System of Environmental Economic Accounting

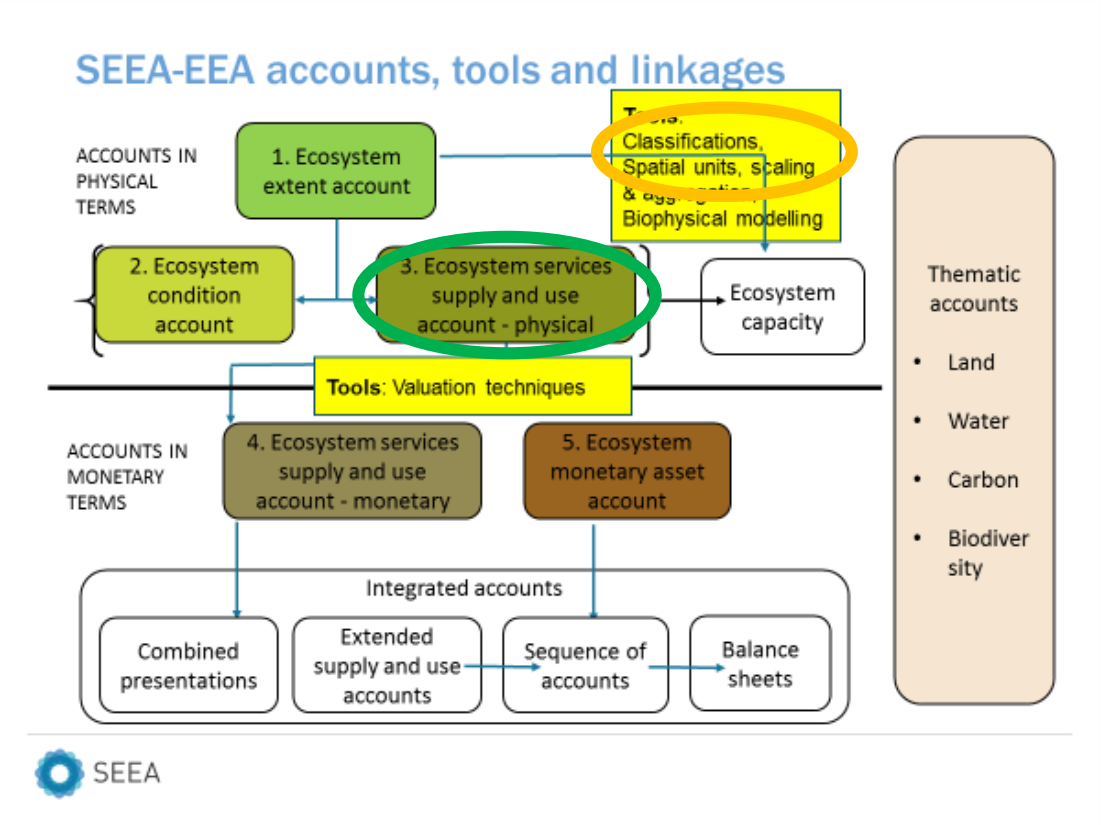
Supply and use of ecosystem services

United Nations

Outline

- Key concepts
- Classifications
- Exercise
- Data sources
- Integrated presentations
- Examples

Context

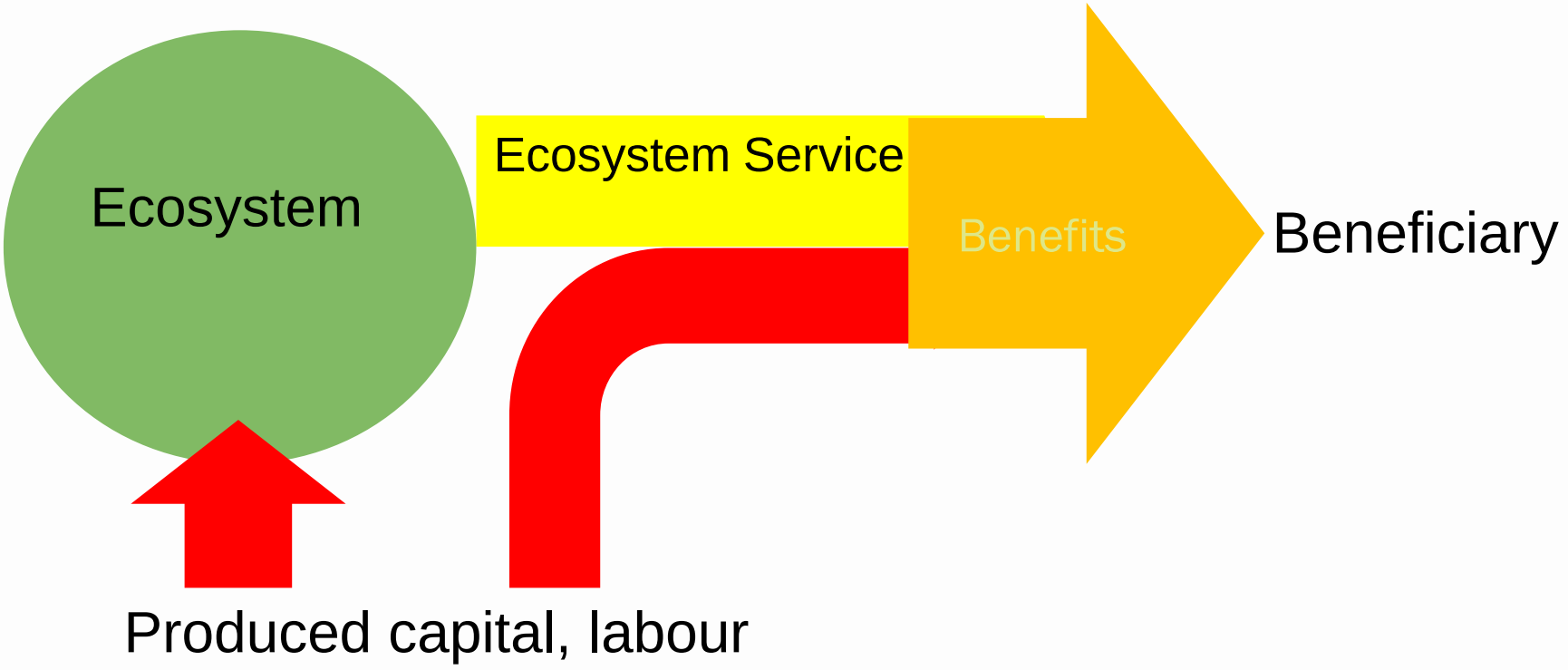

SEEA-EEA accounts, tools and linkages
ACCOUNTS IN PHYSICAL TERMS
1. Ecosystem extent account
Classifications,
Spatial units, scaling
Biophysical modelling
2. Ecosystem condition account
3. Ecosystem services supply and use account - physical
Ecosystem capacity
Thematic accounts
Land
Water
Carbon
Biodiversity
Tools: Valuation techniques
ACCOUNTS IN MONETARY TERMS
4. Ecosystem services supply and use account - monetary
5. Ecosystem monetary asset account
Integrated accounts
Combined presentations
Extended supply and use accounts
Sequence of accounts
Balance sheets
SEEA

Key Concepts

Ecosystem services

- **Ecosystem services: contribution of ecosystem to benefits used in economic and other human activity**
  - They are **not** equal to the benefits;
    - Avoid double counting
    - Need to calculate the contribution of ecosystems
  - ES treated as transactions:
    - National accounts: quadruple entry based system that registers transactions (i.e. flows of goods and money) occurring between statistical units (e.g. households, companies, etc.).
    - Each transaction can only be characterized by a single value (in physical or monetary units) i.e. supply of ES has to equal use
    - Valuation basis of the accounts (which are called exchange values), as it rules out consumer surplus.

Ecosystem services (are not benefits)



Ecosystem services are the contribution of ecosystems to benefits for people.

Ecosystem services

- **The SEEA-EEA focuses on "final" services**
  - Only when there is a beneficiary (or a user) of a service, there is a transaction between units;
  - The ecosystem accounting framework also supports recording flows of intermediate ecosystem services which (e.g. pollination) are flows of services between ecosystem assets
  - Ecosystem processes and functions are **not** final services
    - e.g., reproduction, predation, food web, nutrient cycle…
  - **Biodiversity** itself is not a "final" service
    - It is an aspect of **Ecosystem Condition** and is recorded in the **Biodiversity Account**.

Matching offer & demand to get supply & use

Crop pollination by wild insects

Wild insect pollinators

Pollination **POTENTIAL**

Pollinator-dependent crops

DEMAND for pollination

SEEA EEA accounting tables

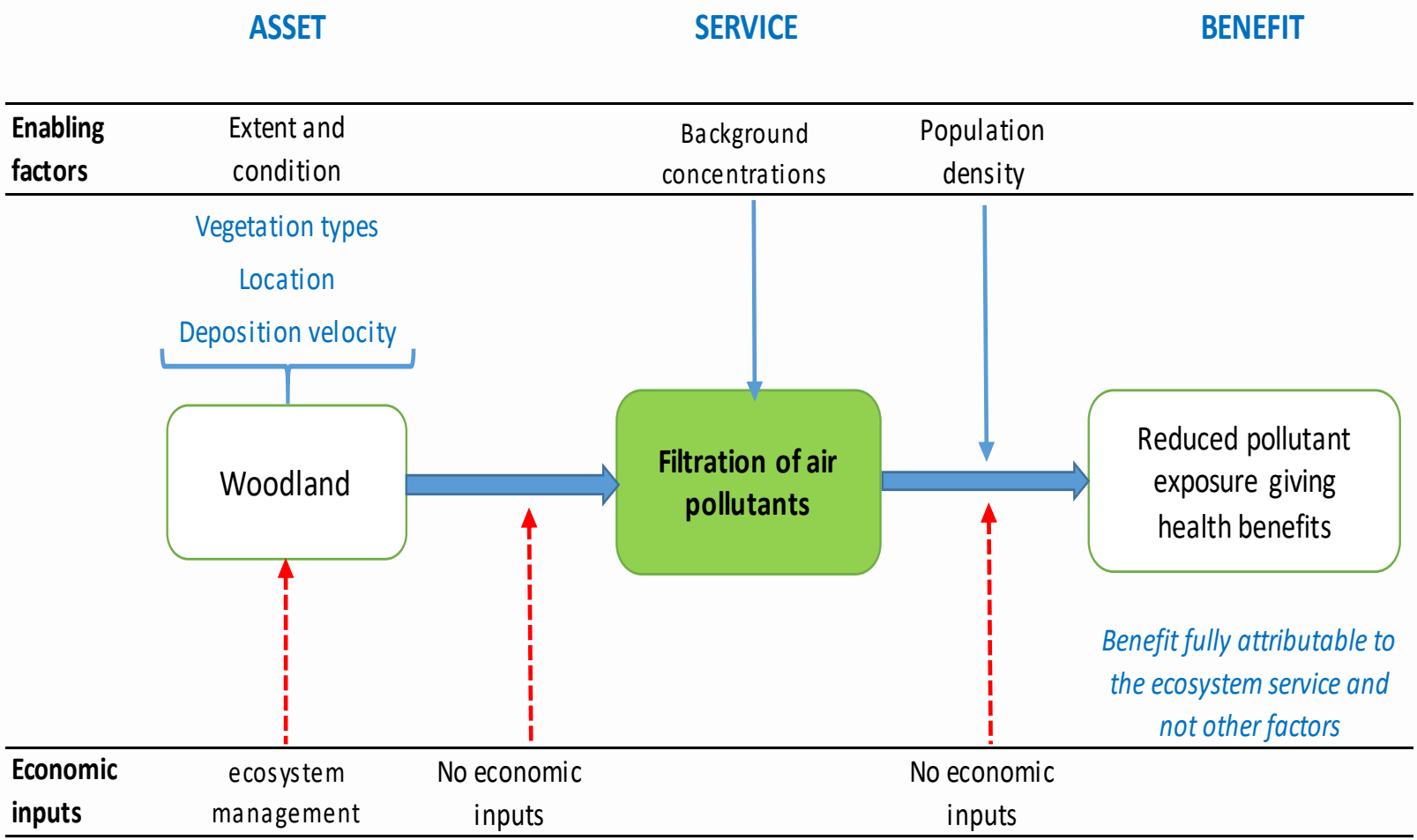
USE of crop pollination

BENEFIT

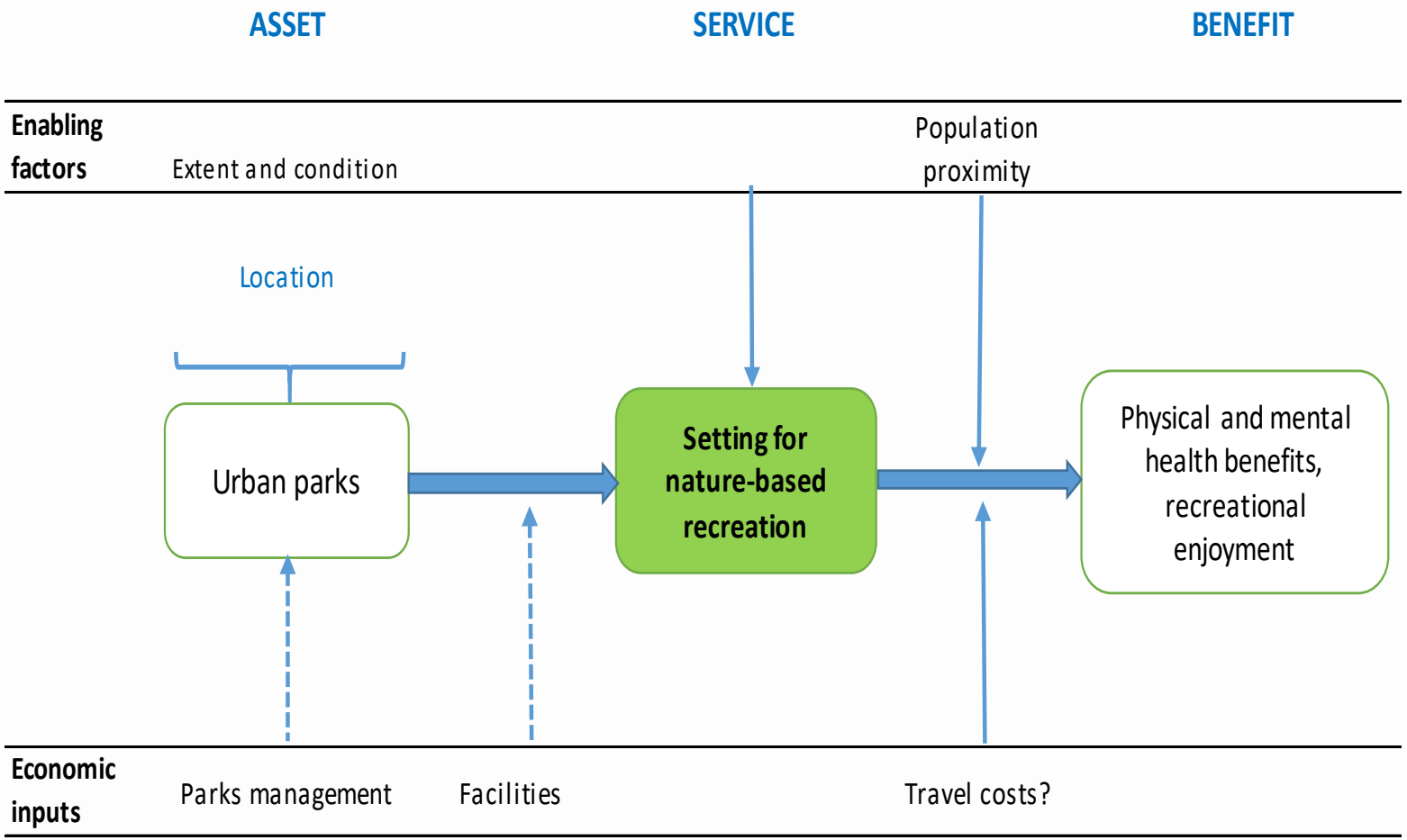
Types of Ecosystem Services

Provisioning Services	= goods that can be harvested from, or extracted from ecosystems	Example: providing fish for fisheries, or providing wood for timber harvest
Regulating Services	= the regulation of climate, hydrological, ecological and soil processes	Example: pollination, carbon sequestration, flood control
Cultural Services	= the non-material benefits provided by ecosystems	Example: recreation, tourism, providing a setting for cultural or religious practices

