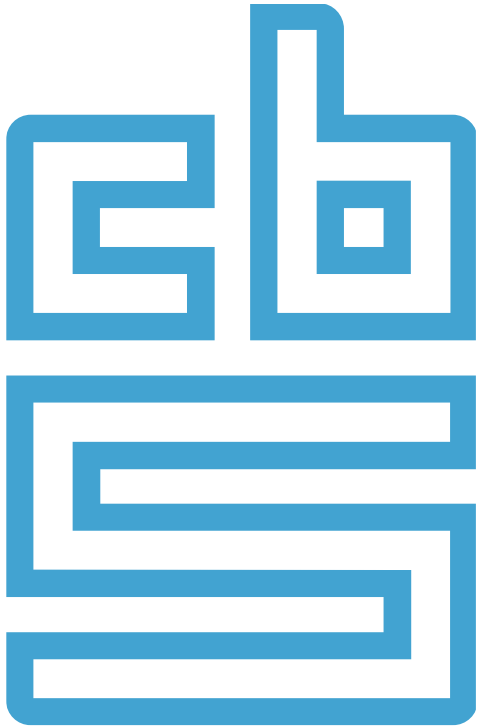


SEEA Ecosystem Extent Accounts

Measuring ecosystem extent

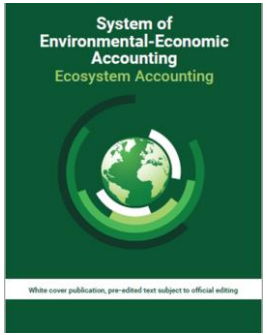
Sjoerd Schenau

20 April 2022

Content

- Ecosystem extent account – overview
- Spatial units in SEEA EA
- Ecosystem type classifications
- The accounts
- Example ecosystem type map and extent account for the Netherlands

SEEA EA extent account - overview



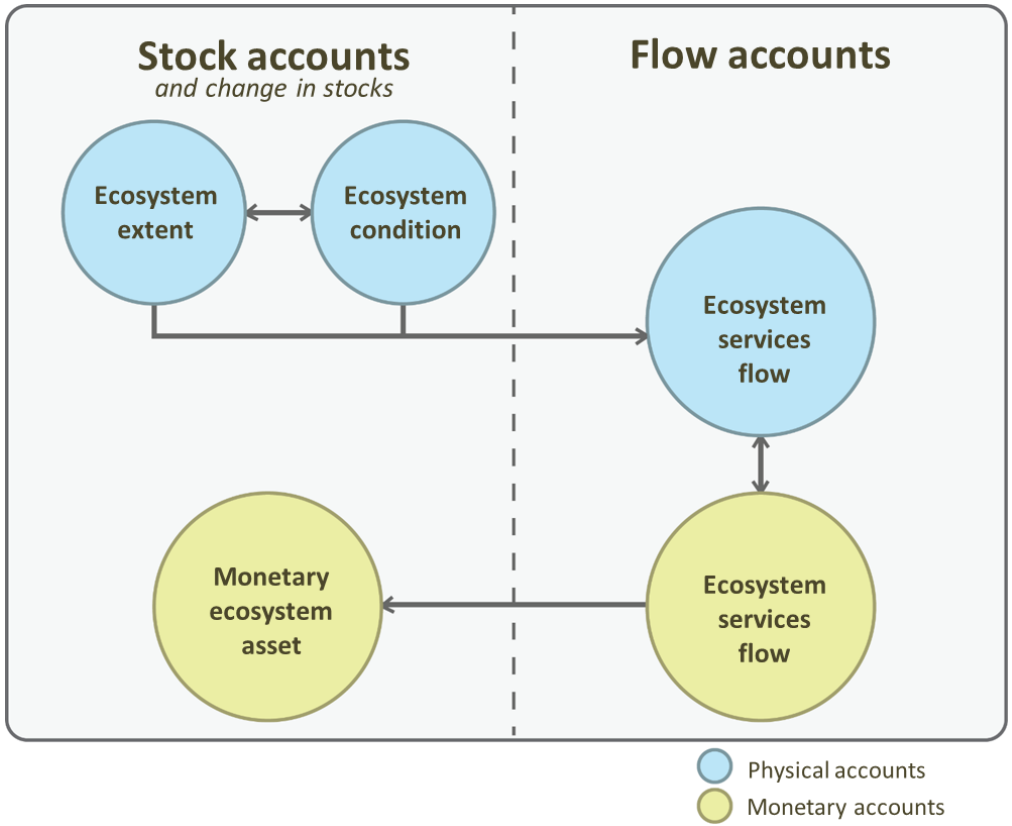
What?

- Starting point for ecosystem accounting
- Records the areas of different ecosystems, and changes in the areas
- National coverage of terrestrial, freshwater, coastal and marine areas
- Mutually exclusive and exhaustive coverage

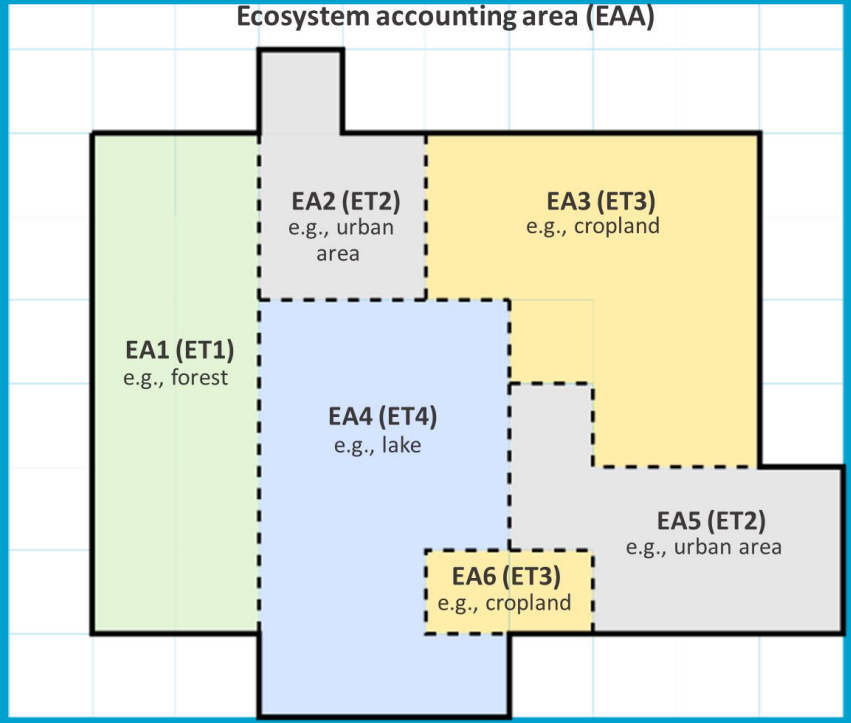
Why?

- Input for **land management, conservation policies**
- Supports the derivation of coherent **indicators** of deforestation, desertification, agricultural conversion, urbanization, ecosystem diversity etc.
- **Spatial foundation for other accounts**
  → basis for allocating macro data to spatial units

