	1	2	1	0	1	0	1	7
Soil Fertility	2	2	0	0	1	1	1	1	2	2	7
Soil Flexation	2	1	1	0	1	1	0	2	2	1	11
Sum Impacts & Dependencies	5	7	3	1	6	4	3	8	6	5	

\*Dep = Dependence, Imp = Impact, 0 = no connection/relevancy, 1 = minor connection, 2 = major connection

## Selection of ecosystem services for assessment

- To sum up, during screening and prioritising, key ES are identified and are linked to development, economic, social and cultural activities.
- They are then prioritised by looking at impacts and dependencies between services and activities or by applying other criteria.
- In addition, the main stakeholders that are involved in the activities are identified.
- This allows focusing on a few key activities and services for the assessment

*In the script you find a table with typical ecosystem services taken into account in ELD studies!*

## Further information and reading:

### Script for this module

### Videos:

Ecosystem services in brief (OPERAs project 2015):

<https://www.youtube.com/watch?v=Y2KdM9zoF8E>

### Further resources:

TEEB Synthesis Report on the economic contribution of biodiversity and ecosystem services to human well-being

<http://www.teebweb.org/our-publications/teeb-study-reports/synthesis-report/>

ValuES (2019) Integrating Ecosystem Services (IES) into Development Planning: Manual for trainers [http://www.aboutvalues.net/data/trainings/1\\_ies-manualtrainer.pdf](http://www.aboutvalues.net/data/trainings/1_ies-manualtrainer.pdf)

Mapping and Assessment of Ecosystems and their Services (MAES 2018)

[https://ec.europa.eu/environment/nature/knowledge/ecosystem\\_assessment/pdf/5th%20MAES%20report.pdf](https://ec.europa.eu/environment/nature/knowledge/ecosystem_assessment/pdf/5th%20MAES%20report.pdf)

A guide to selecting ecosystem service models for decision-making:  
Lessons from Sub-Saharan Africa

<https://www.espa.ac.uk/publications/guide-selecting-ecosystem-service-models-decision-making-lessons-sub-saharan-africa>

## Further information and reading:

ValuES (2018) Principles of Ecosystem Services Assessments for Policy Impacts: Elements, Methods, Tools and Tips: Manual for trainers and exercises

[http://www.aboutvalues.net/data/trainings/3\\_manual\\_principlesesav\\_low.pdf](http://www.aboutvalues.net/data/trainings/3_manual_principlesesav_low.pdf)

[http://www.aboutvalues.net/data/trainings/4\\_exercises\\_principles\\_of\\_esav\\_2018.pdf](http://www.aboutvalues.net/data/trainings/4_exercises_principles_of_esav_2018.pdf)

FAO 2017. Voluntary Guidelines for Sustainable Soil Management

<http://www.fao.org/3/a-bl813e.pdf>

The „4 per 1000“ initiative <https://www.4p1000.org/governance>

UNCCD: Science-Policy Brief 01 “Pivotal Soil Carbon”, November 2015

[https://knowledge.unccd.int/sites/default/files/2018-09/2015\\_PolicyBrief\\_SPI\\_ENG\\_0\\_0.pdf](https://knowledge.unccd.int/sites/default/files/2018-09/2015_PolicyBrief_SPI_ENG_0_0.pdf)

Sustainable Land Management contribution to successful land-based climate change adaptation and mitigation. A Report of the Science-Policy Interface. UNCCD

[https://www.unccd.int/sites/default/files/documents/2017-09/UNCCD\\_Report\\_SLM\\_web\\_v2.pdf](https://www.unccd.int/sites/default/files/documents/2017-09/UNCCD_Report_SLM_web_v2.pdf)

Agriculture production as a major driver of the Earth system exceeding planetary boundaries (Campbell et al. 2017)

[https://www.researchgate.net/publication/320356605\\_Agriculture\\_production\\_as\\_a\\_major\\_driver\\_of\\_the\\_Earth\\_system\\_exceeding\\_planetary\\_boundaries](https://www.researchgate.net/publication/320356605_Agriculture_production_as_a_major_driver_of_the_Earth_system_exceeding_planetary_boundaries)

Global conditions for the future of agriculture in the "Anthropocene"

<http://regardssurlaterre.com/en/global-conditions-future-agriculture-anthropocene>

Sustainability in global agriculture driven by organic farming (Eyhorn et al. Nature Sustainability)

[https://static1.squarespace.com/static/5aa6a1a19d5abb87c61a1225/t/5cb87bbd24a694fbfcb60eae/155594176681/NATSUSTAIN+Policy+Comment\\_OnlinePDF.pdf](https://static1.squarespace.com/static/5aa6a1a19d5abb87c61a1225/t/5cb87bbd24a694fbfcb60eae/155594176681/NATSUSTAIN+Policy+Comment_OnlinePDF.pdf)

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