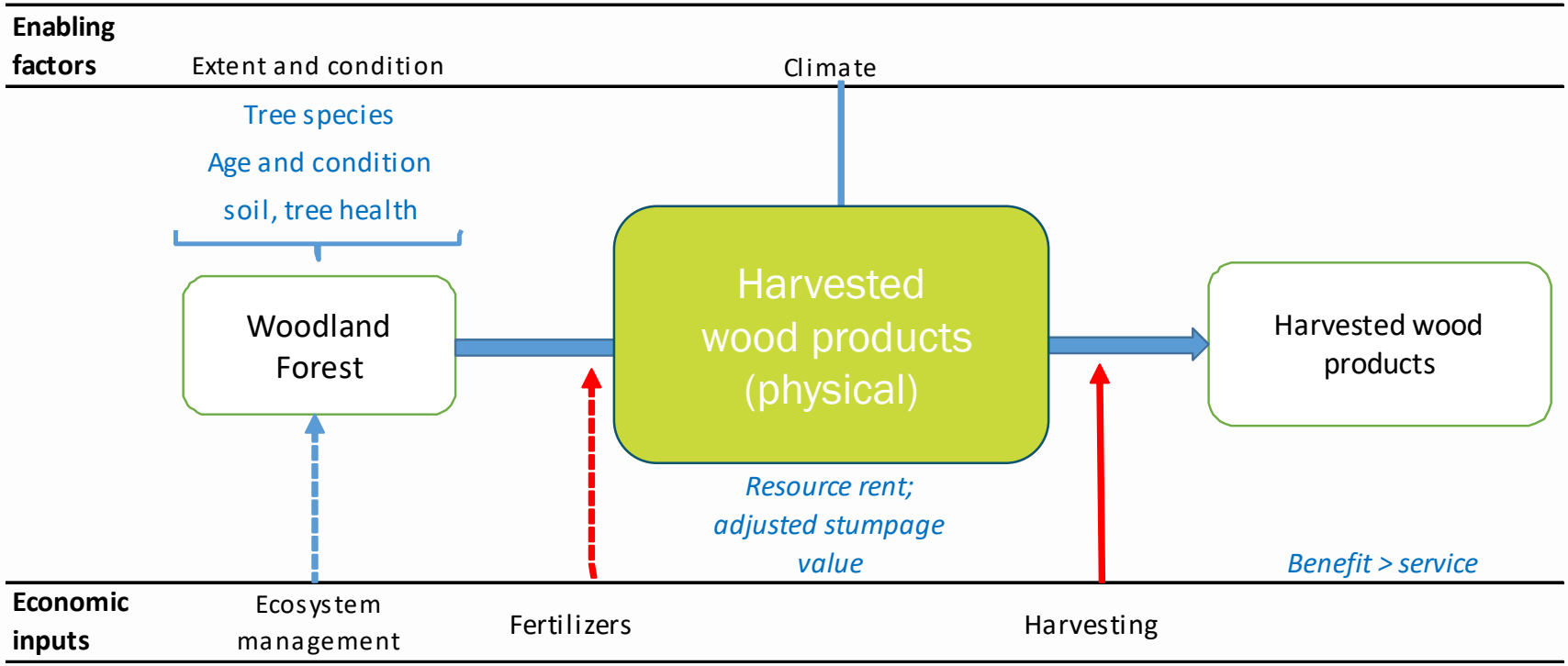
Logic chain – air filtration



Logic chain – nature tourism

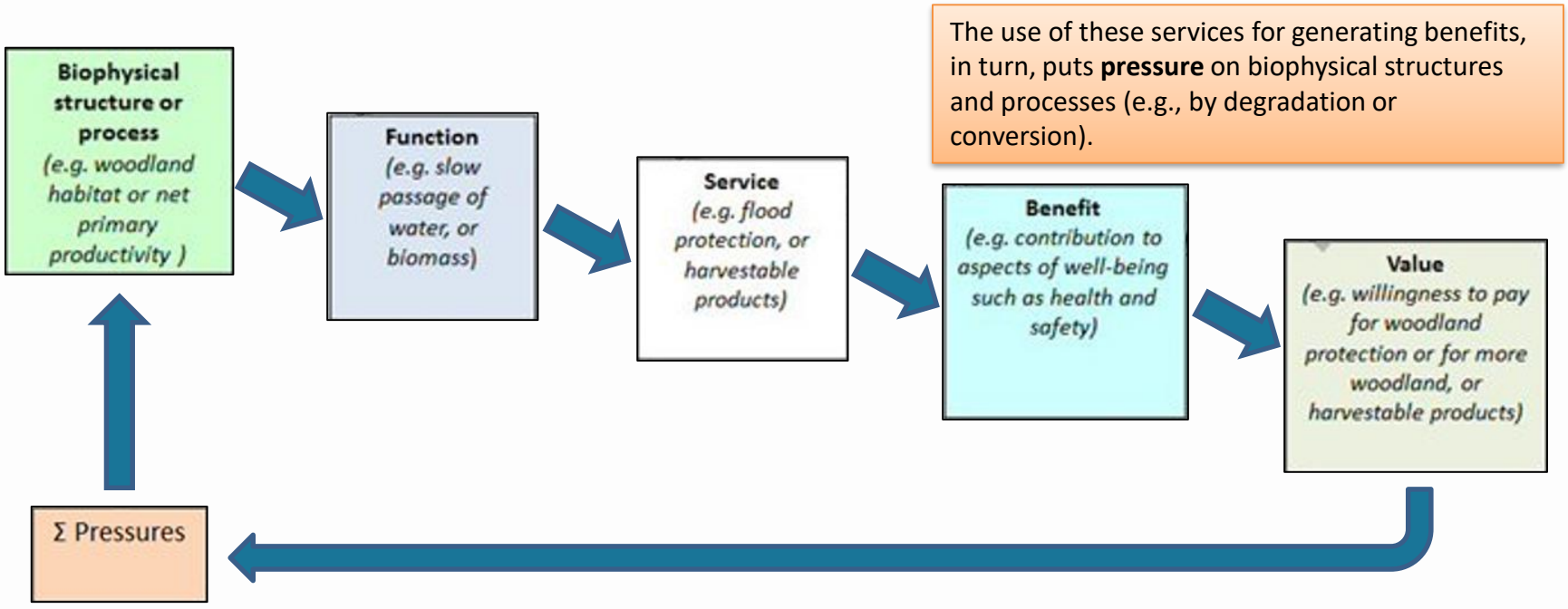


Logic chain - provisioning



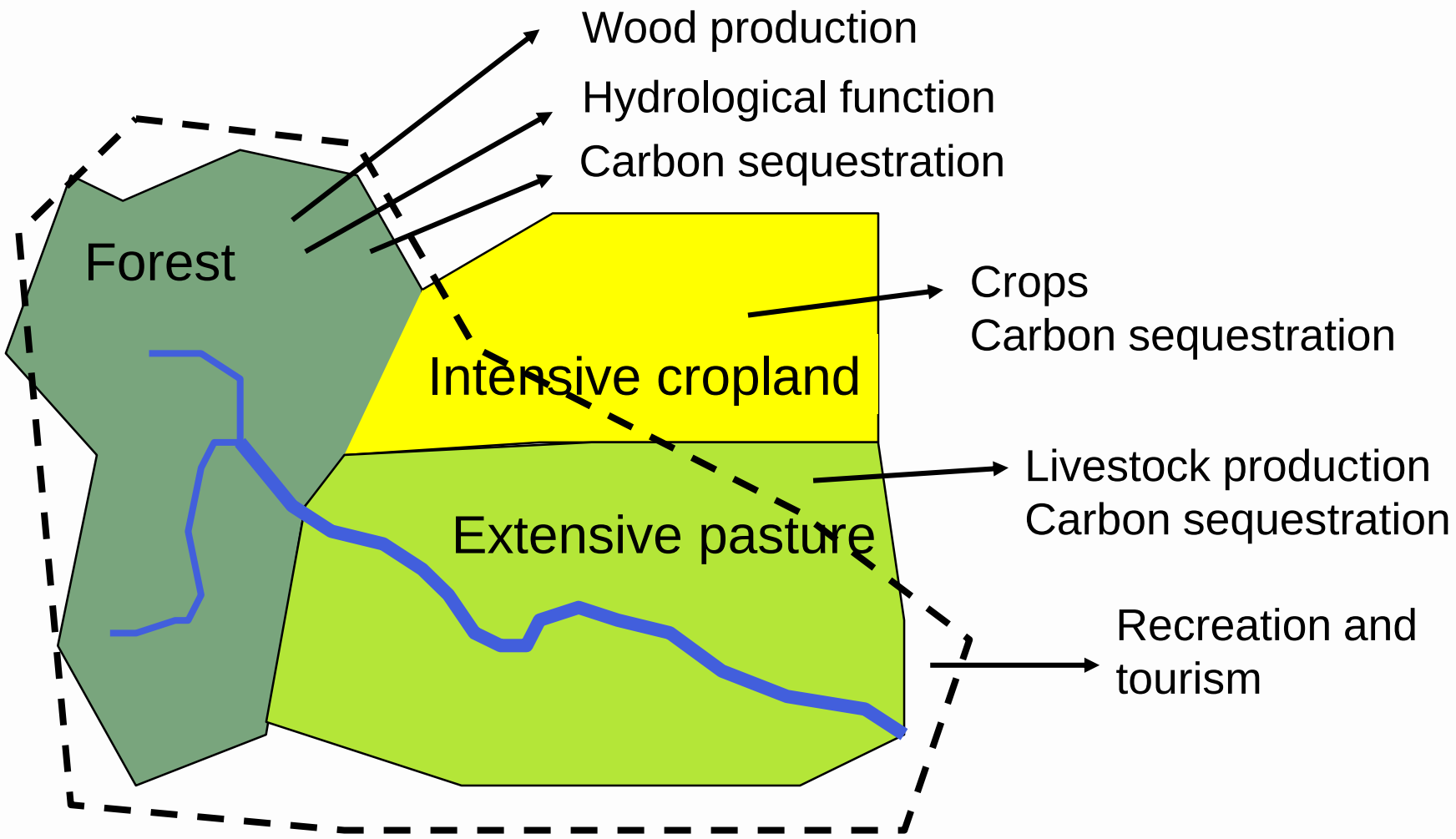
The Ecosystem Services Cascade

Ecosystem services are the contribution of ecosystems to benefits for people…



Source: Nottingham School of Geography

Ecosystem services and maps



Ecosystem services supply and use table

ECOSYSTEM SERVICES SUPPLY TABLE

	UNITS	Type of economic unit							Type of Ecosystem Unit															TOTAL SUPPLY
		Agriculture, forestry and fisheries	Electricity, gas supply	Water collection, treatment and supply	Other industries	Households	Accumulation	Rest of the world - Imports	Artificial surfaces	Herbaceous crops	Woody crops	Multiple or layered crops	Grassland	Tree-covered areas	Mangroves	Shrub-covered areas	Regularly flooded areas	Sparse natural vegetated areas	Terrestrial barren land	Permanent snow and glaciers	Inland water bodies	Coastal water and inter-tidal areas	Sea and marine areas	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15								
Ecosystem services Provisioning services Regulating services Cultural services		A							B															
Products		C							D															

ECOSYSTEM SERVICES USE TABLE

	UNITS	Type of economic unit							Type of Ecosystem Unit															TOTAL USE
		Agriculture, forestry and fisheries	Electricity, gas supply	Water collection, treatment and supply	Other industries	Households	Accumulation	Rest of the world - Exports	Artificial surfaces	Herbaceous crops	Woody crops	Multiple or layered crops	Grassland	Tree-covered areas	Mangroves	Shrub-covered areas	Regularly flooded areas	Sparse natural vegetated areas	Terrestrial barren land	Permanent snow and glaciers	Inland water bodies	Coastal water and inter-tidal areas	Sea and marine areas	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15								
Ecosystem services Provisioning services Regulating services Cultural services		E							F															
Products		G							H															

SEEA

Classifications

Classifications

- Need common and systematic classifications
  - SEEA CF provides classifications for:
    - Land Cover, Land Use, Land Ownership
    - Economic Units, Industry Sectors
  - Classifications principles:
    - Hierarchical
    - Mutually-exclusive
    - Collectively exhaustive
    - Possibility to develop concordance tables
  - Ecosystem accounts
    - Several classifications (or lists) of ecosystem services exist
    - Various classifications (or lists) of ecosystem types exist

Land cover

Land Cover

- From SEEA-CF (p.276)
- Uses FAO LCCS 3 (Food and Agriculture Organization – Land Cover Classification System v3) definitions
- High-level aggregate
- May adapt to local situations
- Used as basis (or proxy) for ecosystem type
- However, other possibilities are explored as well (revision process)