Overview of the SEEA EA accounts



Spatial units in SEEA EA

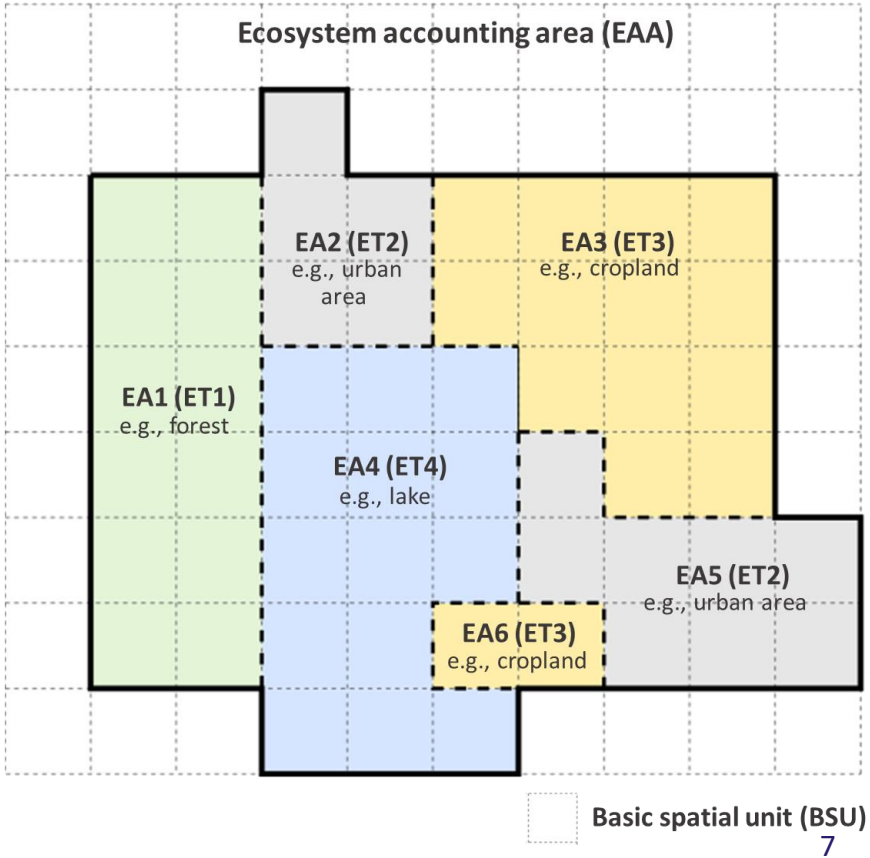


Spatial units in SEEA EA

- General approach for delineation of ecosystem assets well established

- **Three types of units:**

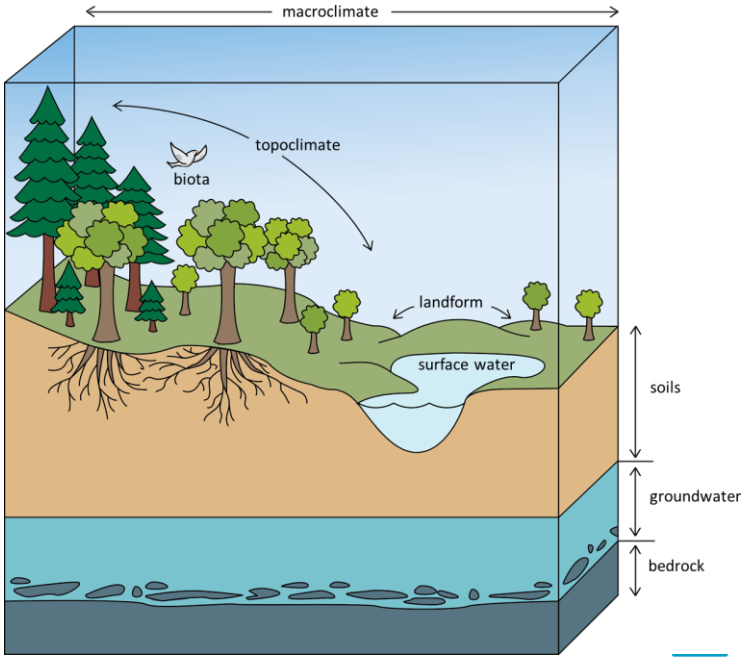
  - Basic spatial units (BSU)
  - Ecosystem Accounting Area (EAA)
  - Ecosystem asset (EA)



Ecosystem assets

Ecosystem assets (EAs) *are contiguous spaces of a specific ecosystem type characterized by a distinct set of biotic and abiotic components and their interactions*

Ecosystem assets are classified by ***ecosystem type (ET)***



Delineation of ecosystem assets

Horizontally

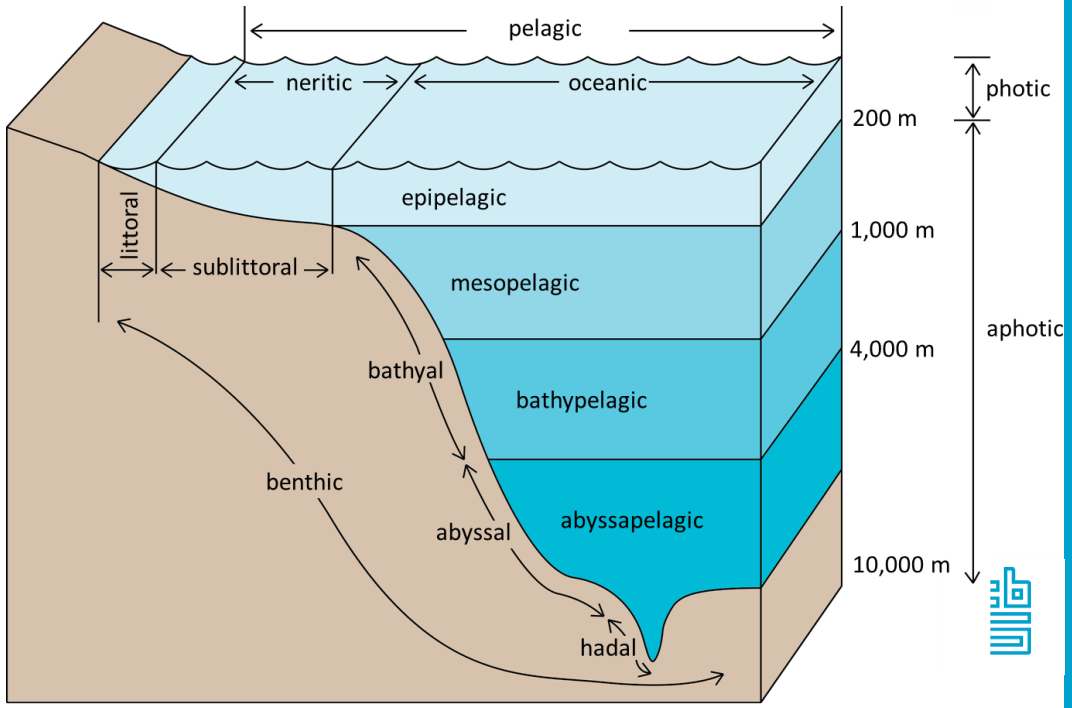
- 2D footprint of 3D entity
- Relatively homogeneous
  - Variability within > accross
- May change over time
- Bounded by EAA
- May have a minimum size

Vertically

- Top: Atmospheric boundary layer
- Bottom: includes soil
  - (precise depth depends on context)
- Special considerations for:
  - Oceans
  - Aquifers
  - Subterranean ecosystems
  - Subsoil abiotic resources

Vertical structure of marine ecosystems

Marine ecosystems are not concentrated near one surface (i.e., the air-land/water interface) but extend throughout the water column and include the underlying sediment and seabed



Principles of ecosystem asset delineation

Ecosystem assets should represent ecosystems

- Alignment with CBD ecosystem definition
- consideration of organisms, their environmental setting and ecosystem processes.
- Keep it realistic: perfect is the enemy of good

Ecosystem assets should be capable of being mapped.

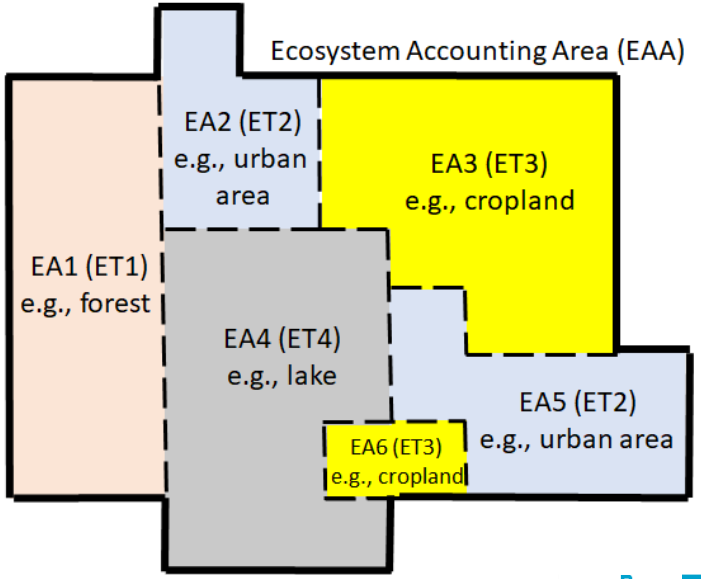
- Location; size; shape

Ecosystem assets should be geographically and conceptually exhaustive across ecological realms.

- Spatially comprehensive (no gaps)
- Conceptually comprehensive

Ecosystem assets should be mutually exclusive

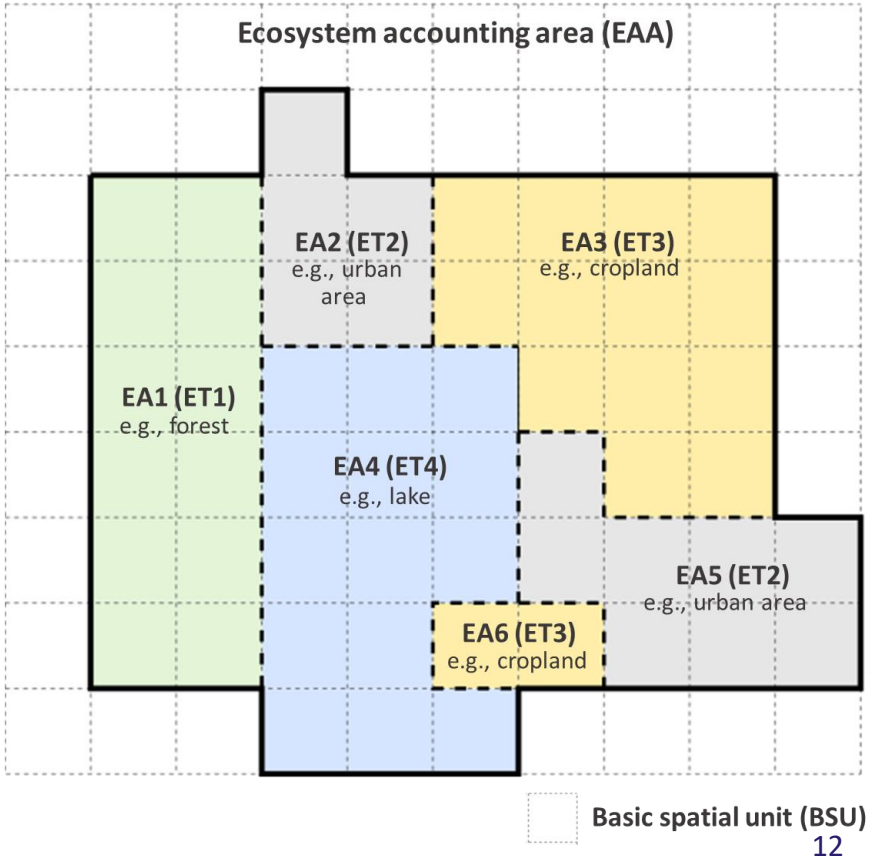
- Conceptually (single ecosystem type)
- Geographically (no overlaps between e.g. land and ocean).