01 Artificial surfaces (including urban and associated areas)
02 Herbaceous crops
03 Woody crops
04 Multiple or layered crops
05 Grassland
06 Tree covered areas
07 Mangroves
08 Shrub covered areas
09 Shrubs and/or herbaceous vegetation, aquatic or regularly flooded
10 Sparsely natural vegetated areas
11 Terrestrial barren land
12 Permanent snow and glaciers
13 Inland water bodies
14 Coastal water bodies and inter-tidal areas

Land use

Land Use

- From SEEA-CF (p. 266)
- Detailed (4-digit level)

1.0 Land
- 1.1 Agriculture
- 1.2 Forestry
- 1.3 Aquaculture
- 1.4 Built up and related areas
- 1.5 Maintenance and restoration of environmental functions
- 1.6 Other uses of land
- 1.7 Land not in use

2.0 Inland waters
- 2.1 Aquaculture and holding facilities
- 2.2 Maintenance and restoration of environmental functions
- 2.3 Other uses of inland waters
- 2.4 Inland waters not in use

3.0 Coastal waters
- 3.1 Aquaculture and holding facilities
- 3.2 Maintenance and restoration of environmental functions
- 3.3 Other uses of coastal waters
- 3.4 Coastal waters not in use

4.0 Exclusive Economic Zone (EEZ)
- 4.1 Aquaculture and holding facilities
- 4.2 Maintenance and restoration of environmental functions
- 4.3 Other uses of coastal waters
- 4.4 Coastal waters not in use

Ecosystem services supply table
(focus on quadrant B)

Classification of ecosystem types

Classification of ecosystem services

	UNITS	Type of economic unit							Type of Ecosystem Unit														TOTAL SUPPLY
		Agriculture, forestry and fisheries	Electricity, gas supply	Water collection, treatment and supply	Other industries	Households	Accumulation	Rest of the world - Imports	Artificial surfaces	Herbaceous crops	Woody crops	Multiple or layered crops	Grassland	Tree-covered areas	Mangroves	Shrub-covered areas	Regularly flooded areas	Sparse natural vegetated areas	Terrestrial barren land	Permanent snow and glaciers	Inland water bodies	Coastal water and inter-tidal areas	Sea and marine areas	
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Ecosystem services Provisioning services Regulating services Cultural services		A							B														
Products		C							D														

SEEA

Classification of ecosystem services

Commonly used classifications / lists for ecosystem accounting

- Millennium Ecosystem Assessment (MEA 2005)
  - > TEEB is derived from this
- Common International Classification of Ecosystem Services (CICES)
  - > developed by the European Environment Agency
  - > available at https://cices.eu/
- Final Ecosystem Goods and Services Classification System (FEGS-CS) / National Ecosystem Services Classification System (NESCS)
  - > Developed by the US Environmental Protection Agency
  - > Available at https://www.epa.gov.
- Nature's Contribution to People
  - > Developed by IPBES

Costanza et al 1997

- List of

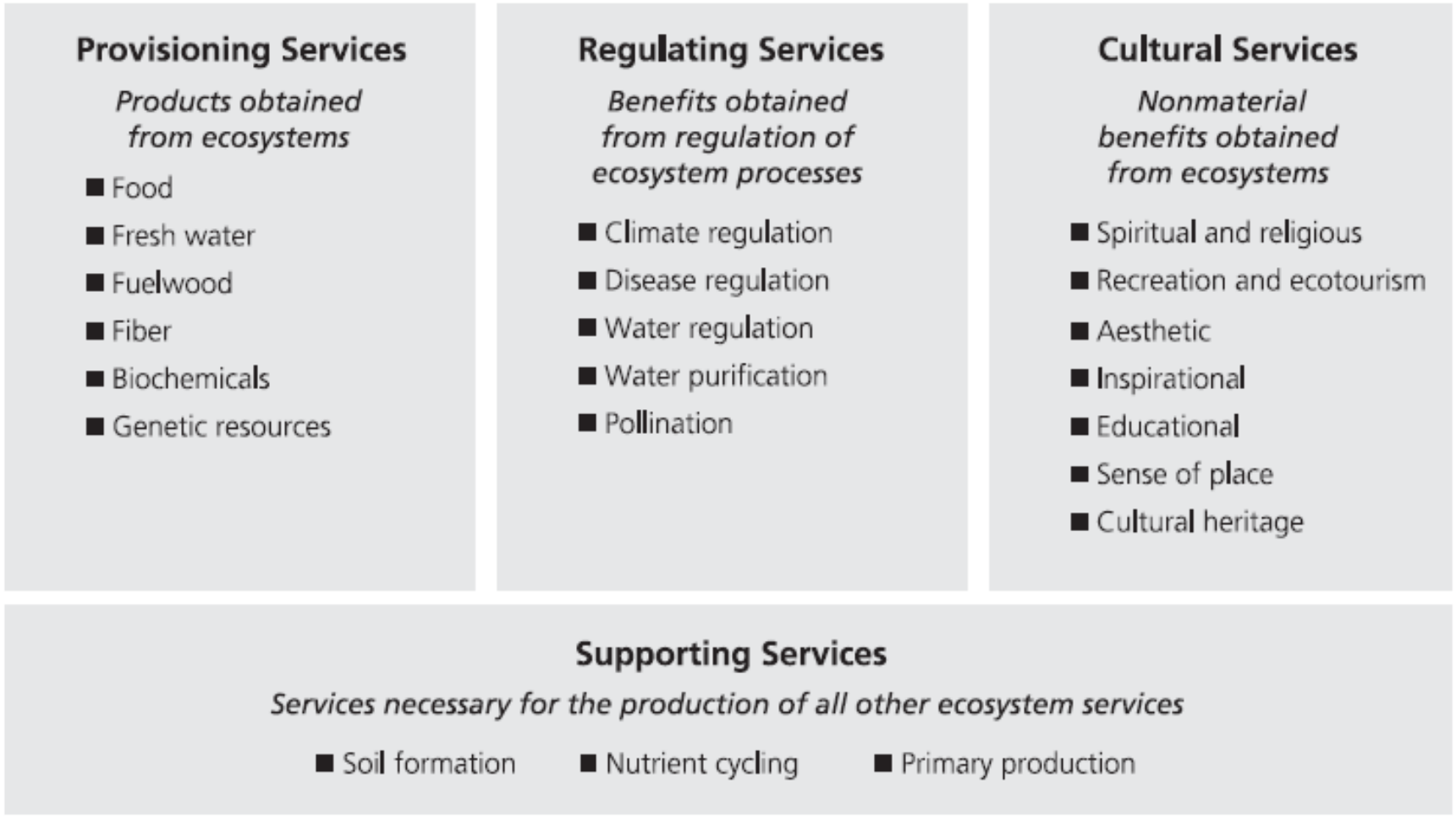
17 services

Table 1 Ecosystem services and functions used in this study

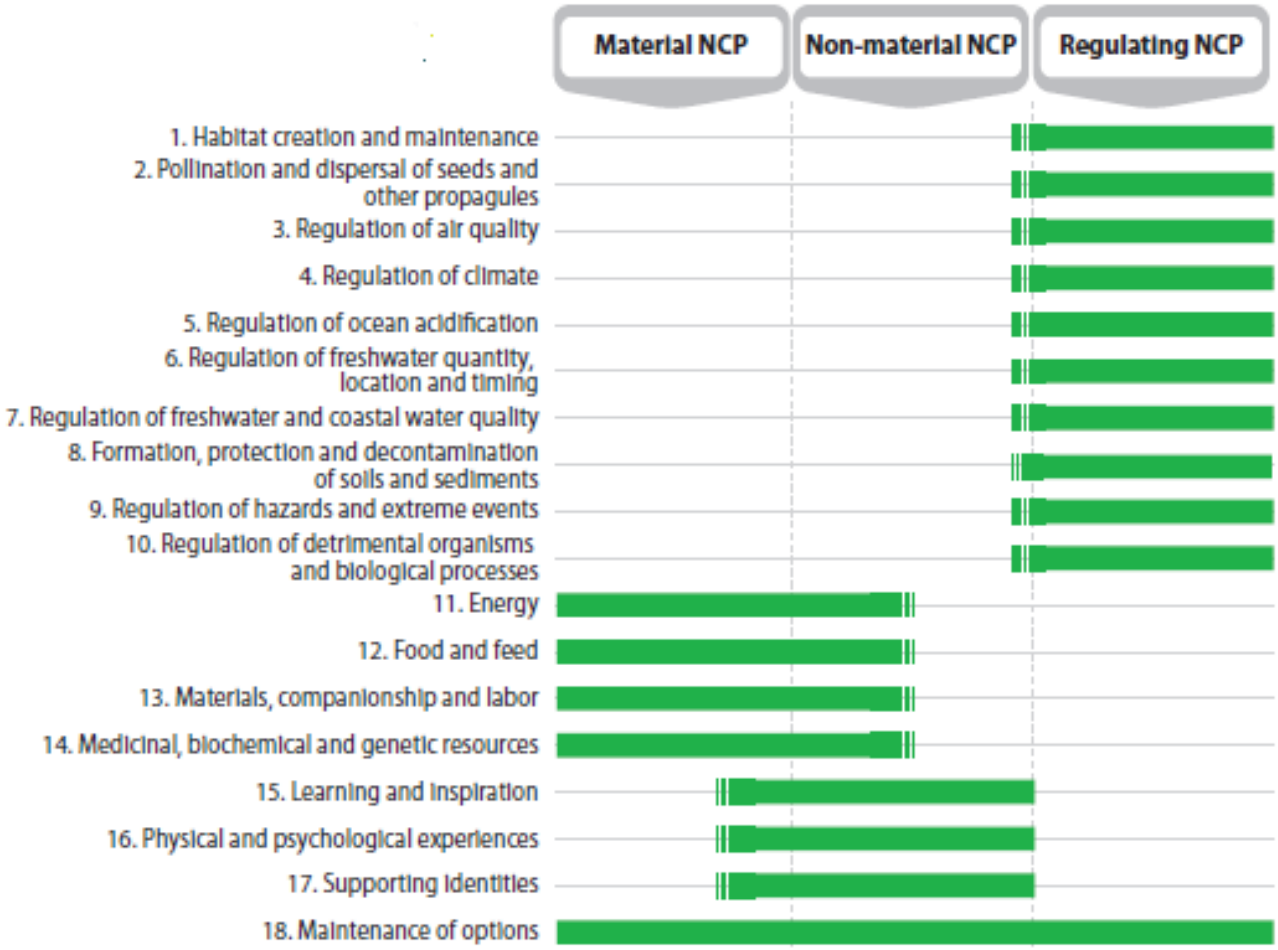
Number	Ecosystem service*	Ecosystem functions	Examples
1	Gas regulation	Regulation of atmospheric chemical composition.	CO_2/O_2 balance, O_3 for UVB protection, and SO_x levels.
2	Climate regulation	Regulation of global temperature, precipitation, and other biologically mediated climatic processes at global or local levels.	Greenhouse gas regulation, DMS production affecting cloud formation.
3	Disturbance regulation	Capacitance, damping and integrity of ecosystem response to environmental fluctuations.	Storm protection, flood control, drought recovery and other aspects of habitat response to environmental variability mainly controlled by vegetation structure.
4	Water regulation	Regulation of hydrological flows.	Provisioning of water for agricultural (such as irrigation) or industrial (such as milling) processes or transportation.
5	Water supply	Storage and retention of water.	Provisioning of water by watersheds, reservoirs and aquifers.
6	Erosion control and sediment retention	Retention of soil within an ecosystem.	Prevention of loss of soil by wind, runoff, or other removal processes, storage of stilt in lakes and wetlands.
7	Soil formation	Soil formation processes.	Weathering of rock and the accumulation of organic material.
8	Nutrient cycling	Storage, internal cycling, processing and acquisition of nutrients.	Nitrogen fixation, N, P and other elemental or nutrient cycles.
9	Waste treatment	Recovery of mobile nutrients and removal or breakdown of excess or xenic nutrients and compounds.	Waste treatment, pollution control, detoxification.
10	Pollination	Movement of floral gametes.	Provisioning of pollinators for the reproduction of plant populations.
11	Biological control	Trophic-dynamic regulations of populations.	Keystone predator control of prey species, reduction of herbivory by top predators.
12	Refugia	Habitat for resident and transient populations.	Nurseries, habitat for migratory species, regional habitats for locally harvested species, or overwintering grounds.
13	Food production	That portion of gross primary production extractable as food.	Production of fish, game, crops, nuts, fruits by hunting, gathering, subsistence farming or fishing.
14	Raw materials	That portion of gross primary production extractable as raw materials.	The production of lumber, fuel or fodder.
15	Genetic resources	Sources of unique biological materials and products.	Medicine, products for materials science, genes for resistance to plant pathogens and crop pests, ornamental species (pets and horticultural varieties of plants).
16	Recreation	Providing opportunities for recreational activities.	Eco-tourism, sport fishing, and other outdoor recreational activities.
17	Cultural	Providing opportunities for non-commercial uses.	Aesthetic, artistic, educational, spiritual, and/or scientific values of ecosystems.