Ecosystem accounting area

"The **ecosystem accounting area (EAA)** is the geographical territory for which an ecosystem account is compiled." (§3.22)

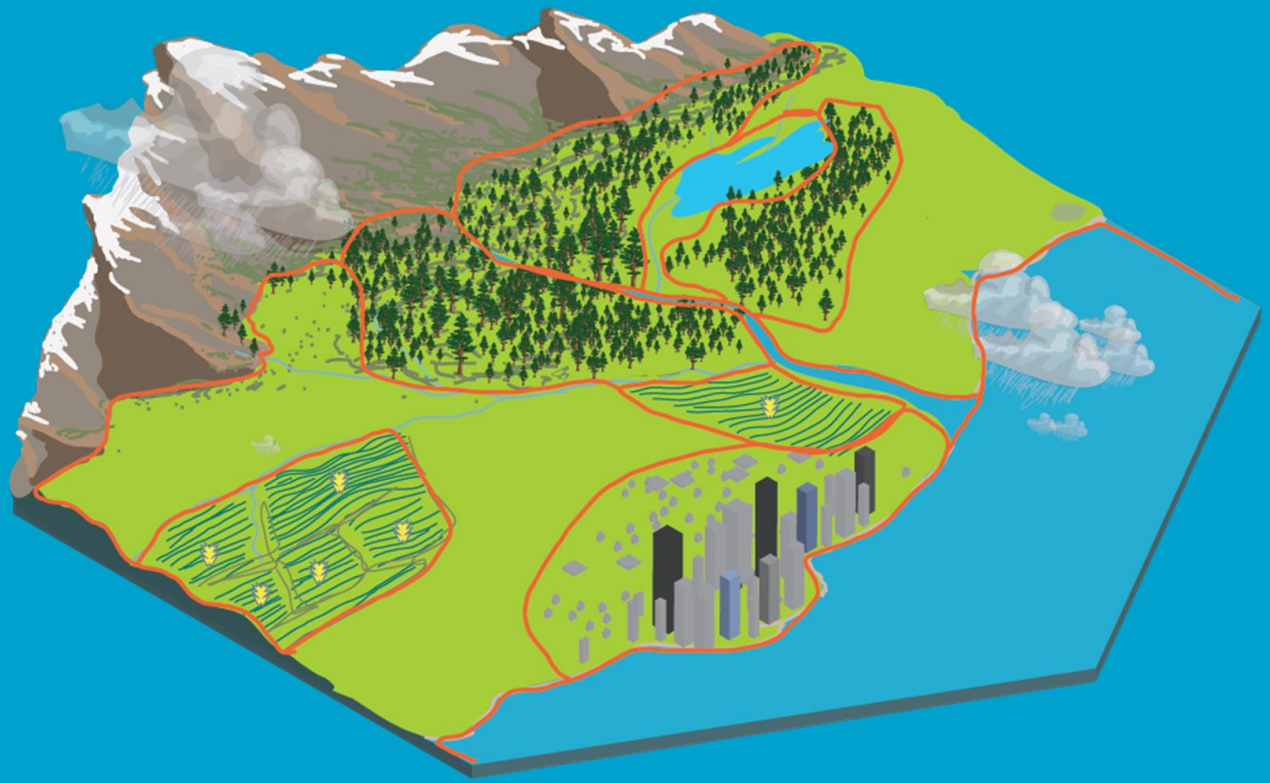
The EAA therefore determines which ecosystem assets are included in an ecosystem account.



Common forms of EAA

- **National jurisdictions / groups of countries**
- **Subnational administrative areas**
  - (e.g., state, province);
- **Environmentally defined areas within a country**
  - (e.g., water catchments, ecoregions)
- **or across countries**
  - (e.g., regions defined by river systems such as the Amazon, the Mekong and the Nile);
- **Other areas of policy or analytical interest such as**
  - protected areas
  - areas owned by specific industries or sectors, e.g., government-owned land
  - or areas outside national jurisdiction, e.g., open oceans and high seas

Classifying ecosystem assets



An ecosystem type classification for SEEA EA

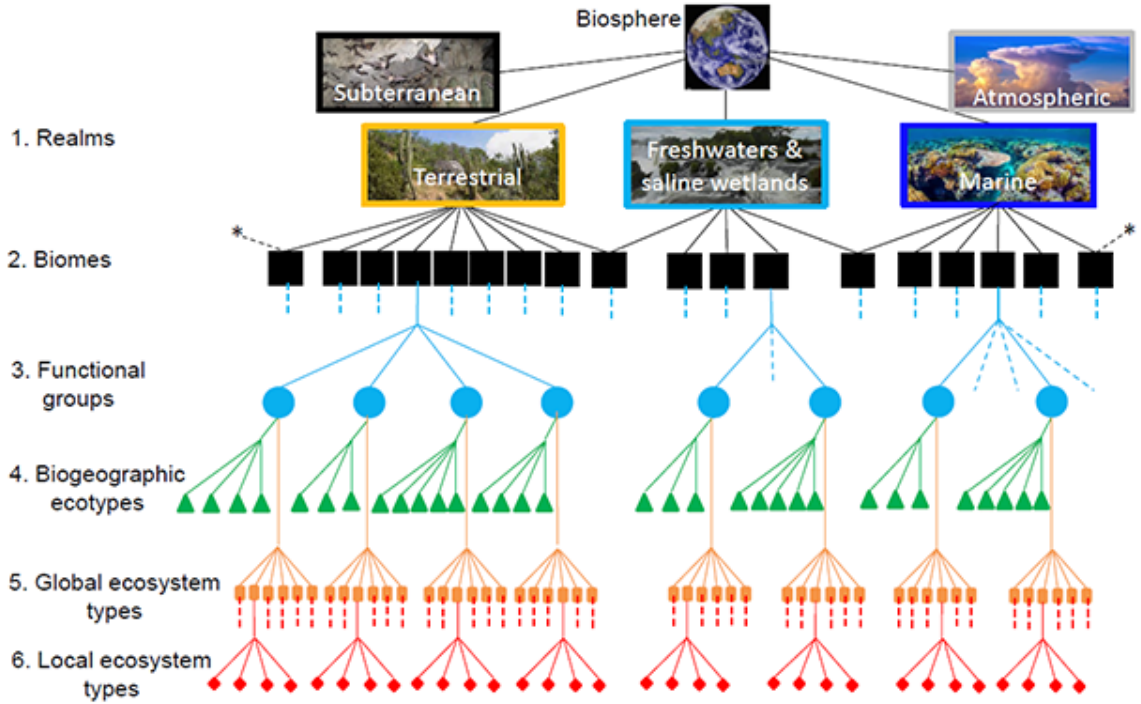
- A classification describing the ecosystem types and a map are **essential components** of ecosystem accounting
- It is expected that countries will use their national ecosystem maps and classifications as the basis for SEEA ecosystem accounting.
- However, for international comparability, these classifications should be linked to a **reference classification**.
- **A key revision issue** for SEEA EA was to develop a proposal for a reference classification that better represents the concept and coverage of ecosystems
- **SEEA EA endorses the IUCN GET as the international reference classification**

IUCN Global Ecosystem Typology

- Ecosystems are defined by their ***biotic*** and ***physical*** components and the ***ecological processes*** that sustain them
- Ecosystem accounts require assets that reflect:
  - Ecological functions (the basis for ecosystem services)
  - Biological composition (biodiversity)
- **IUCN Ecosystem Typology**
  - A hierarchical framework combining both components

IUCN Global Ecosystem Typology (GET)

- All ecosystems of the biosphere
- Hierarchical structure
- Representation of ***function*** – upper levels, top-down
- Representation of ***composition*** – lower levels, bottom-up



IUCN Global Ecosystem Typology (GET)

Four core realms

- Marine (M)
- Freshwater (F)
- Terrestrial (T)
- Subterranean (S)

… and 6 transitional

- MT; SF; FM; SM; TF; MFT




IUCN Global Ecosystem Typology (GET)

Terrrestrial realm: 7 biomes

T1 Tropical-subtropical forests

T2 Temperate-boreal forests and woodlands

T3 Shrublands and shrubby woodlands

T4 Savannas and grasslands

T5 Deserts and semi-deserts

T6 Polar/alpine (cryogenic)

T7 Intensive land-use

IUCN Global Ecosystem Typology (GET)

T2 Temperate-boreal forests and woodlands: 6 functional groups

- T2.1 Boreal and temperate high montane forests and woodlands
- T2.2 Deciduous temperate forests
- T2.3 Oceanic cool temperate rainforests
- T2.4 Warm temperate laurophyll forests
- T2.5 Temperate pyric humid forests
- T2.6 Temperate pyric sclerophyll forests and woodlands