SEEA

Millennium Ecosystem Assessment

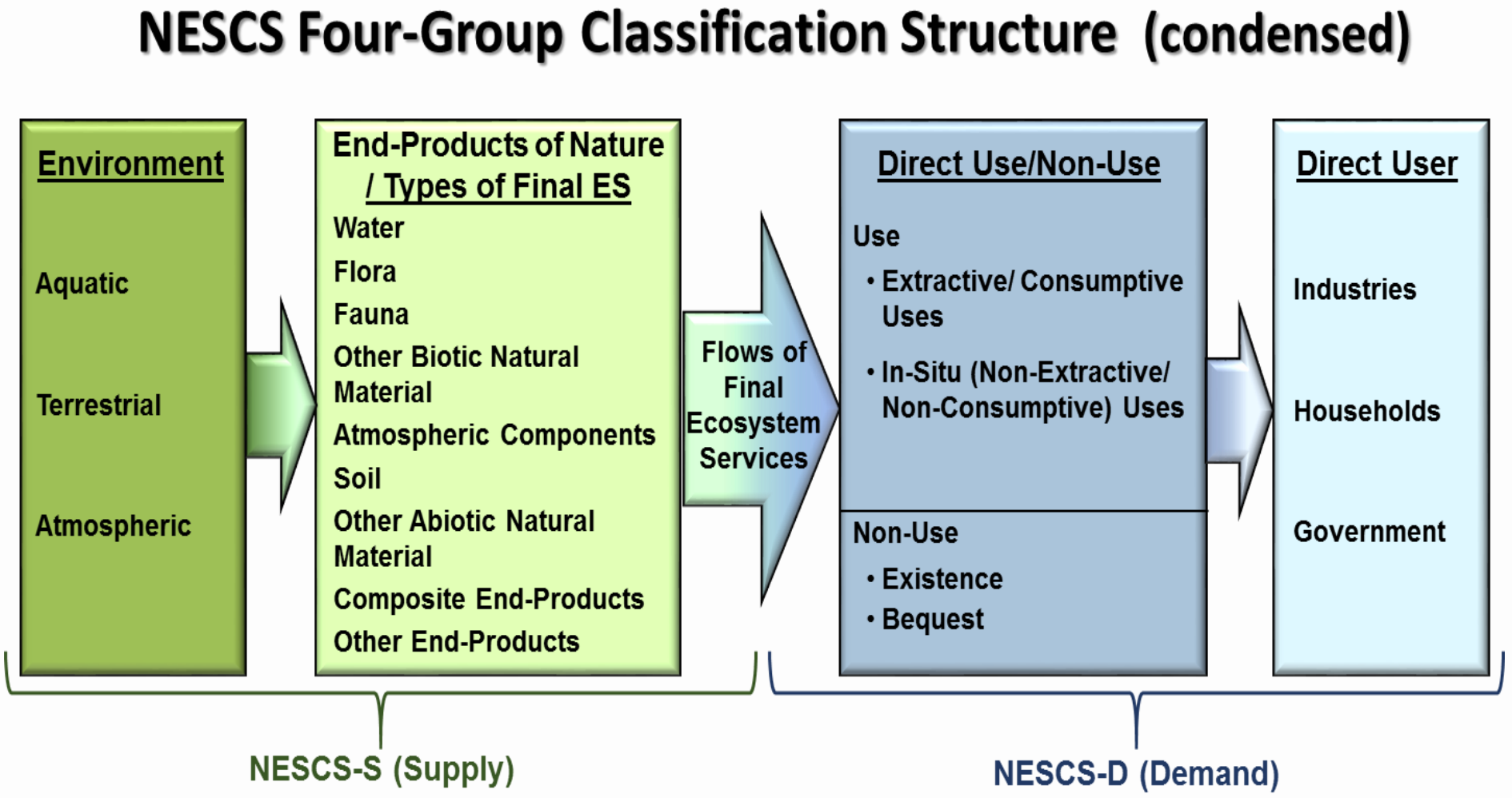


Nature's Contribution to People



SEEA

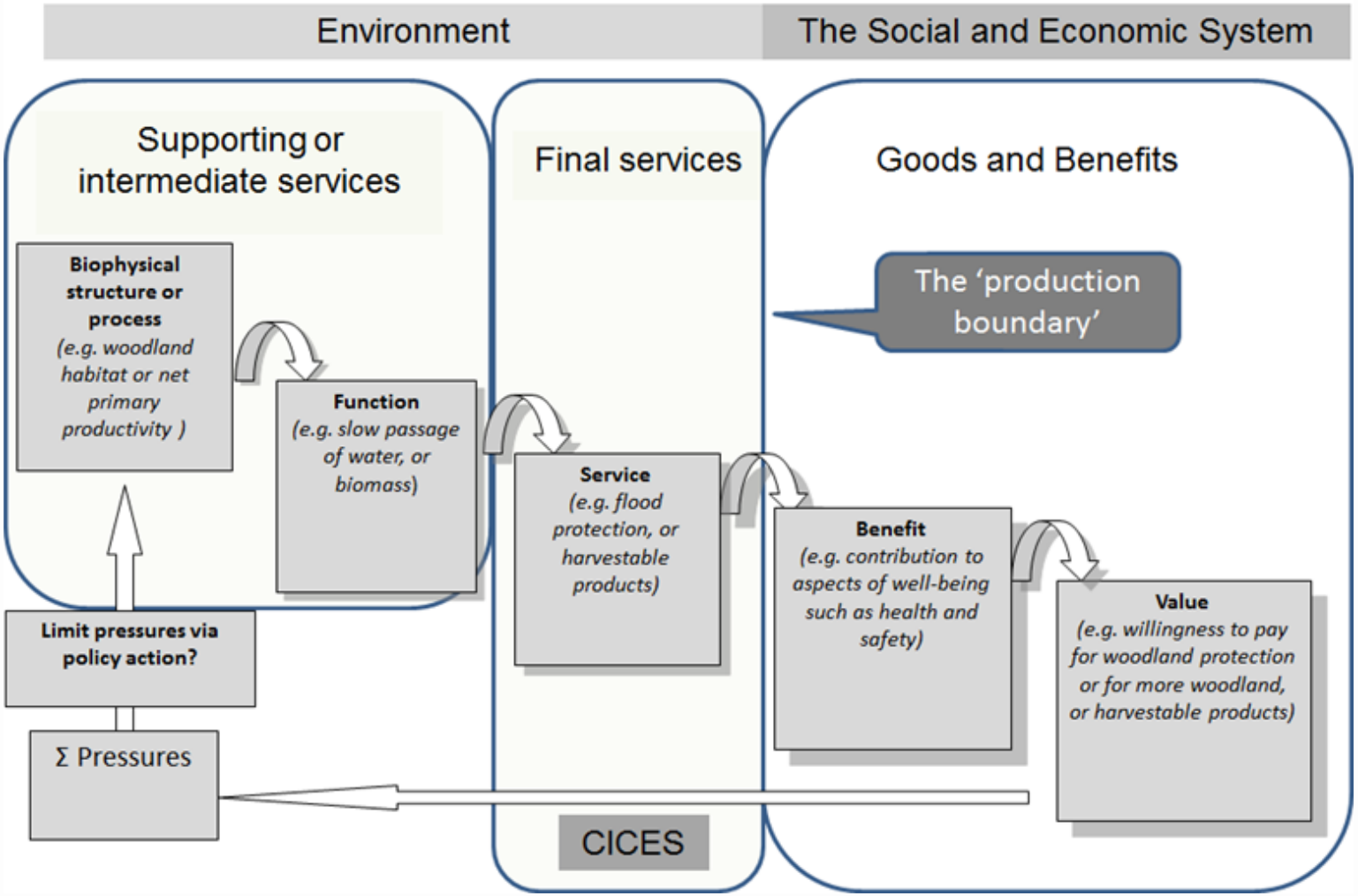
NESCS: Classification structure



SEEA

Source: United States Environmental Protection Agency (2015).*"National Ecosystem Services Classification System (NESCS): Framework Design and Policy Application "*

Common International Classification of Ecosystem Services (CICES)



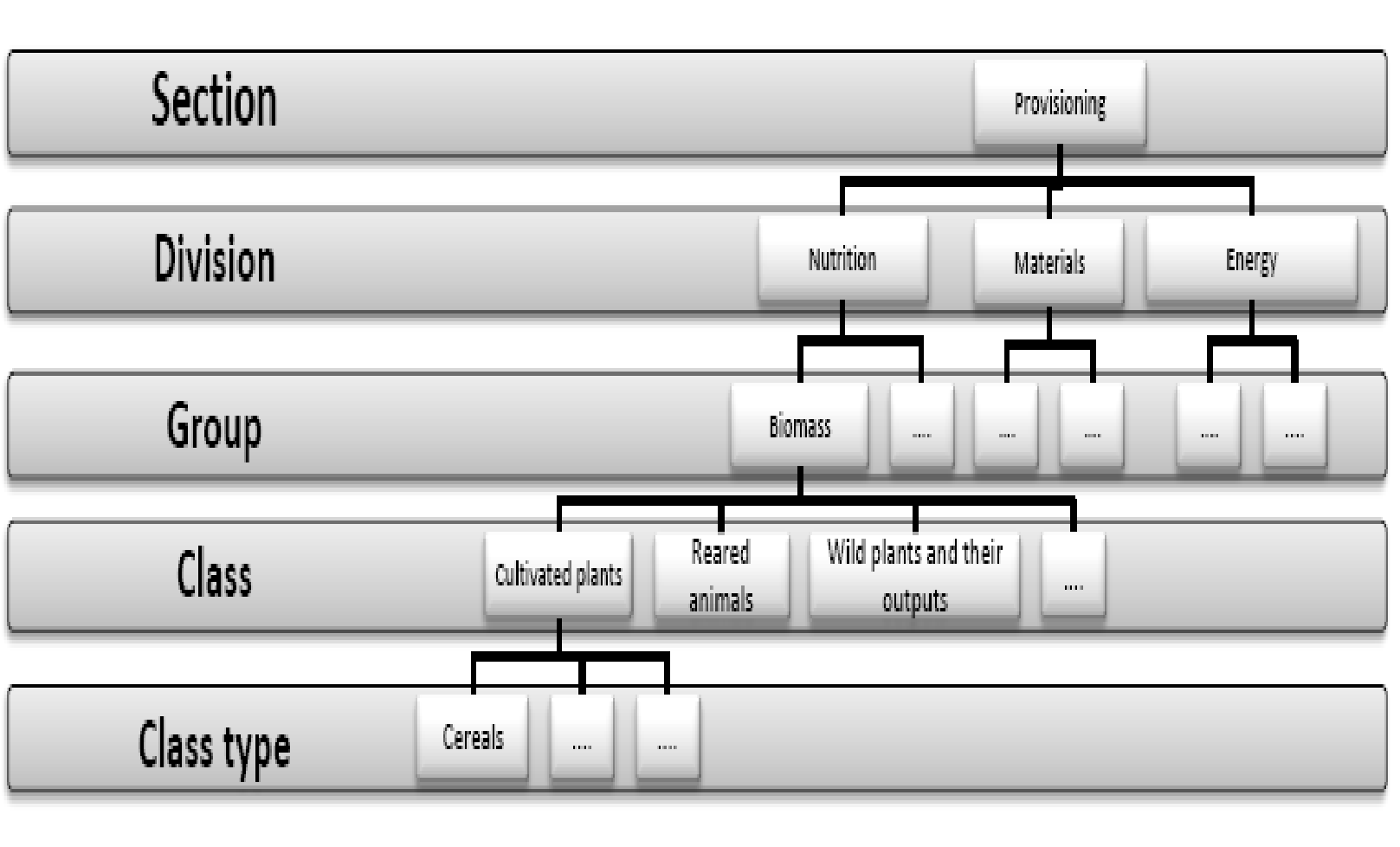
SEEA

Source: Haines-Young, R. and M.B. Potschin (2017): Common International Classification of Ecosystem Services (CICES) V5.0 and Guidance on the Application of the Revised Structure.

CICES: Scope and coverage

- Provisioning:
  - the nutritional, material and energetic contributions of living systems to essential human needs & economic activity
- Regulation and maintenance:
  - ways in which living organisms can mediate or moderate the ambient environment that affects human quality of life, safety and production systems
- Cultural:
  - the non-material, and normally non-consumptive, outputs of ecosystems that affect the physical and mental well being of people
- Does not include "supporting" or "intermediate" services (= ecosystem functions)
- Classification system (4-digit)

CICES: Structure



SEEA

Source: Haines-Young, R. and M.B. Potschin (2017): Common International Classification of Ecosystem Services (CICES) V5.0 and Guidance on the Application of the Revised Structure.

Provisioning services

Division	Group	Class	Code
Nutrition	Biomass	Cultivated plants (Terrestrial), fungi, algae and their outputs	1.1.1.1
	Biomass	Reared animals (Terrestrial) and their outputs	1.1.1.2
	Biomass	Wild plants, fungi, algae and their outputs [both terrestrial and aquatic]	1.1.1.3
	Biomass	Wild animals and their outputs [both terrestrial and aquatic]	1.1.1.4
	Biomass	Plants and algae from in-situ aquaculture	1.1.1.5
	Biomass	Animals from in-situ aquaculture	1.1.1.6
Materials	Biomass	Fibres and other materials from cultivated plants, fungi, algae and bacteria for direct use or processing	1.2.1.1
	Biomass	Fibres and other materials from reared animals for direct use or processing	1.2.1.2
	Biomass	Genetic materials from all biota	1.2.1.3
	Biomass	Fibres and other materials from wild plants, fungi, algae and bacteria for direct use or processing	1.2.1.4
	Biomass	Fibres and other materials from wild animals for direct use or processing	1.2.1.5
Energy	Biomass	Cultivated plant-based materials used as an energy source (including materials derived from algae)	1.3.1.1
	Biomass	Reared Animal-based materials used as an energy source	1.3.1.2
	Biomass	Mechanical energy provided by animals	1.3.1.3
	Biomass	Wild plants, fungi, algae used as an energy source [both terrestrial and aquatic]	1.3.1.4
	Biomass	Material derived from wild animals used as an energy source	1.3.1.5

Regulation & Maintenance services

Division	Group	Class	Code
Transformation of biochemical or physical inputs to ecosystems	Mediation of wastes or toxic substances of anthropogenic origin by living processes	Bio-remediation by micro-organisms, algae, plants, and animals	2.1.1.1
		Filtration/sequestration/storage/accumulation by micro-organisms, algae, plants, and animals	2.1.1.2
	Mediation of nuisances of anthropogenic origin	Smell reduction	2.1.2.1
		Noise attenuation	2.1.2.2
		Visual screening	2.1.2.3
Regulation of physical, chemical, biological conditions	Regulation of baseline flows and extreme events	Mass stabilisation and control of erosion rates	2.2.1.1
		Buffering and attenuation of mass flows	2.2.1.2
		Hydrological cycle and water flow regulation (Including flood control)	2.2.1.3
		Storm protection	2.2.1.4
		Fire protection	2.2.1.5
	Lifecycle maintenance, habitat and gene pool protection	Pollination (or 'gamete' dispersal in a marine context)	2.2.2.1
		Seed dispersal	2.2.2.2
		Maintaining nursery populations and habitats (Including gene pool protection)	2.2.2.3
	Pest and disease control	Pest control (including invasive species)	2.2.3.1
		Disease control	2.2.3.2
	Regulation of soil quality	Weathering processes and their effect on soil quality	2.2.4.1
		Decomposition and fixing processes and their effect on soil quality	2.2.4.2
	Water conditions	Regulation of the chemical condition of freshwaters by living processes	2.2.5.1
		Regulation of the chemical condition of salt waters by living processes	2.2.5.2
	Atmospheric composition and conditions	Regulation of chemical composition of atmosphere	2.2.6.1
		Regulation of temperature and humidity, including ventilation and transpiration	2.2.6.2

SEEA

Cultural services

Division	Group	Class	Code
Direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting	Physical and experiential interactions with natural environment	Characteristics of living systems that that enable activities promoting health, recuperation or enjoyment through active or immersive interactions	3.1.1.1
		Characteristics of living systems that enable activities promoting health, recuperation or enjoyment through passive or observational interactions	3.1.1.2
	Intellectual and representative interactions with natural environment	Characteristics of living systems that enable scientific investigation or the creation of traditional ecological knowledge	3.1.2.1
		Characteristics of living systems that enable education and training	3.1.2.2
		Characteristics of living systems that are resonant in terms of culture or heritage	3.1.2.3
		Characteristics of living systems that enable aesthetic experiences	3.1.2.4
Indirect, remote, often indoor interactions with living systems that do not require presence in the environmental setting	Spiritual, symbolic and other interactions with natural environment	Elements of living systems that have symbolic meaning	3.2.1.1
		Elements of living systems that have sacred or religious meaning	3.2.1.2
		Elements of living systems used for entertainment or representation	3.2.1.3
	Other biotic characteristics that have a non-use value	Characteristics or features of living systems that have an existence value	3.2.2.1
		Characteristics or features of living systems that have an bequest value	3.2.2.2

Key requirements of ES Classification for SEEA EEA

- The measurement scope and definition of ecosystem services in the SEEA EEA is defined in the context of the SNA production boundary.
- Distinction between ecosystem services and the benefits to which they contribute.
- Focus on final ecosystem services as contributions to the production of benefits.
- For each (final) ecosystem service there must be an associated (and distinct) benefit
- Individual services are mutually exclusive and can be aggregated.
- The various classifications that are relevant for ecosystem accounting can be linked
  - Ecosystem types (presently missing/not well developed)
  - Ecosystem services
- Important topic (WG 1 of the SEEA EEA revision process)

Exercise

Provisioning services

Food: Ecosystems provide the conditions for growing food. Food comes principally from managed agro-ecosystems but marine and freshwater systems or forests also provide food for human consumption. Wild foods from forests are often underestimated.