IUCN Global Ecosystem Typology

Current information resources

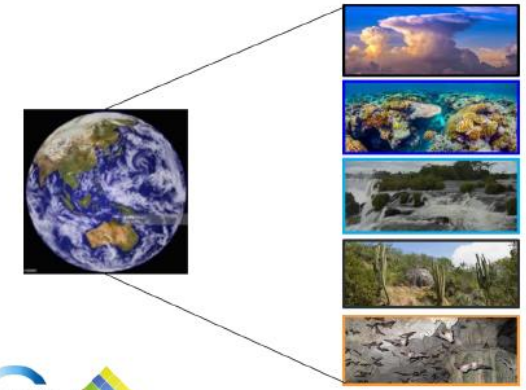
- report describing details of the typology structure and the descriptive profiles for all Ecosystem Functional Groups
- version 1.01
- Available for download from https://iucnrle.org/about-rle/ongoing-initiatives/global-ecosystem-typology/ since February 2020

The IUCN Global Ecosystem Typology v1.01: Descriptive profiles for Biomes and Ecosystem Functional Groups

David A. Keith, Jose R. Ferrer, Emily Nicholson, Melanie J. Bishop, Beth A. Polidoro, Eva Ramirez-Llodra, Mark G. Tozer, Jeanne L. Nel, Ralph Mac Nally, Edward J. Gregr, Kate E. Watermeyer, Franz Essl, Don Faber-Langendoen, Janet Franklin, Caroline E. R. Lehmann, Andres Etter, Dirk J. Roux, Jonathan S. Stark, Jessica A. Rowland, Neil A. Brummitt, Ulla C. Fernandez-Arcaya, Iain M. Suthers, Susan K. Wiser, Ian Donohue, Leland J. Jackson, R. Toby Pennington, Nathalie Pettorelli, Angela Andrade, Tytti Kontula, Arild Lindgaard, Teemu Tahvanainan, Aleks Terauds, Oscar Venter, James E. M. Watson, Michael A Chadwick, Nicholas J. Murray, Justin Moat, Patricio Pliscoff, Irene Zager, Richard T. Kingsford

Adapted from: 'Earth's ecosystems: a function-based typology for conservation and sustainable management'

February 2020

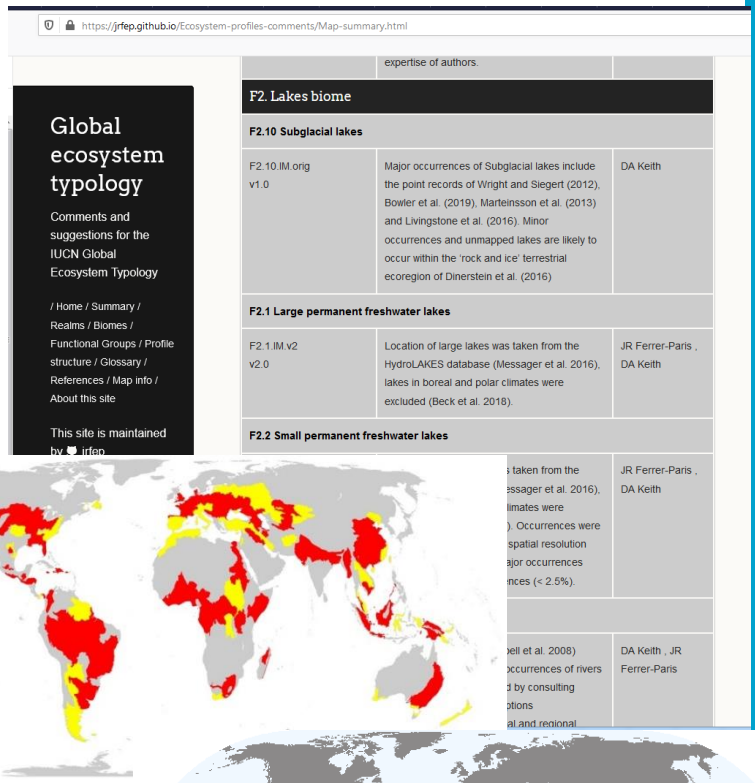


IUCN CEM

IUCN Global Ecosystem Typology

Mapping

- Coarse-scale indicative maps (1st gen) available for all Ecosystem Functional Groups
- Finer-scale maps (2nd gen) based on published material
- Spatial models of terrestrial & marine ecosystems (3rd gen)
- Assembly of a global composite map of EFGs in planning



World Ecosystems (WES)

- A New Map of World Ecosystems – A USGS/Esri/TNC collaboration
- 431 ecosystems globally; 1778 when segregated by biogeographic realm

Global Ecology and Conservation 21 (2020) e00860

Contents lists available at ScienceDirect

Global Ecology and Conservation

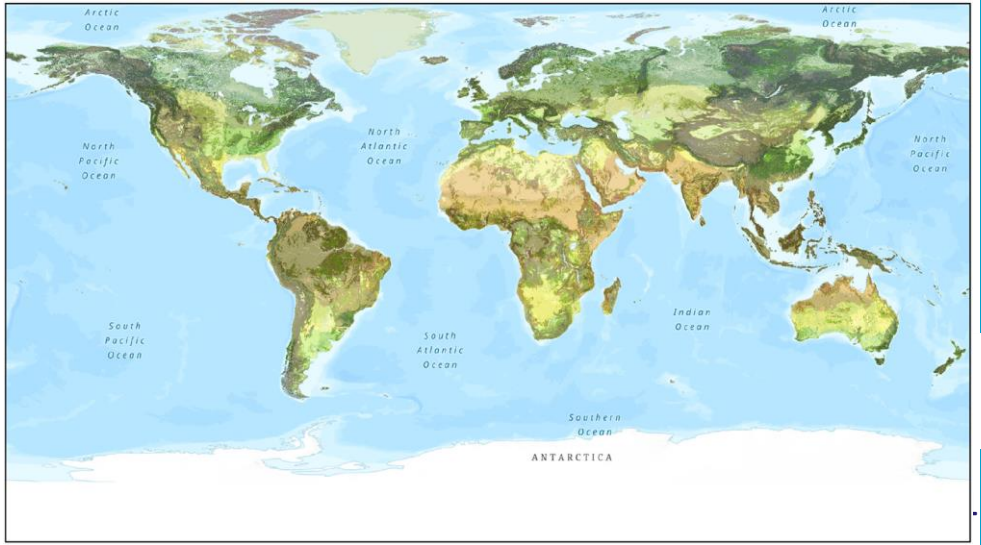
journal homepage: http://www.elsevier.com/locate/gecco

Original Research Article

An assessment of the representation of ecosystems in global protected areas using new maps of World Climate Regions and World Ecosystems

Roger Sayre [a, *], Deniz Karagulle [b], Charlie Frye [b], Timothy Boucher [c], Nicholas H. Wolff [d], Sean Breyer [b], Dawn Wright [b], Madeline Martin [a], Kevin Butler [b], Keith Van Graafeiland [e], Jerry Touval [c], Leonardo Sotomayor [f], Jennifer McGowan [c], Edward T. Game [g], Hugh Possingham [g]

[a] US. Geological Survey, 516 National Center, Reston, VA, 20192, USA
[b] Esri, 380 New York Street, Redlands, CA, 92373, USA
[c] The Nature Conservancy, 4245 Fairfax Drive, Arlington, VA, 22203, USA
[d] The Nature Conservancy, 14 Maine Street, New Brunswick, ME, 04011, USA
[e] Esri, 8619 Westwood Center Drive, Vienna, VA, 22182, USA
[f] The Nature Conservancy, Avenida de los Shyris E9-38 y Bélgica, Edificio Shyris Century Oficina 2D, Quito, Ecuador
[g] The Nature Conservancy, University of Queensland, St. Lucia, QLD, 4072, Australia



Three ways to to compile ecosystem type maps

1) Use existing national ecosystem classification / maps

→ *cross walk to IUCN classification*

2) Use existing global maps

→ ARIES, WES, IUCN, etc.

3) Construct your own ecosystem classification / maps

Example: Mapping of Indian forest types to IUCN GET forest ecosystem functional groups (EFG)

In India, compilation of ecosystem extent accounts is based on locally relevant ecosystem type classifications. These have been mapped to the IUCN GET classification at the EFG level for the purposes of international comparability.

The values in the cells represent the share of Indian forests that map to the GET categories:

- **Values of 1** represent a 1-to-1 match.
- **Values less than 1** indicate that the Indian forest type maps to more than one GET forest type - in proportion to the values given in the corresponding cells.

National Classification		IUCN EFGs							
Level I	Level II	T1.1Tropical/ subtropical lowland rainforests	T1.2 Tropical/ subtropical dry forests and scrubs	T1.3 Tropical/ subtropical montane rainforests	T2.1 Boreal and montane needle-leaved forest and woodland	T2.2 Temperate deciduous forests and shrublands	T5.2 Thorny deserts and semi-deserts	TF1.1 Tropical flooded forests and peat forests	TM2.1 Coastal shrublands and grasslands
Forest	Tropical wet evergreen forests	1							
Forest	Tropical semi evergreen forests	1							
Forest	Tropical moist deciduous forests			1					
Forest	Littoral & swamp forests							0.25	0.75
Forest	Tropical dry deciduous forests				1				
Forest	Tropical thorn forests						1		
Forest	Tropical dry evergreen Forests		1						
Forest	Subtropical broad leaved hill forests					1			
Forest	Subtropical pine forests				1				
Forest	Subtropical dry evergreen forests		1						
Forest	Montane wet temperate forests			1					
Forest	Himalayan moist temperate forests			1					
Forest	Himalayan dry temperate Forests					1			
Forest	Sub alpine forests					1			
Forest	Moist alpine scrub					1			
Forest	Dry alpine scrub					1			

Source: Ministry of Statistics and Programme Implementation, 2021.