Raw Materials: Ecosystems provide a great diversity of materials for construction and fuel including wood, biofuels and plant oils that are directly derived from wild and cultivated plant species.

Fresh water: Ecosystems play a vital role in the global hydrological cycle, as they regulate the flow and purification of water. Vegetation and forests influence the quantity of water available locally.

Medicinal resources: Ecosystems and biodiversity provide many plants used as traditional medicines as well as providing the raw materials for the pharmaceutical industry. All ecosystems are a potential source of medicinal resources.

Regulating services

Local climate and air quality: Trees provide shade whilst forests influence rainfall and water availability both locally and regionally. Trees or other plants also play an important role in regulating air quality by removing pollutants from the atmosphere.

Carbon sequestration and storage: Ecosystems regulate the global climate by storing and sequestering greenhouse gases. As trees and plants grow, they remove carbon dioxide from the atmosphere and effectively lock it away in their tissues. In this way forest ecosystems are carbon stores. Biodiversity also plays an important role by improving the capacity of ecosystems to adapt to the effects of climate change.

Moderation of extreme events: Extreme weather events or natural hazards include floods, storms, tsunamis, avalanches and landslides. Ecosystems and living organisms create buffers against natural disasters, thereby preventing possible damage. For example, wetlands can soak up flood water.

Waste-water treatment: Ecosystems such as wetlands filter both human and animal waste and act as a natural buffer to the surrounding environment. Through the biological activity of microorganisms in the soil, most waste is broken down. Thereby pathogens (disease causing microbes) are eliminated, and the level of nutrients and pollution is reduced.

Erosion prevention and maintenance of soil fertility: Soil erosion is a key factor in the process of land degradation and desertification. Vegetation cover provides a vital regulating service by preventing soil erosion. Soil fertility is essential for plant growth and agriculture. etc

Pollination: Insects and wind pollinate plants and trees which is essential for the development of fruits, vegetables and seeds. Animal pollination is an ecosystem service mainly provided by insects but also by some birds and bats. Some 87 out of the 115 leading global food crops depend upon animal pollination including important cash crops such as cocoa and coffee (Klein et al. 2007).

Biological control: Ecosystems are important for regulating pests and vector borne diseases that attack plants, animals and people. Ecosystems regulate pests and diseases through the activities of predators and parasites. Birds, bats, flies, wasps, frogs and fungi all act as natural controls.

Habitat or supporting services

Habitats for species: Habitats provide everything that an individual plant or animal needs to survive: food; water; and shelter. Each ecosystem provides different habitats that can be essential for a species' lifecycle. Migratory species including birds, fish, mammals and insects all depend upon different ecosystems during their movements.

Maintenance of genetic diversity: Genetic diversity is the variety of genes between and within species populations. Genetic diversity distinguishes different breeds or races from each other thus providing the basis for locally well-adapted cultivars and a gene pool for further developing commercial crops and livestock.

Cultural Services

Recreation and mental and physical health: Walking and playing sports in green space is not only a good form of physical exercise but also lets people relax. The role that green space plays in maintaining mental and physical health is increasingly being recognized, despite difficulties of measurement.

Tourism: Ecosystems and biodiversity play an important role for many kinds of tourism which in turn provides considerable economic benefits and is a vital source of income for many countries. In 2008 global earnings from tourism summed up to US$ 944 billion.

Aesthetic appreciation and inspiration for culture, art and design: Language, knowledge and the natural environment have been intimately related throughout human history. Biodiversity, ecosystems and natural landscapes have been the source of inspiration for much of our art, culture and increasingly for science..

Spiritual experience and sense of place: In many parts of the world natural features such as specific forests, caves or mountains are considered sacred or have a religious meaning. Nature is a common element of all major religions and traditional knowledge, and associated customs are important for creating a sense of belonging.

Exercise

- In your country (or region), what are three important ecosystem services that should be included in a Services Supply Account?
- Which ecosystems (types) supply them?
- What national data are available in your country on the supply of these services?
- What is the main policy interest in looking at these services?

Exercise

- Concepts Group exercise (15m)
- Group reports
  - The **ecosystem services** you selected
  - The main land cover types for each
  - Are **national data** available in your country on the supply of these services?
- Discussion
  - What other ecosystem services would be important to measure?
  - On what topic might a special survey be used to fill priority data gaps?

Integrated presentations

Combined presentations

- Tables that support the presentation of information from a variety of sources in a manner that facilitates comparison between economic and environmental data.
  - > Possible because of common classifications and accounting principles.
  - > Well-known is decoupling graphs, indicators on resource productivity / intensity
- Two examples in ecosystem accounting:
  - > (i) combine changes in condition with expenditure on environmental protection on those assets; and
  - > (ii) information on flows of ecosystem services generated by an ecosystem asset combined with information on economic activity associated with that asset

Extended supply and use accounts

- Augmented SUA present information on the supply and use of ecosystem services as extensions to the standard SNA SUA.
  - > Ecosystem accounting -> extension to the production boundary
  - > Additional rows for ES (as set of products within scope of the SUA is broader and hence the size)
  - > Additional columns (as ecosystem assets considered additional producing units)
- Environmentally-extended input-output tables (EE-IOT).
  - > Requires information on environmental flows classified and structured as for the standard input-output data.
  - > Matrix algebra (Leontief inverse) -> consumption based indicators (e.g. Carbon or biodiversity footprints / embodied water)
- IO tables are regularly compiled (national and multi-regional)

Sequence of accounts

Sequence of accounts (SNA) provide a complete overview of all economic transactions:

- Current accounts (production, income, savings)
- Capital accounts
- Balance sheets

- Focus on the institutional sector level (i.e. corporations, governments, households)
- Full suite of indicators (income, saving, investment and wealth)
- **Integrated sequence of institutional sector accounts**
  - Environmentally adjusted aggregates (depletion or degradation adjusted NDP ("green GDP")

Balance sheets

Balance sheets: record all assets and liabilities of country (by institutional sector) and changes during accounting period

- The integration of ecosystem asset -> extended measures of wealth (wealth accounting)
- Issues:
  - > avoid double counting with existing values for natural resources, such as timber and fish
  - > in many countries value of land already recorded on the SNA balance sheet in terms of its market price (but may not capture all ecosystem services)
  - > Ecosystems that provide intermediate (or supporting services)

Data sources

Data sources

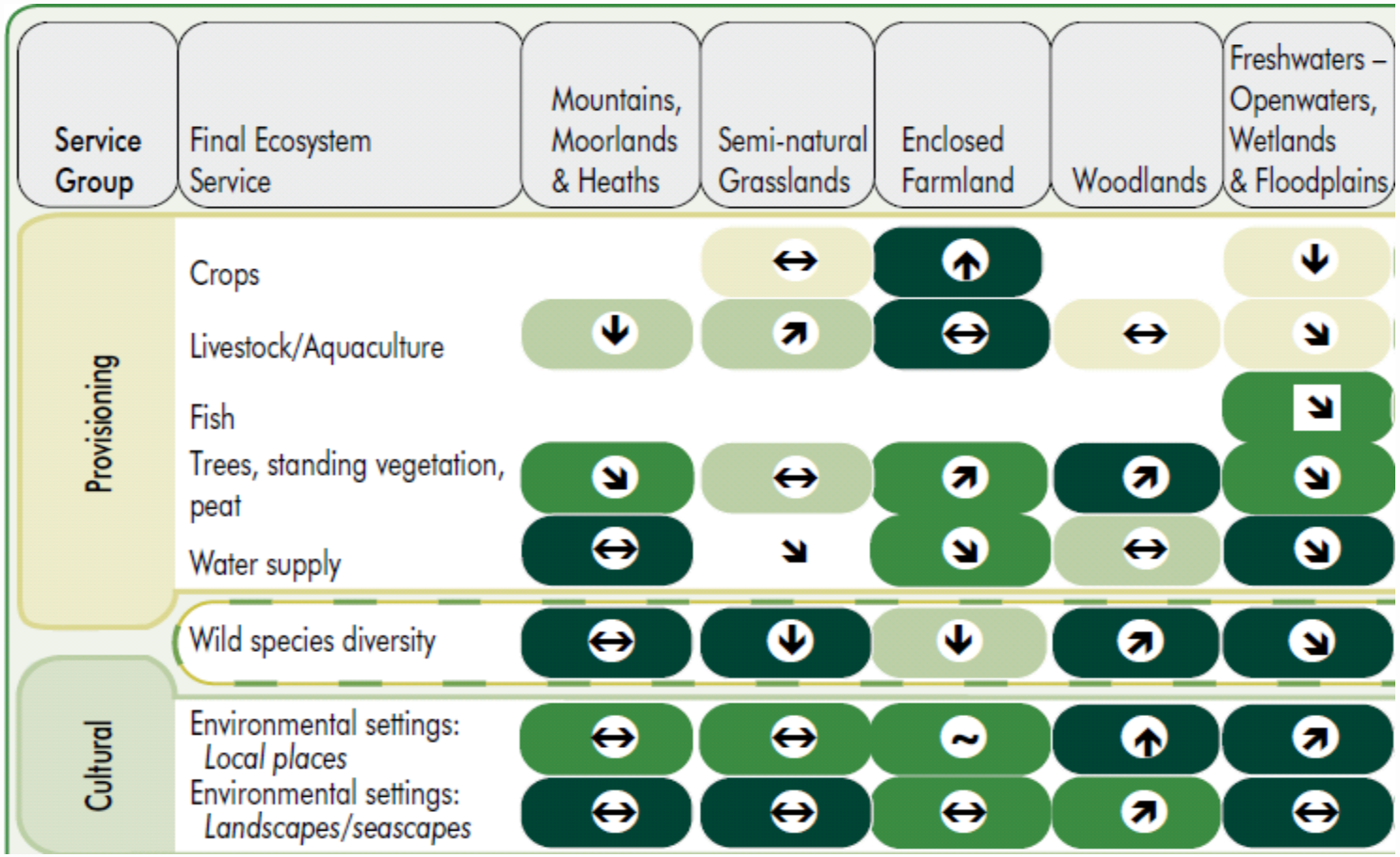
- **Data sources:**
  - Socio-economic statistics
  - Agricultural statistics: crop, livestock production
  - Energy statistics: biomass for fuel
  - Fisheries statistics: catch, stock
  - Forestry statistics: timber stock, harvest
  - Park surveys: visitors, use
  - Water statistics: withdrawals, consumption
  - Natural disasters: incidence of floods, erosion, storms
  - Soil inventories: erosion potential
  - Health statistics: regulation of biotic environment
- Best if they are national and good quality

Beneficiaries

- Provisioning services easiest to link to beneficiaries
- Regulating (and cultural services), assumptions or models may be required
- Important to know where the beneficiaries are located
  - > E.g. Geo-coded business register
  - > Agricultural census
  - > Social statistics (population etc.)
- Use table allows integration with economic statistics
- When there is no user, no transaction, -> no service flow