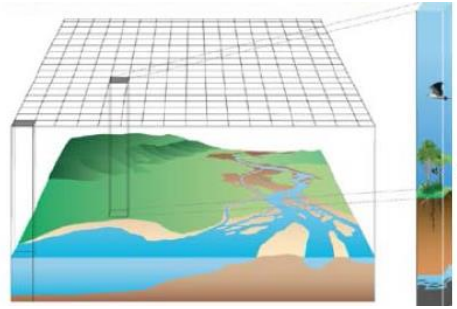
The SEEA extent account

	Selected ecosystem types (based on Level 3 - EFG of the IUCN Global Ecosystem Typology)																				
Realm	Terrestrial							Freshwater			Marine				Transitional						
Selected Ecosystem Functional Group (EFG)	Tropical-subtropical lowland rainforests	Boreal and temperate montane forests and woodlands	Seasonally dry tropical shrublands	Trophic savannas	Semi-desert steppes	Ice sheets, glaciers and perennial snowfields	Croplands	Permanent upland streams	Large permanent freshwater lakes	Large reservoirs	Seagrass meadows	Epipelagic ocean waters	Continental and island slopes	Submerged artificial structures	Tropical flooded forests and peat forests	Deepwater coastal inlets	Rocky shores	Coastal shrublands and grasslands	Artificial shores	Coastal river deltas	TOTAL
	T1.1	T2.1	T3.1	T4.1	T5.1	T6.1	T7.1	F1.1	F2.1	F3.1	M1.1	M2.1	M3.1	M4.1	TF1.1	FM1.1	MT1.1	MT2.1	MT3.1	MFT1.1	
Opening extent																					
Additions to extent																					
Expansions																					
Managed expansion																					
Natural expansion																					
Upward reappraisals																					
Reductions in extent																					
Regressions																					
Managed regression																					
Natural regression																					
Downward reappraisals																					
Net change in extent																					
Closing extent																					

General principles

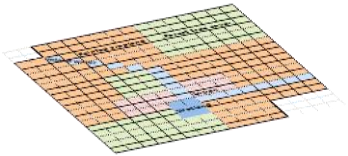
- ***Ecosystem extent is the size of an ecosystem asset***.
- It is usually measured in terms of spatial area but may also be measured in terms of length or volume
- Provide an overview of the composition (mix/combination) of, and changes in, ecosystem types within an EEA.

Extent account



- Vegetation
- Hydrology
- Pedology
- Elevation
- Bio-climate
- Etc.

Maps



Ecosystem type

Spatial units
Classifications

Realm	Selected ecosystem types (based on Level 3 - EFG of the IUCN Global Ecosystem Typology)																		
	Terrestrial							Freshwater			Marine				Transitional						
Selected Ecosystem Functional Group (EFG)	Tropical-subtropical lowland rainforests	Boreal and temperate montane forests and woodlands	Seasonally dry tropical shrublands	Trophic savannas	Semi-desert steppes	Ice sheets, glaciers and perennial snowfields	Croplands	Permanent upland streams	Large permanent freshwater lakes	Large reservoirs	Seagrass meadows	Epipelagic ocean waters	Continental and island slopes	Submerged artificial structures	Tropical flooded forests and peat forests	Deepwater coastal inlets	Rocky shores	Coastal shrublands and grasslands	Artificial shores	Coastal river deltas	TOTAL
	T1.1	T2.1	T3.1	T4.1	T5.1	T6.1	T7.1	F1.1	F2.1	F3.1	M1.1	M2.1	M3.1	M4.1	TF1.1	FM1.1	MT1.1	MT2.1	MT3.1	MFT1.1	
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Downward reappraisals																					
Net change in extent																					
Closing extent																					

Extent account - structure

	Selected ecosystem types (based on Level 3 - EFG of the IUCN Global Ecosystem Typology)																			
Realm	Terrestrial							Freshwater			Marine				Transitional					
Selected Ecosystem Functional Group (EFG)	Tropical-subtropical lowland rainforests	Boreal and temperate montane forests and woodlands	Seasonally dry tropical shrublands	Trophic savanna	Semi-desert	Ice sheets, glaciers and snowfields	Croplands	Permanent	Large perm	Large rese	Seagrass	Epipelagic	Continent	Submerge	Tropical fl forests	Deepwater	Rocky shores	Coastal shrubl grasslands	Artificial shores	Coastal river deltas	TOTAL
	T1.1	T2.1	T3.1	T4.1	T5.1	T6.1	T7.1	F1.1	F2.1	F3.1	M1.1	M2.1	M3.1	M4.1	TF1.1	FM1.1	MT1.1	MT2.1	MT3.1	MFT1.1	
Opening extent																					
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Downward reappraisals																					
Closing extent																					

Ecosystem classification

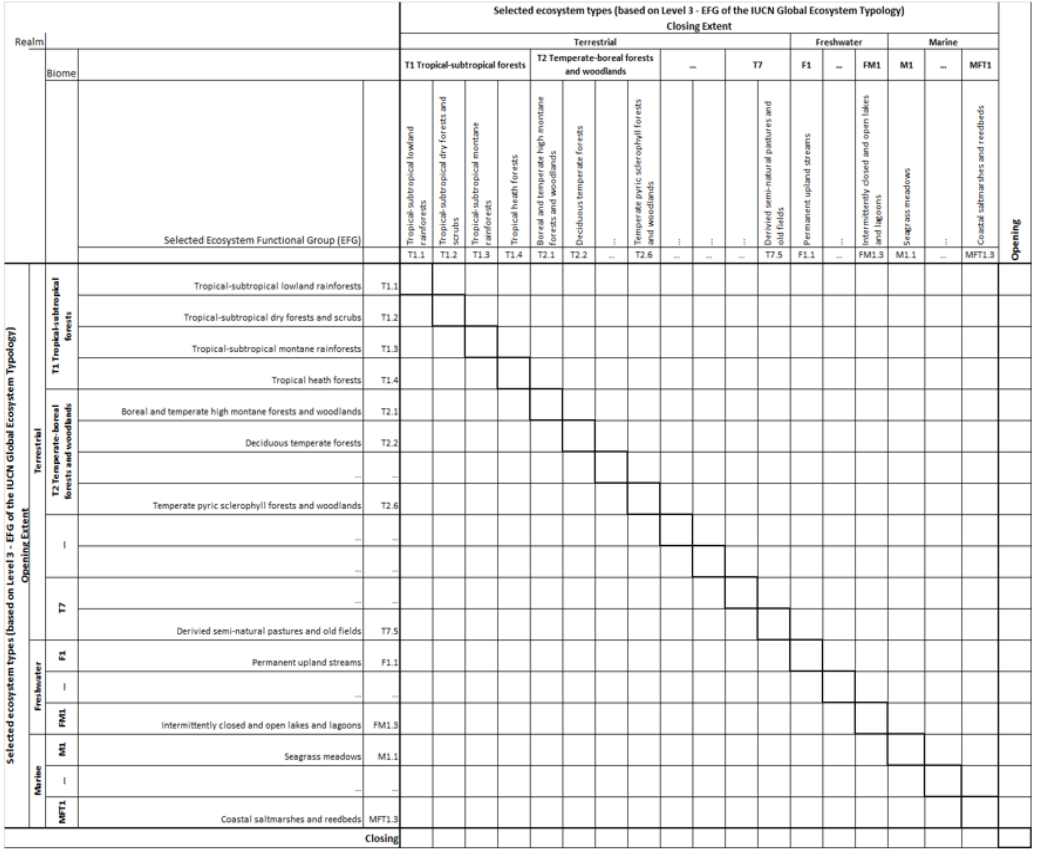
Additions in extent

Reductions in extent

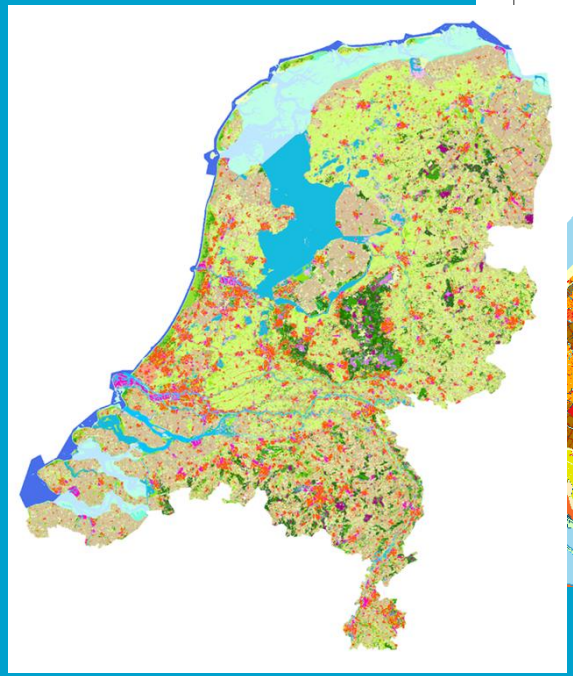
ET change matrix

The ET change matrix shows :

- the area of different ecosystem types at the beginning of the accounting period;
- the increases and decreases in this area according to the ecosystem type it was converted from or to;
- the area covered by different ecosystem types at the end of the accounting period.