Examples

United Kingdom

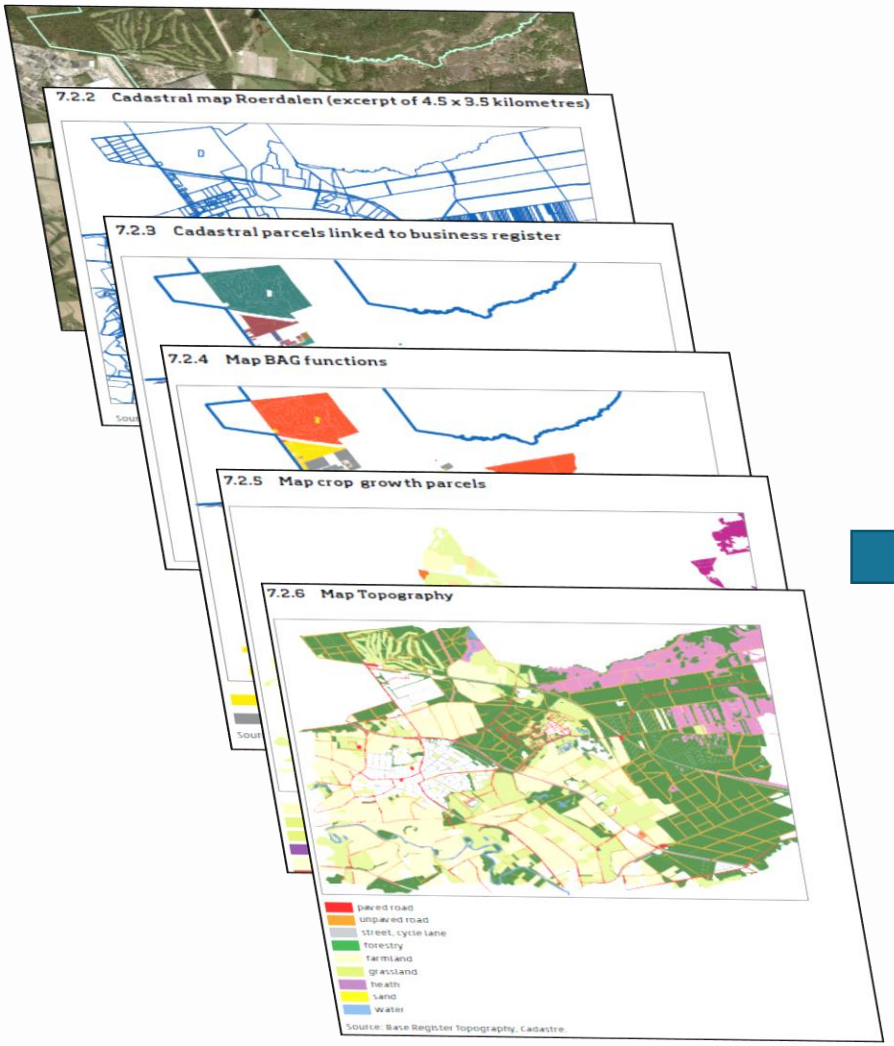


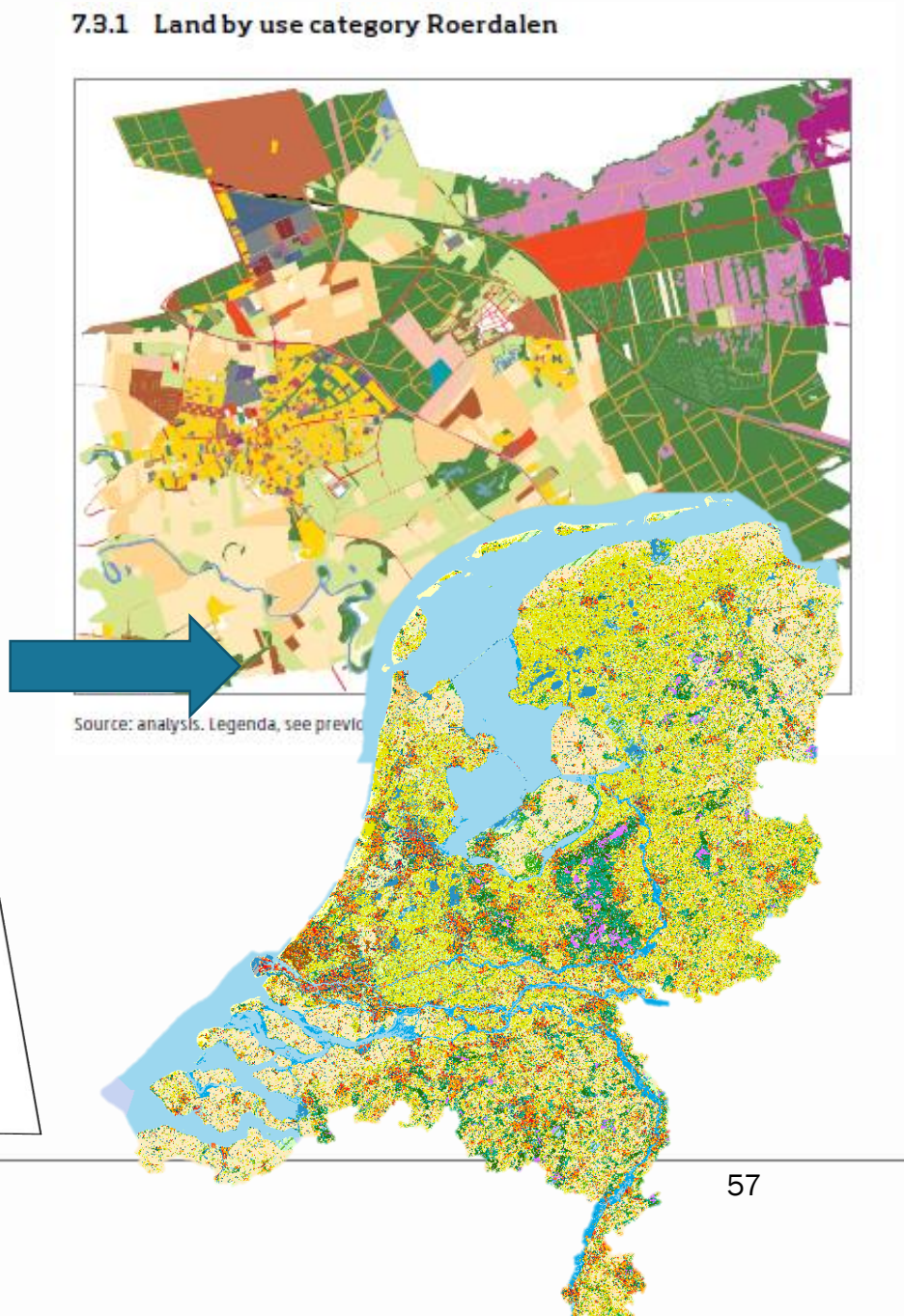
Source: UK National Ecosystem Assessment (2011)

Source: PBL, RIVM, WUR, CICES 2014

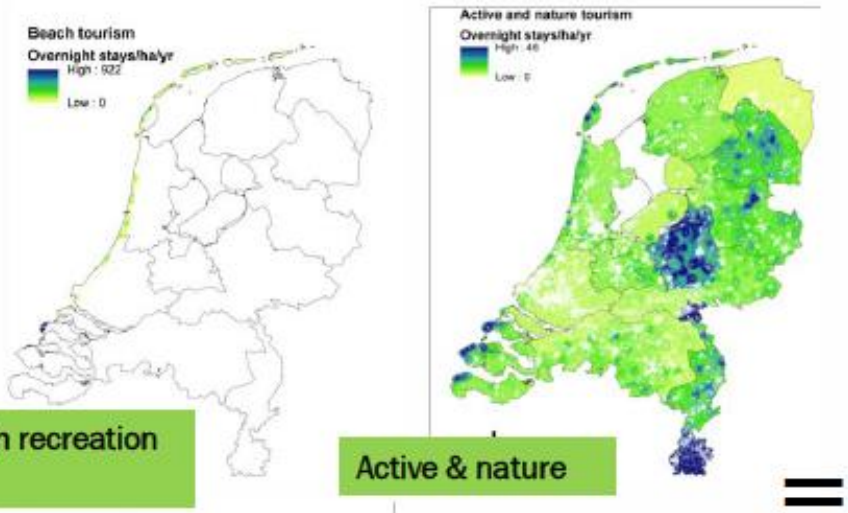
SEEA

Netherlands





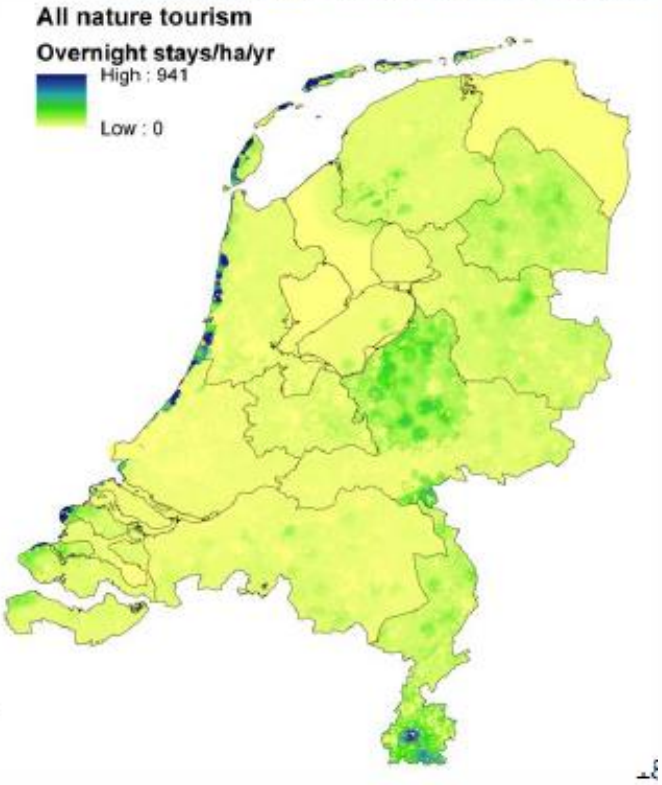
Example: Nature tourism



Beach recreation

Active & nature

=



Watersport

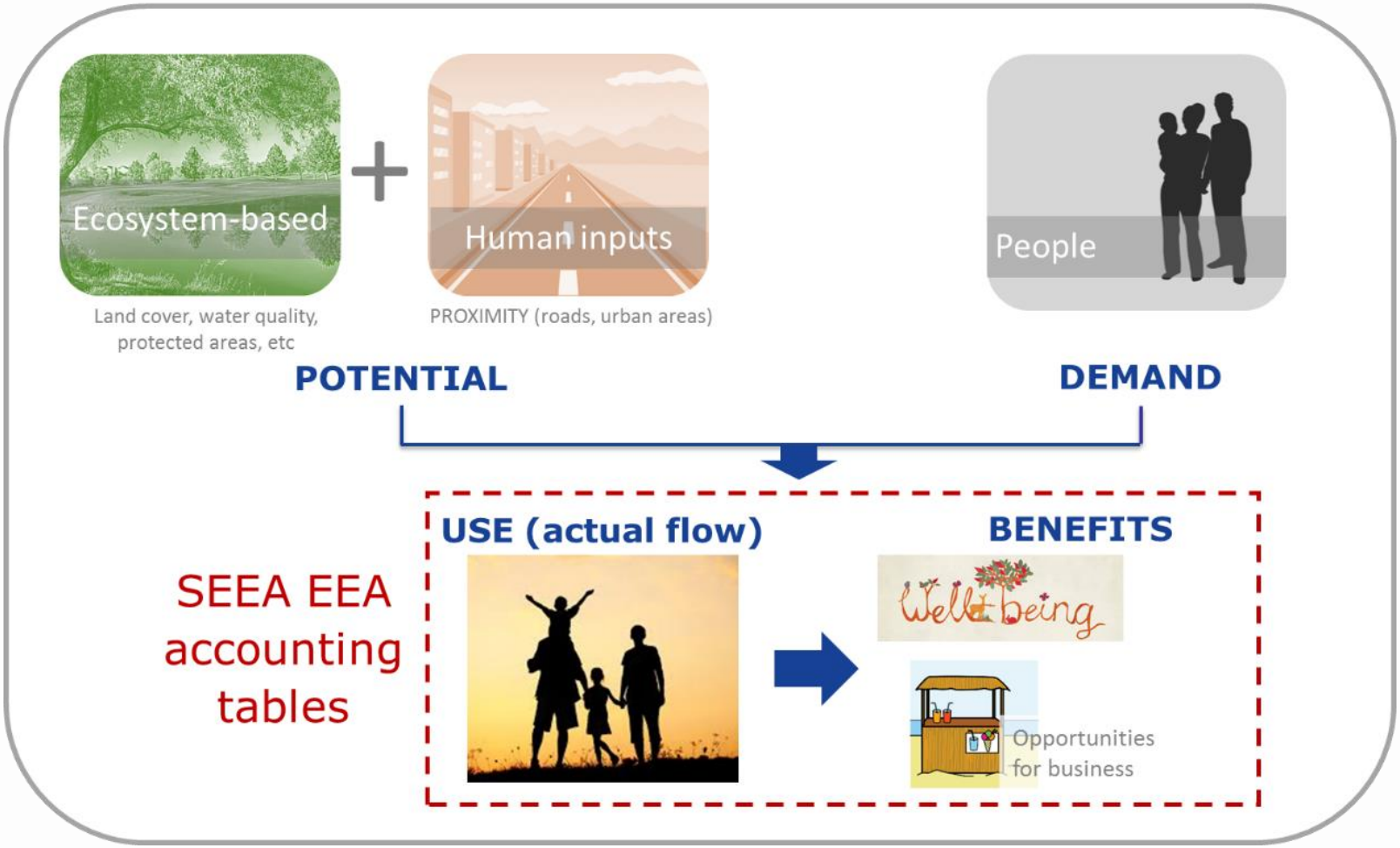
Physical Supply table ecosystem services

Ecosystem unit / Ecosystem service	Unit	Agriculture - annual crops	Agriculture - perennial crops	Agriculture - glass houses	Agriculture - grassland	Agriculture - buffer strips	Agriculture - built-up	Dunes with permanent vegetation	Beach, sand and active dunes	Broad leafed forest	Coniferous forest	Mixed forest	Heath	Sand	Wetlands	Non-agricultural grassland
Area	ha	781.401	79.228	11.790	927.216	36.492	35.491	15.943	33.946	109.142	81.923	118.571	40.813	2.364	34.346	54.010
Crop production	ktons	15.177	1.081	0	0	0	0	0	0	0	0	0	0	0	0	0
Fodder production	ktons	9.517	0	0	6.181	0	0	0	0	0	0	0	0	0	0	0
Wood production	ktons	0	0	0	0	0	0	45	0	502	195	393	0	0	0	0
Biomass production	ktons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Drinking water production	mln m3	2.991	453	10	4.845	151	141	3.119	7.742	1.526	2.780	3.809	1.405	83	143	434
Carbon sequestration in biomass	ktons	0	23	0	167	6	0	23	0	158	119	172	8	0	8	10
Pollination	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Natural pest control	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Erosion control	ktons soil	-3	21	6	930	79	47	195	-546	468	317	517	167	-24	32	163
Air filtration	ktons PM10	2.725	287	0	3.266	127	0	463	0	4.063	5.014	5.835	145	114	192	252
Protection against heavy rainfall	mln liters in 1 hour	171.713	23.731	953	193.341	8.166	5.019	10.895	16.799	48.138	57.441	79.896	23.636	1.161	7.156	16.841
Nature recreation (hiking)	x1000 hikers	29.126	5.762	651	42.238	2.103	3.397	11.406	16.922	27.937	25.474	32.975	11.826	703	6.290	6.022
Nature tourism	x1000 tourists	798	97	0	1.042	46	2	367	704	148	168	240	87	6	31	73