Extent account for the Netherlands



The ecosystem type classification for the Netherlands

A new map and legend were constructed with a focus on ecology and ecosystem services, and maximal compliance with the SEEA-EA guidelines and the IUCN global ecosystem typology.

In the Netherlands, 49 different ecosystem types are being recognized

Main category	Publication level	Code	Ecosystem Type	(Dutch)
Natural	Forest	111	(Semi-)natural forest	Natuurbos
		112	Hedges and treelines	Houtsingel
		113	Plantation forest	Productiebos
		421	Other forest	Overig bos
	Open nature	114	Tall herbs	Ruigte
		115	Heathland	Heide
		116	Drift sand	Stuifzand
		117	Semi-natural grassland	Natuurgras
		118	Biodiverse cropland	Akkerland_nat
	Wetlands	121	Swamp forest	Moerasbos
		122	Bogs	Hoogveen
		123	Fens	Laagveen
	Water	131	Streams and rivers	Waterloop
		132	Lakes	Meer, plas
		133	Brackish	Brakwater
	Coastal	141	Coastal dunes	Kustduinen
		142	Salt marshes	Kwelder
		143	Beach	Strand
	Marine	144	Intertidal and mud flats	Intertidal
		145	Shoals	Zandplaat
		146	Estuarium	Estuarium
		147	North sea	Noordzee
		148	Wadden sea	Waddenzee
Agriculture	Cropland	211	Cropland, regular	Akkerbouw_reg
		212	Cropland, extensive	Akkerbouw_ext
		213	Perannuals, regular	Meerjarig_reg
		214	Perannuals, extensive	Meerjarig_ext
	Grassland	221	Pasture, permanent	Grasland_blv
		222	Pasture, temporal	Grasland_tijd
		223	Pasture, extensive	Grasland_ext
	Horticulture	231	Greenhouse horticulture	Glastuinbouw
		232	Nursery container fields	Pot_Container
	Other	241	Fallow land	Braakliggend
		242	Arable field margins	Faunarand
Urban and other (semi-) built-up	Urban & Infra	311	Built-up (urban)	Built-up (urban)
		312	Built-up (rural)	Built-up (rural)
		321	Business park	Bedrijfsterrein
		322	Mining, land fills, etc.	Grondgebonden
		331	Infrastructural	Infrastructuur
		411	Marine, other	Zee, overig
		351	Sport park	Sportterrein
		352	Residential recreation	Verblijfsrecreatie
	Public green space	341	Landscape garden	Landschapstuin
		342	Public park (large)	Park
		343	Public park (small)	Plantsoen
		344	Public green space, other	Groenvoorziening
		345	Semi-public green space	Semi-op. groen
	Other unpaved	422	Grassland, other	Overig grasland
		423	Other terrain	Overig terrein

Data Sources

- Digital topographic map 1:10k
  - Baseline geometry
  - Land cover
  - Land use (selected uses)
- Nature:
  - Nature management types
- Agriculture:
  - Agricultural parcel registry
- Urban:
  - Large-scale topography
  - Public green
- Special topic maps
  - Salt marshes

Construction of the ecosystem type maps

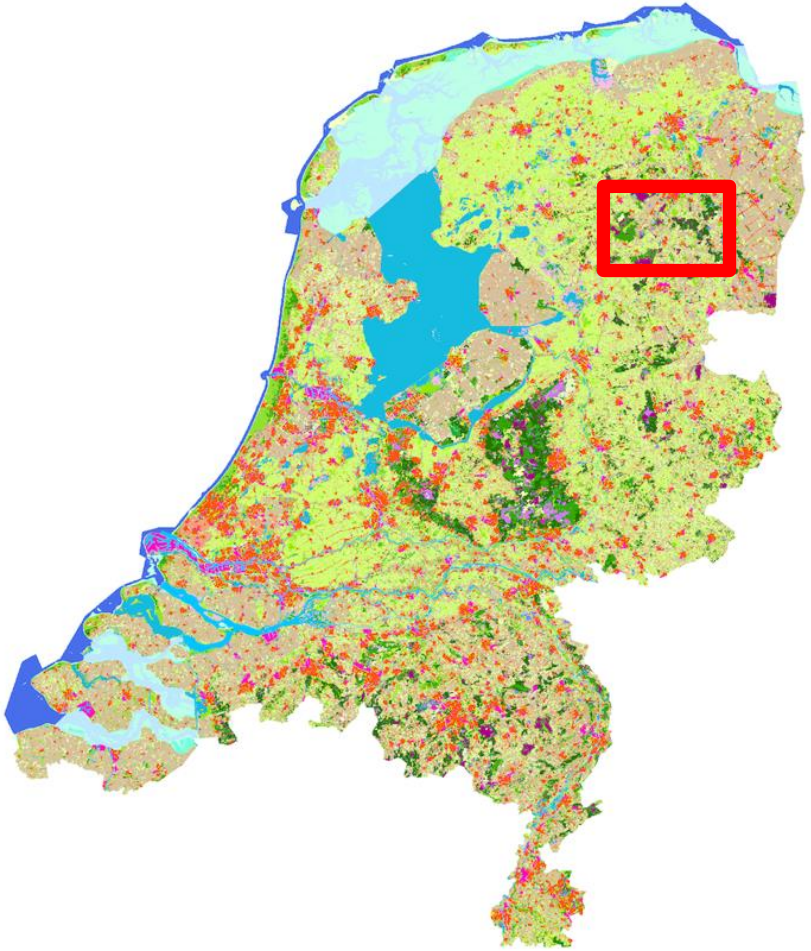
Ecosystem types maps were constructed using a fully automated process implemented in ArcGIS. The end result of this process is a vector map, where each map units is an ecosystem asset, each characterized by the following attributes

- **Ecotype** – the ecosystem type
- **Ecocode** – 3-digit numerical code for each ecosystem type
- **Subtype** – Sub type. Used to specify the nature management type (Nature); dominant crop type (Agriculture) or land cover (urban, built up, and other).

Along with the original vector maps, raster maps are constructed with multiple resolutions (2.5m; 10m; 25m; 100m).

Orvelte:

- Intensive agriculture
- Extensive agriculture
- Nature



Orvelte:

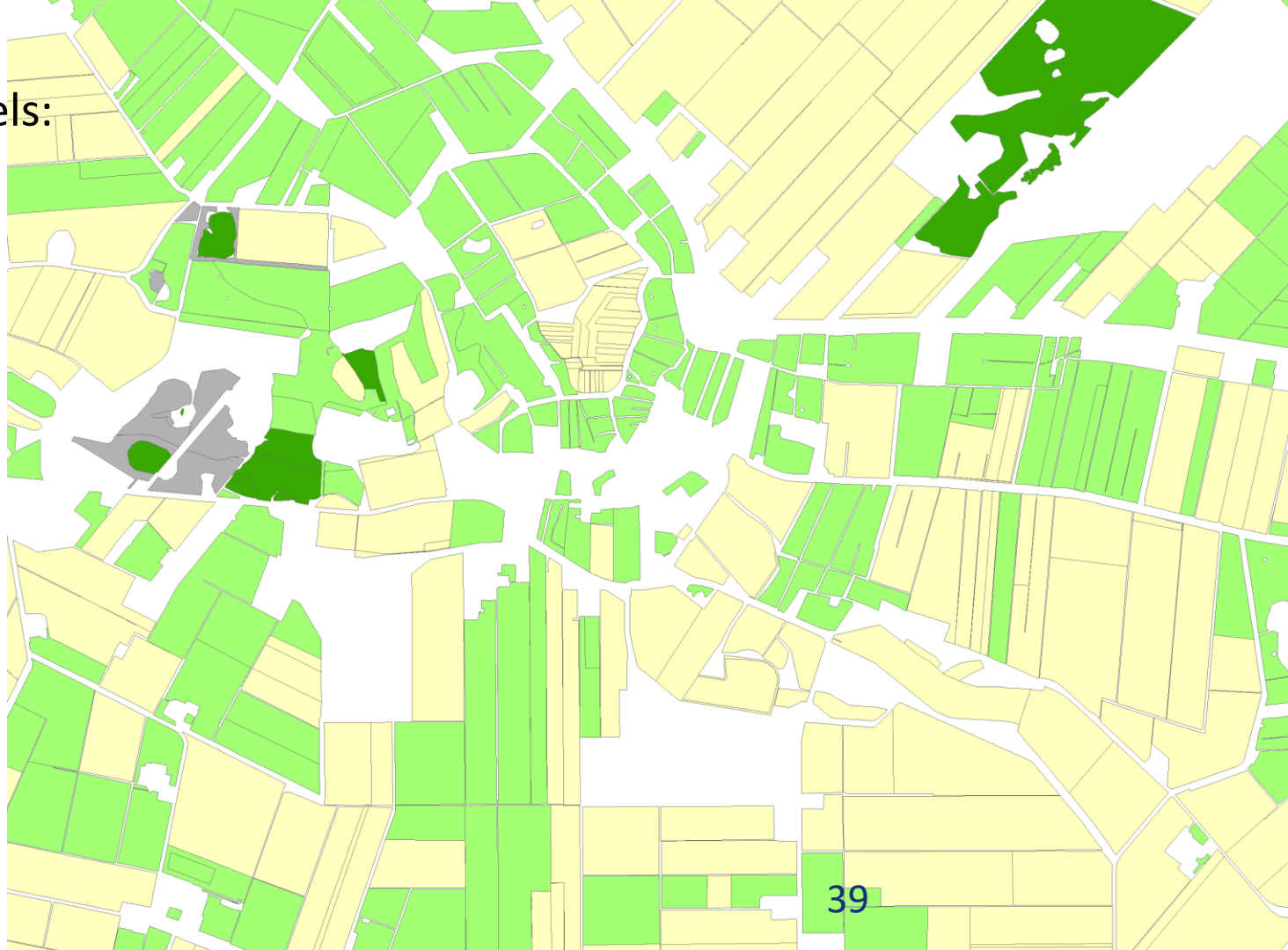
- Intensive agriculture
- Extensive agriculture
- Nature