Physical Use table ecosystem services

Ecosystem service	Unit	A - Agriculture, forestry and fishing	B,C - Mining and manufacturing	D - Electricity	E - Water supply	F-H - Contruction, Wholesale and transportation	I,R - Accommodation and food service, culture, sports and recreation	Other sectors	Export	Households	Government	Investments	Inventories	Environment (Global goods)	Total
Crop production	ktons	16.259													16.259
Fodder production	ktons	16.039													16.039
Wood production	ktons	1.134													1.134
Biomass production	ktons			360											360
Drinking water production	mln m3				41.313										41.313
Carbon sequestration in biomass	ktons													823	823
Pollination	-	x													x
Natural pest control	-	x													x
Erosion control	ktons soil	1.766	30		26	158	129	60		277	1.705				4.150
Air filtration	ktons PM10									23.832					23.832
Regulation against heavy rainfall	mln liter in 1 hour	506.112	2.002	43	689	13.682	22.355	12.255		59.866	288.493				905.497
Nature recreation (hiking)	x1000 hikers									429.526					429.526
Nature tourism	x1000 tourists						4.505								4.505

Outdoor recreation accounting



Vallecillo, La Notte, Zulian, Ferrini, Maes (2019) 'Ecosystem services accounts: valuing the service flow of nature based recreation from ecosystems to people'. Ecological Modelling

SEEA

Outdoor recreation potential

Land cover

- Suitability of land to support recreation

Natural settings

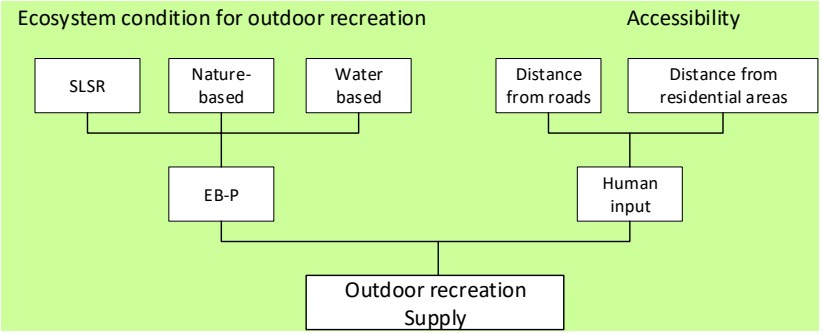
- Protected areas

Water

- Presence and geomorphology of coast
- Lakes
- Bathing water quality

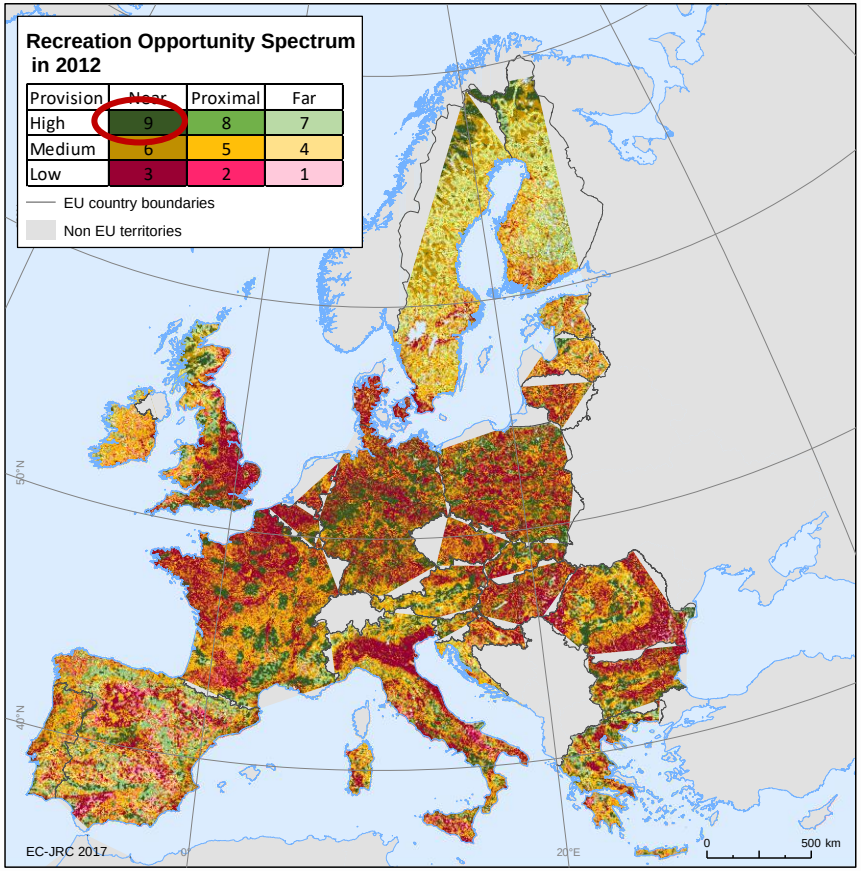
Features to reach

- Distance to the road network
- Distance to residential areas

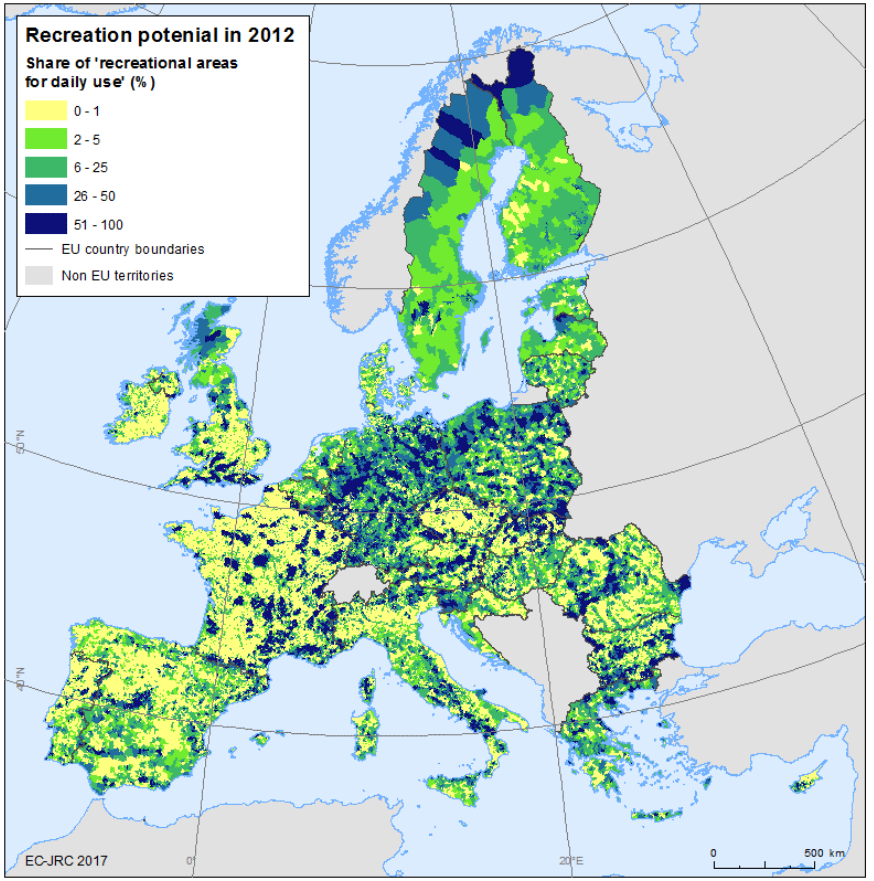


From ES potential to actual flow for outdoor recreation

ES potential



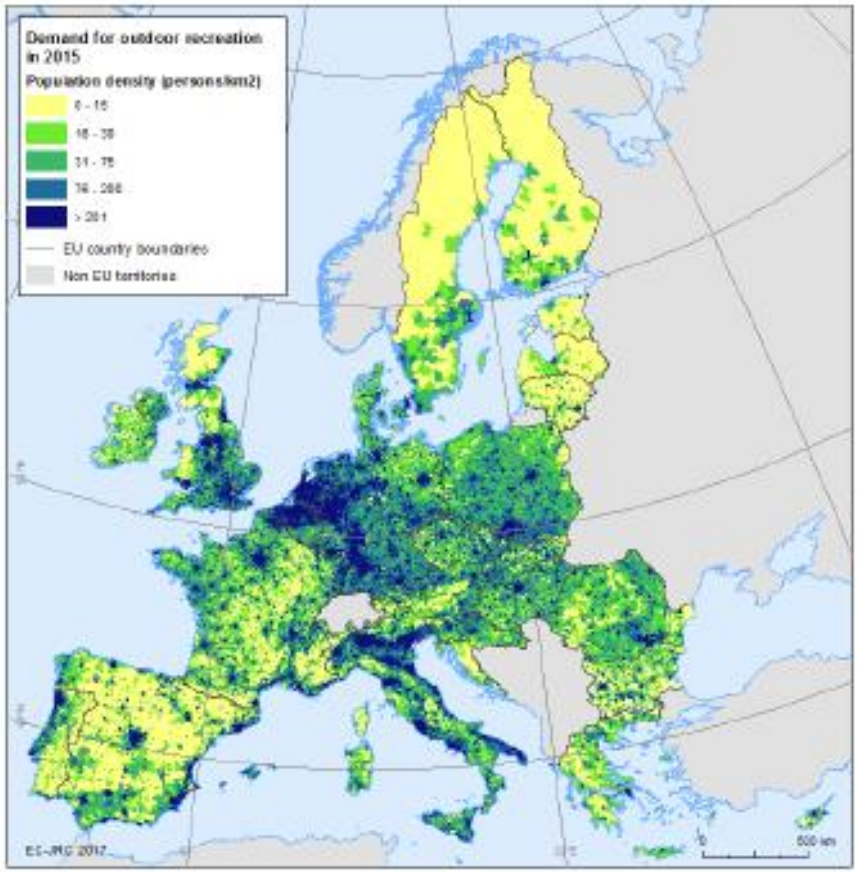
(as share of LAU)



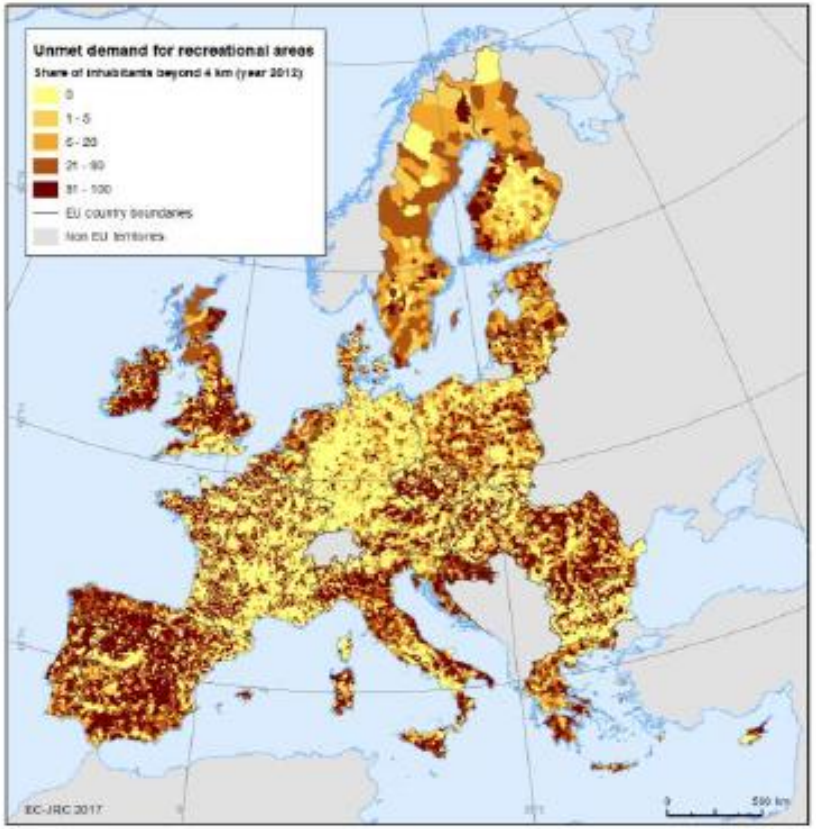
SEEA

From ES potential to actual flow for outdoor recreation

Demand



Unmet



SEEA

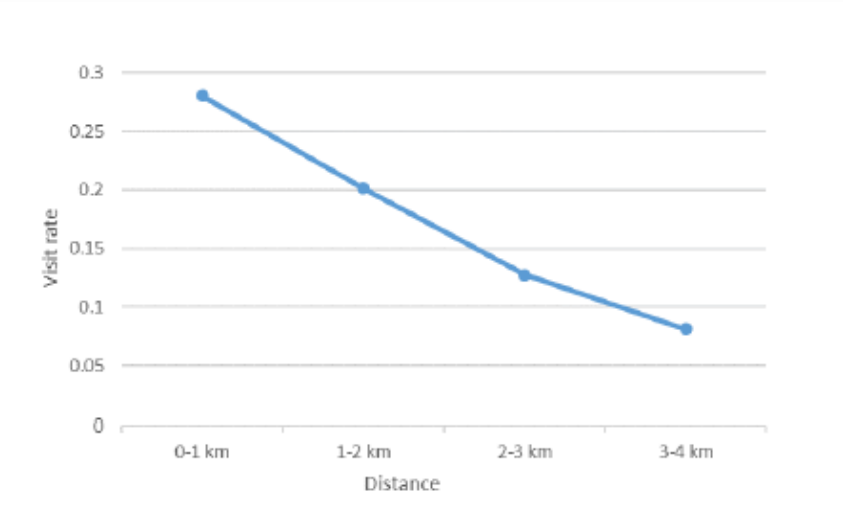
Outdoor recreation: actual flow

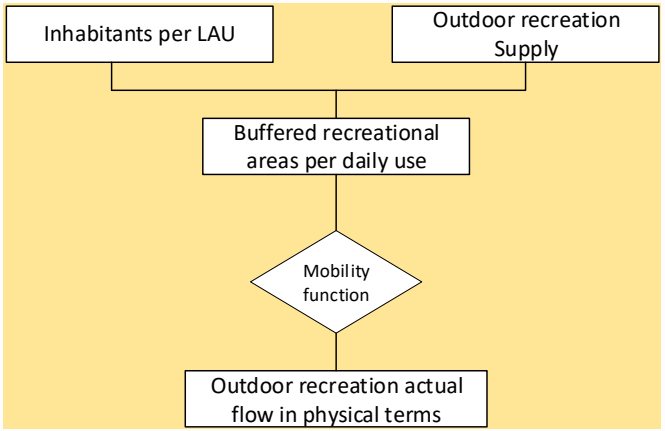
Potential users
(within 4 km)

How often do they use recreational areas?

Mobility model

Potential visits (flow)

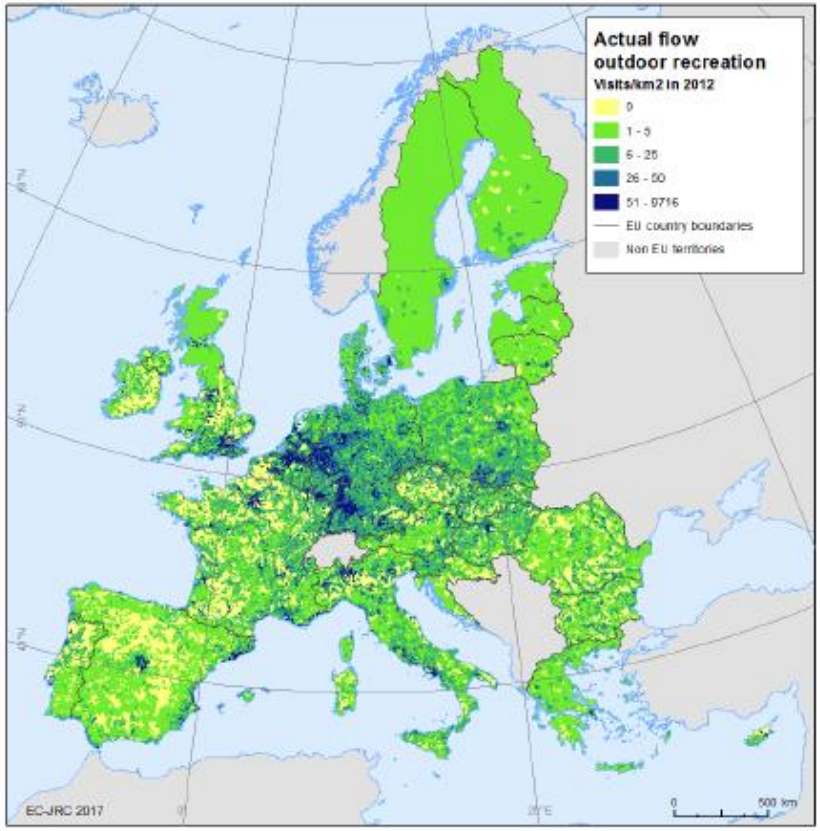




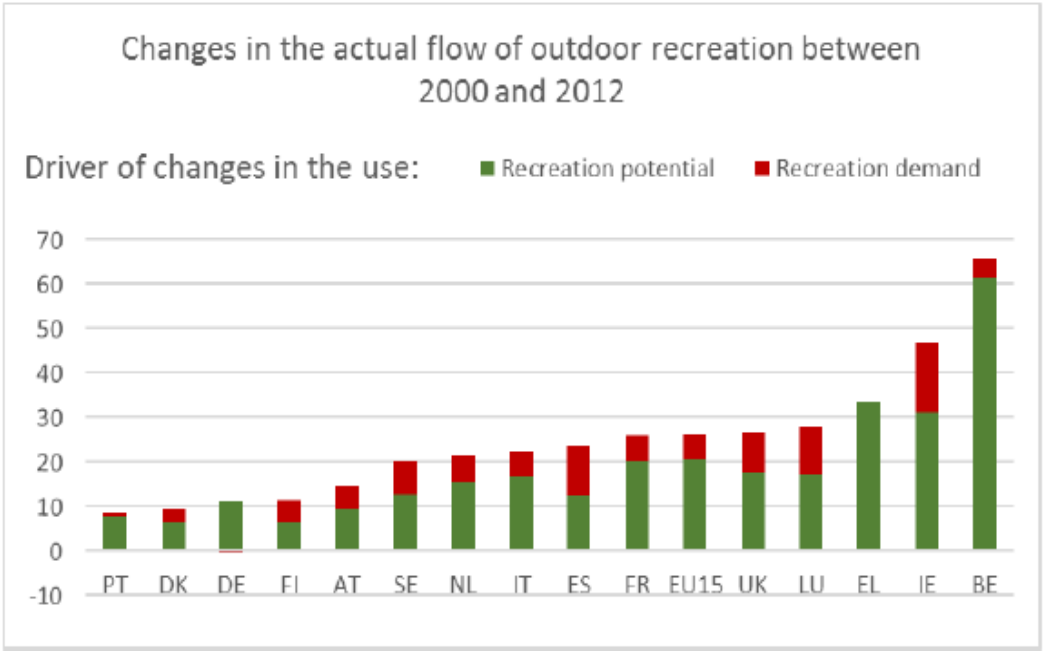
SEEA

From ES potential to actual flow for outdoor recreation

Actual flow



Over time



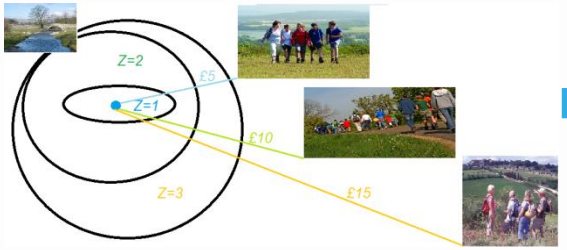
SEEA

Policy implications

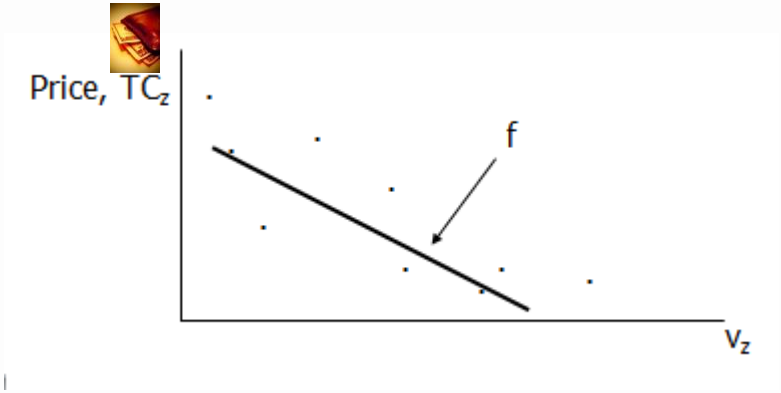
- In the EU Forests provide highest value of outdoor recreation
- Households are the user of the service, with Germany as the country with the largest actual flow: about 9 million potential visits to 'recreational areas for a daily use' in 2012 (absolute terms),
- Highest actual flow per capita is found in Denmark, where 18% of the total population visit 'recreational areas for a daily use' in 2012 (relative terms),
- At the EU level in 2012, there are 40 million potential visits to 'recreational areas for a daily use', with a total value of 50 billion euro,
- Overall increase in the use of the service, due to increase of the recreation potential, and at lower extent, an increase of the demand (population),
- Spatial maps and accounting tables can be used to support policy decisions related to land planning to guarantee the equitable accessibility to outdoor recreation opportunities (citizen right):

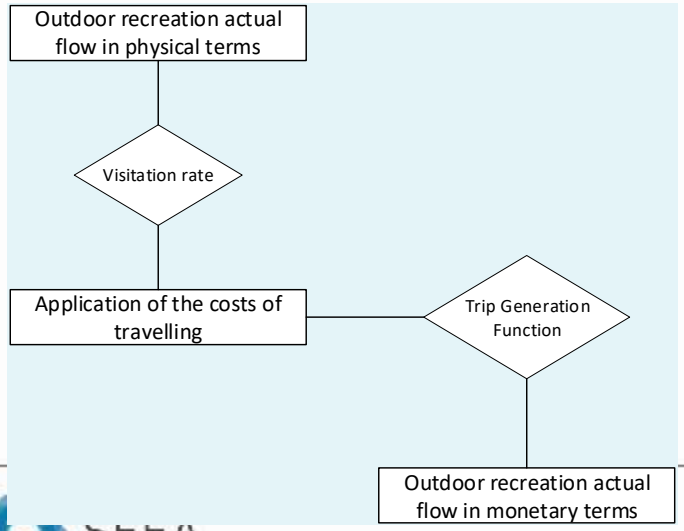
Outdoor recreation: travel cost values

For each municipality



$V_z = f(TC)$





Existence of natural recreational areas is valued as € per year

Accounting for outdoor recreation

Supply table

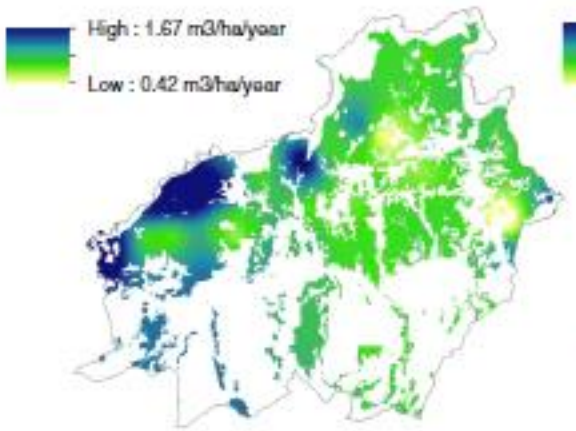
	Type of economic unit					Type of ecosystem unit								
	Primary sector	Secondary sector	Tertiary sector	Households	rest of the world - exports	Green urban areas	Cropland	Grassland	Heatland and shrub	Woodland and forest	Sparsely vegetated land	Wetlands	Rivers and lakes	Coastal and intertidal areas
outdoor recreation *mlln euro*														
2000						85.60	3536.09	6355.58	2713.85	27750.86	1178.82	2084.50	279.31	63.61
2012						83.32	4026.24	7516.82	3257.64	30902.34	1546.16	2850.97	302.23	78.50

Use table

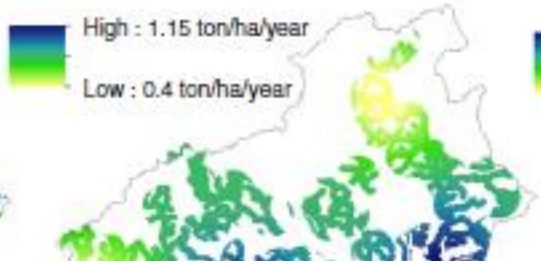
	Type of economic unit					Type of ecosystem unit								
	Primary sector	Secondary sector	Tertiary sector	Households	Rest of the world - exports	Green urban areas	Cropland	Grassland	Heat land and shrub	Woodland and forest	Sparsely vegetated land	Wetlands	Rivers and lakes	Coastal and intertidal areas
outdoor recreation *mlln euro*														
2000				44048.22										
2012				50564.22										

SEEA

Example – Indonesia (Kalimantan)



a



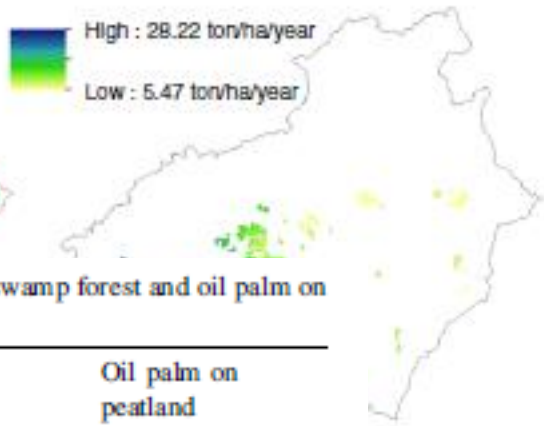
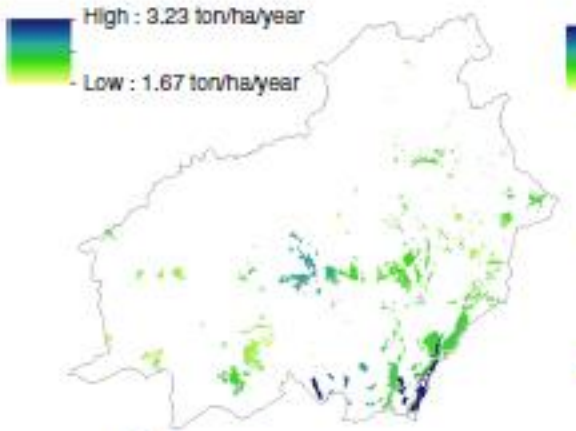
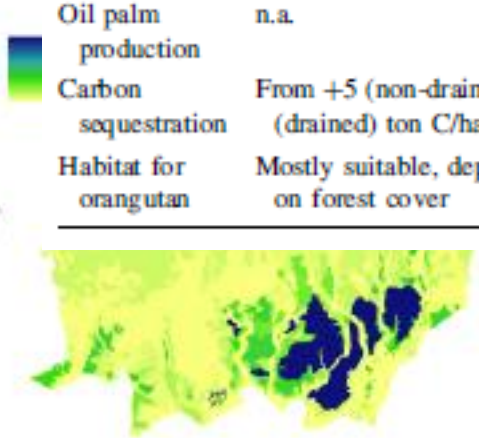


Table 3 Average ES provided by peat swamp forest and oil palm on peatland

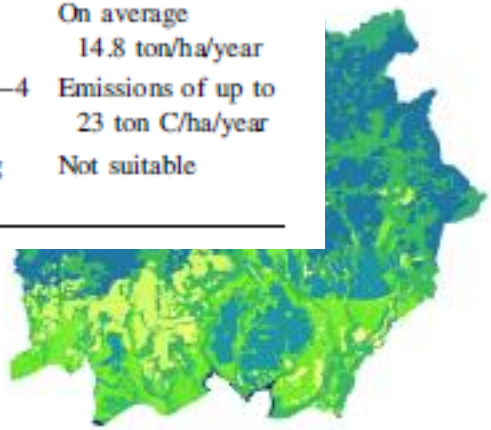
	Peat swamp forest	Oil palm on peatland
Timber production	On average 0.83 m^3/ha/year	n.a.
Oil palm production	n.a.	On average 14.8 ton/ha/year
Carbon sequestration	From +5 (non-drained) to −4 (drained) ton C/ha/year	Emissions of up to 23 ton C/ha/year
Habitat for orangutan	Mostly suitable, depending on forest cover	Not suitable



d



e



f

SEEA

Source: Sumarga and Hein, 2014

Acknowledgements

These materials have been developed in partnership with various organizations including the United Nations Statistics Division, UN Environment, the Convention on Biological Diversity, supported by the Norwegian Ministry of Foreign Affairs, and the European Union.

United Nations UNEP Convention on Biological Diversity NORWEGIAN MINISTRY OF FOREIGN AFFAIRS