Orvelte:

- Top10 NL

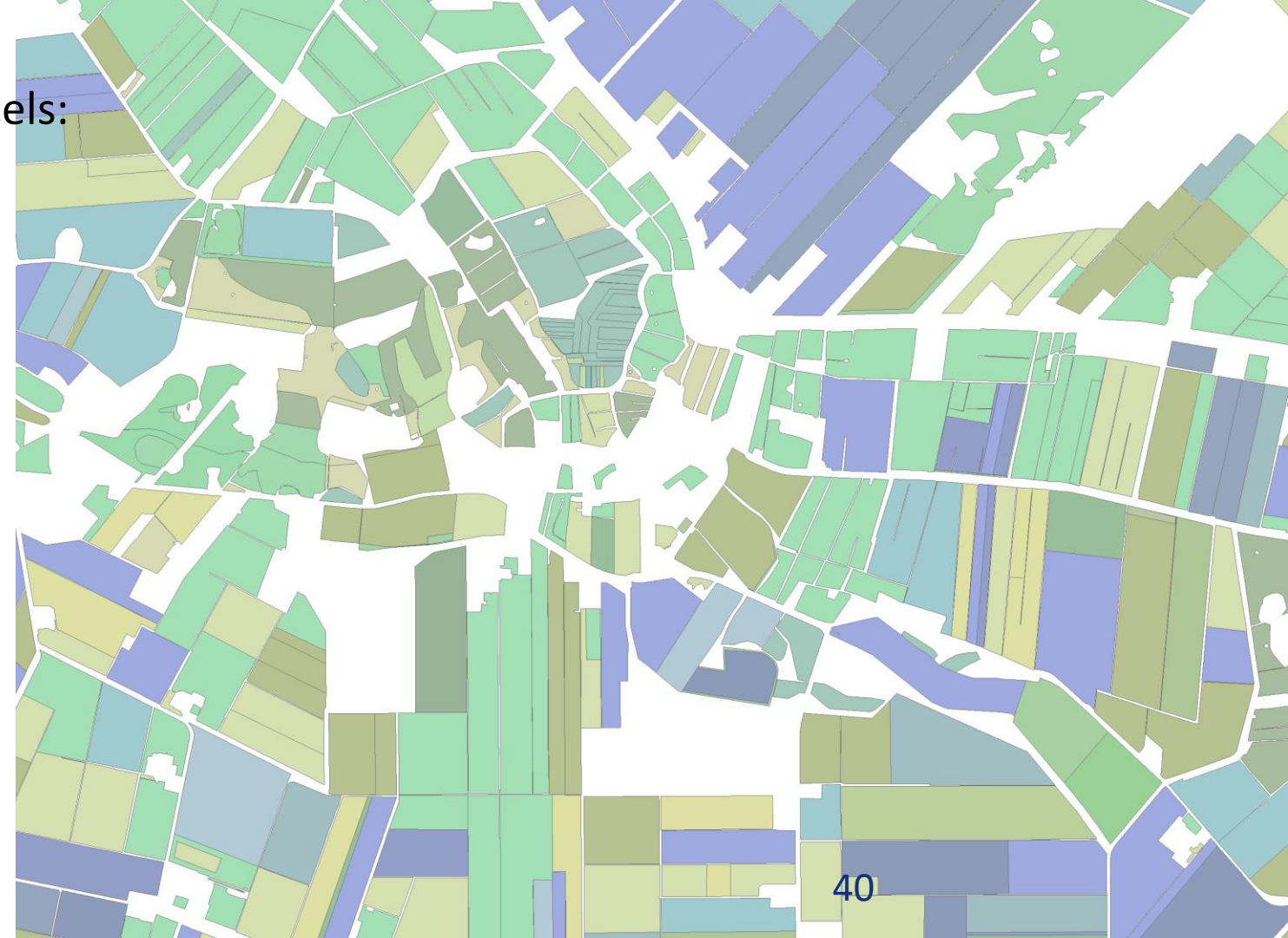
Orvelte:

- Agricultural parcels:
  - Grassland
  - Cropland
  - Nature



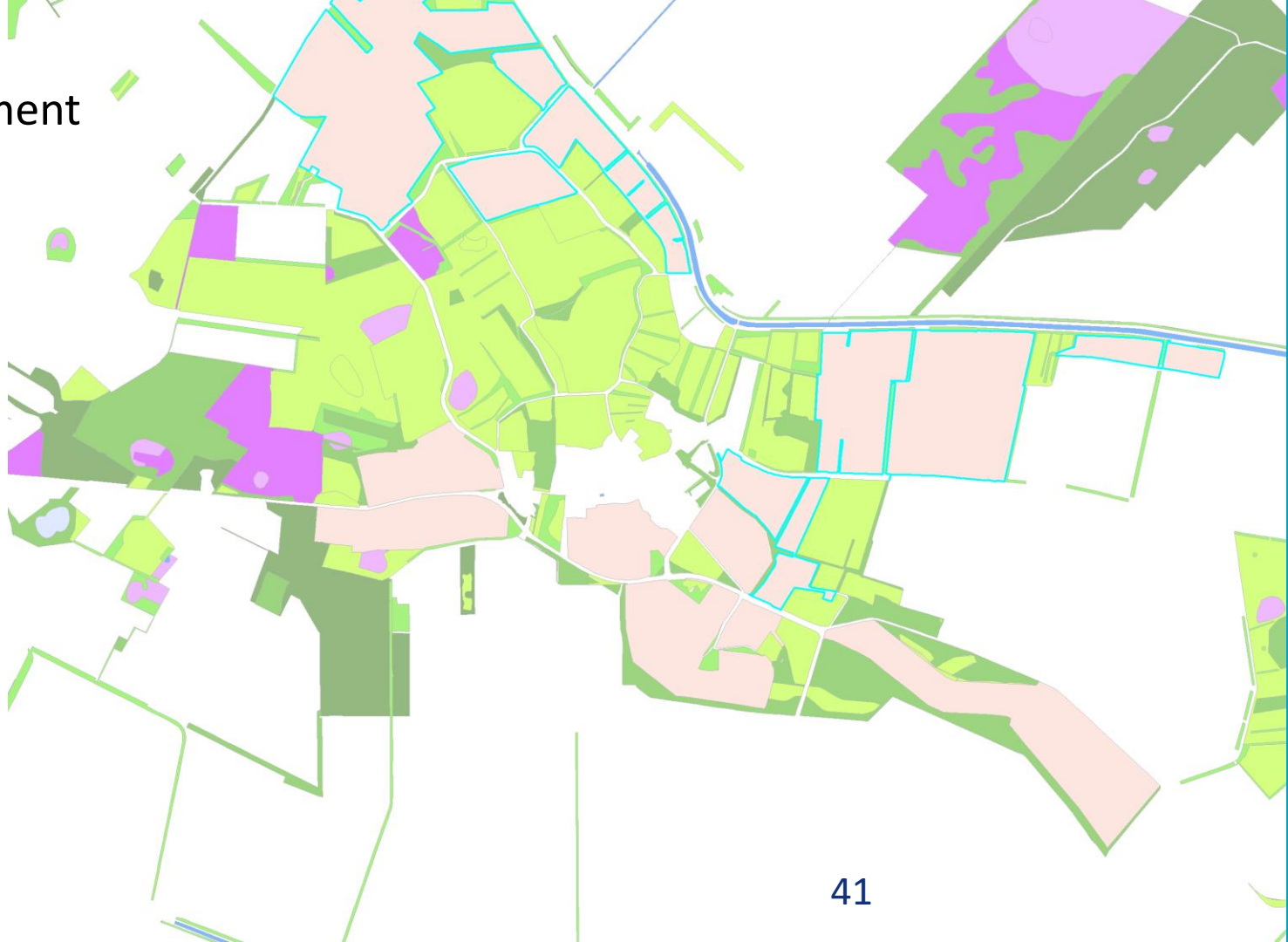
Orvelte:

- Agricultural parcels:
  - Crop types



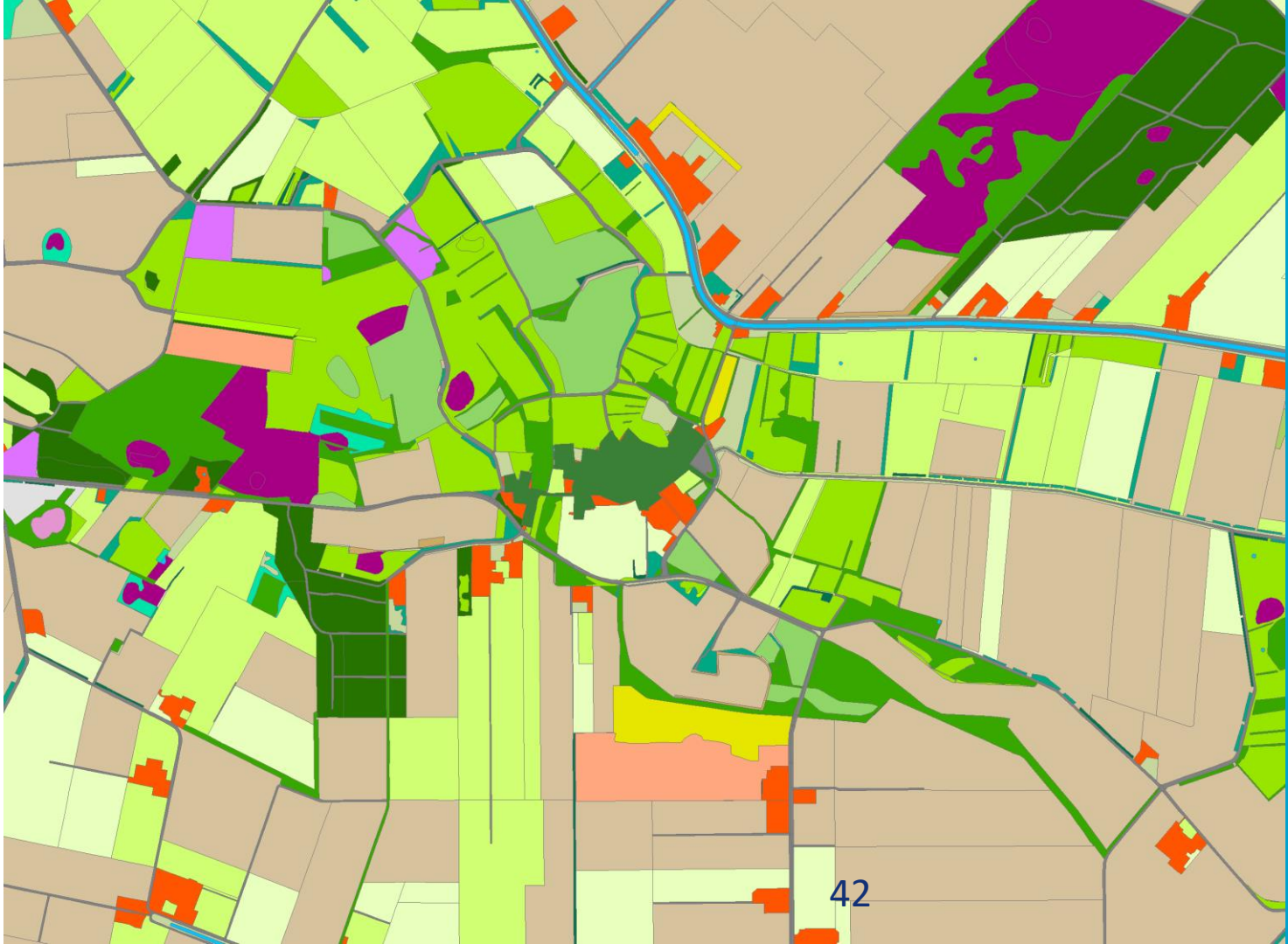
Orvelte:

- Nature management



Orvelte:

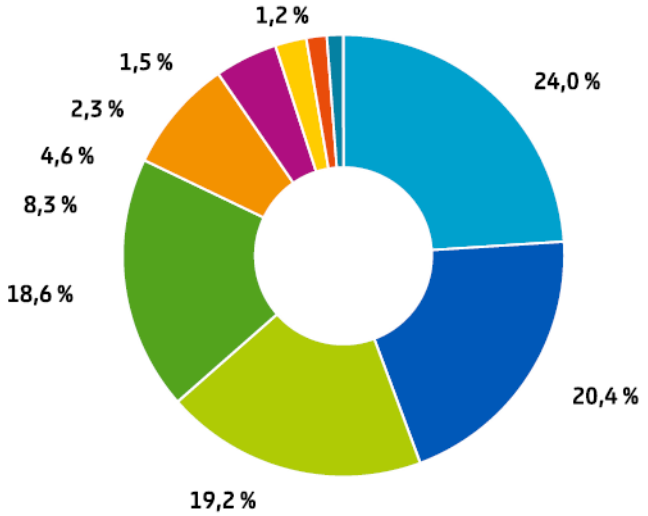
- Ecosystem types



Extent account for the Netherlands

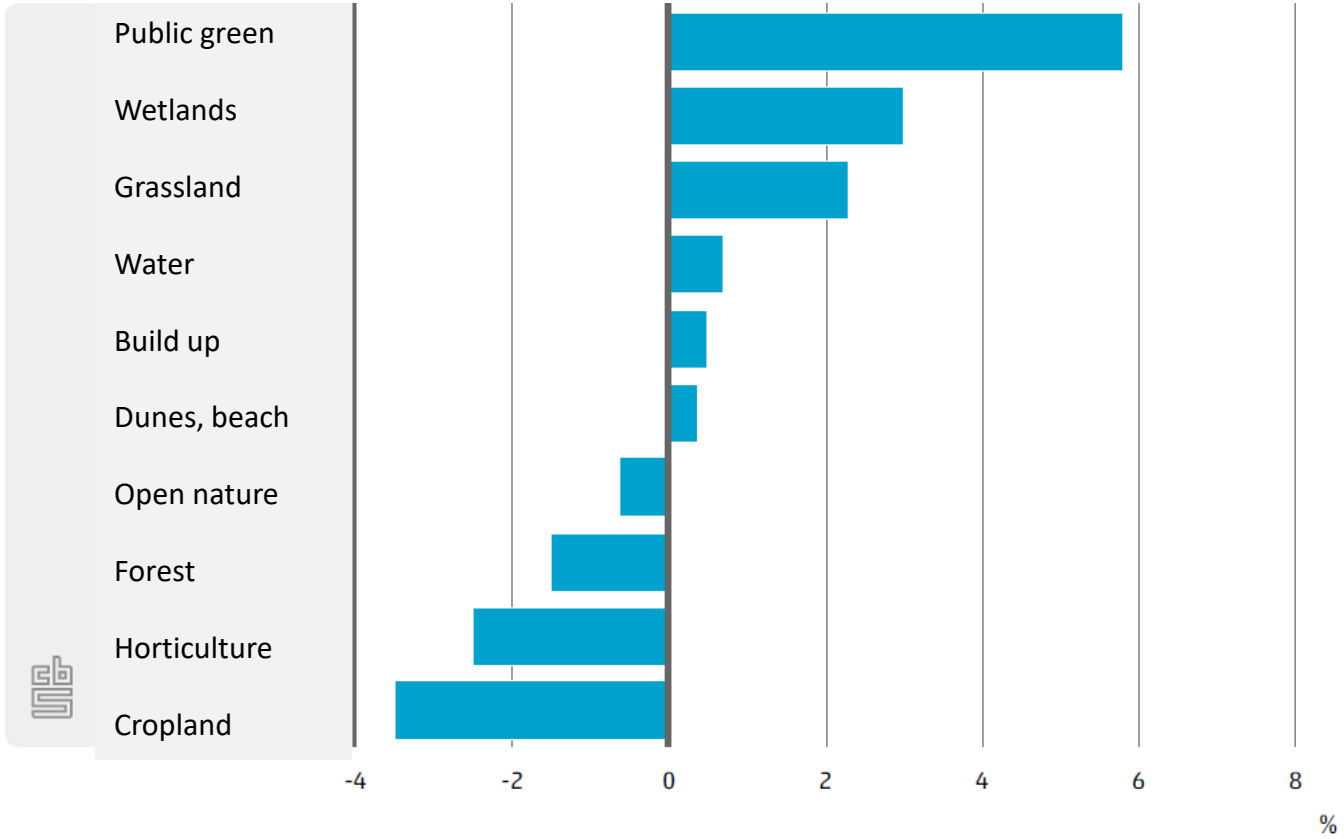
	Extent (km²) 2013	Increase (km²) 2013-2015	Decrease (km²) 2013-2015	Net change (km²) 2013-2015	Extent (km²) 2015	Increase (km²) 2015-2018	Decrease (km²) 2015-2018	Net change (km²) 2015-2018	Extent (km²) 2018
Total	41.542	3.357	3.357	0	41.542	3.629	3.629	0	41.542
Forest	3.475	74	106	-32	3.443	84	106	-22	3.422
Open nature	1.892	230	246	-17	1.876	240	235	5	1.881
Wetlands	612	42	29	13	625	44	38	6	631
Dunes, beach	497	18	20	-3	494	32	27	5	499
Water	7.861	64	47	17	7.879	86	45	41	7.920
Cropland	8.719	938	1.271	-332	8.386	1.238	1.208	30	8.416
Grassland	9.697	1.467	1.124	343	10.040	1.347	1.471	-123	9.917
Horticulture	203	12	19	-7	196	15	13	2	198
Other agr.	61	27	44	-18	43	34	31	2	46
Build up	7.636	382	373	9	7.645	399	370	29	7.674
Public green	888	104	78	27	915	111	86	25	940

Extent ecosystem types, 2018



Grassland
Cropland
Water
Build up
Forest
Open nature
Public green
Wetland
Beach, dunes

Change in ecosystem extent, 2013-2018




Thank for your attention!