

Ecosystem Accounting in the Netherlands

Sjoerd Schenau
Statistics Netherlands



Centraal Bureau
voor de Statistiek



WAGENINGEN
UNIVERSITY & RESEARCH

Content

- Ecosystem accounting in the Netherlands
- Ecosystem type map and extent account
- Condition account
- Physical ecosystem services
- Monetary accounts
- Carbon account
- Future plans

Why SEEA ecosystem accounts for the Netherlands ?



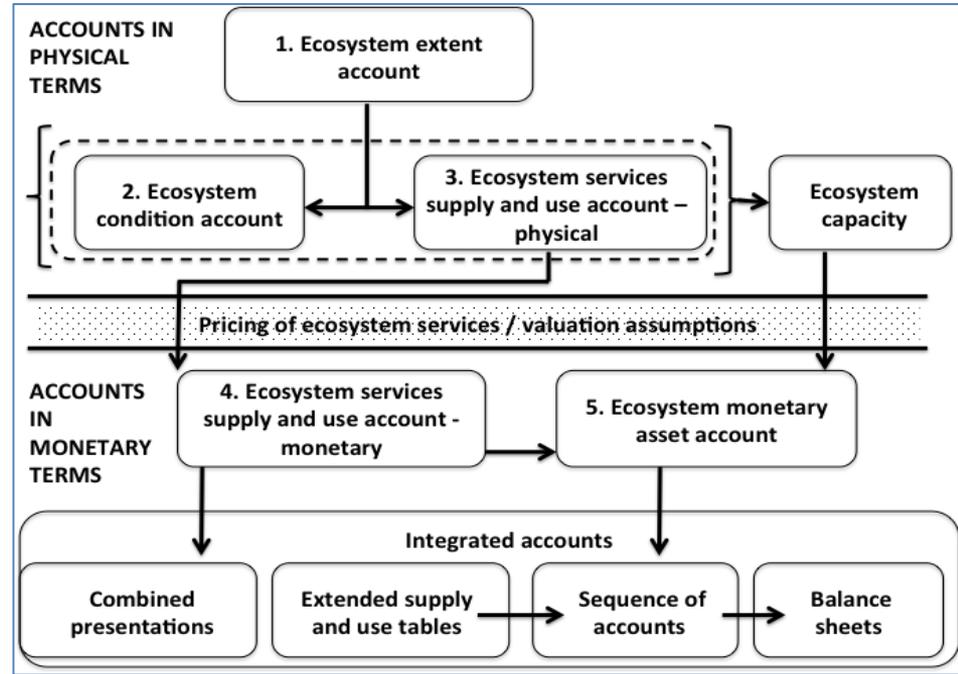
Ecosystem accounts in the NL



- **Aim:** *To test and develop detailed physical ecosystem accounts for the Netherlands and to experiment with the monetary ecosystem accounts.*
- Conform the international guidelines of SEEA-EEA
- National and regional level
- Financed by the ministry of Economic affairs and the ministry of infrastructure and environment
- By Statistics Netherlands and Wageningen university
- Four year project (2016-2020) in 3 phases (2 have been approved)

The SEEA-EEA Framework

1. Extent
 - (spatial)
2. Condition
 - (indicators)
3. ESS Supply/use
 - (physical)
4. ESS Supply/use
 - (monetary)
5. Asset account
 - (monetary)

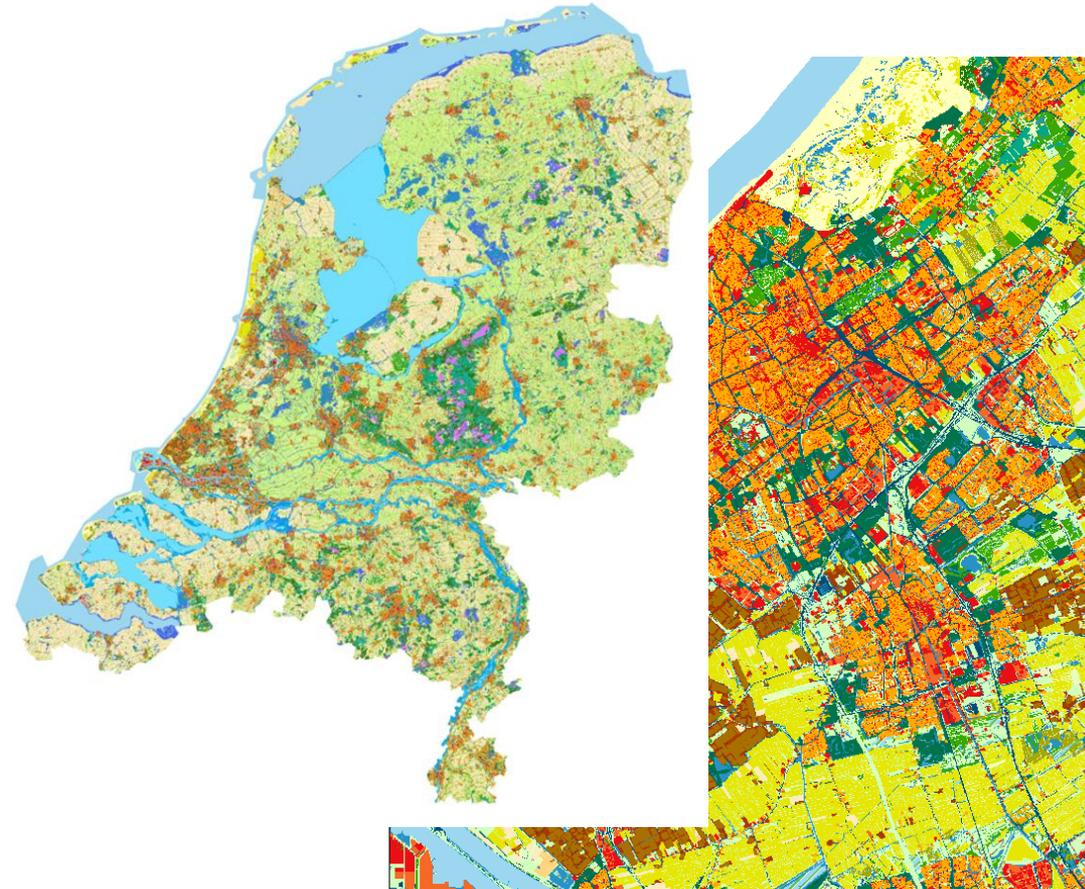


Ecosystem accounts NL

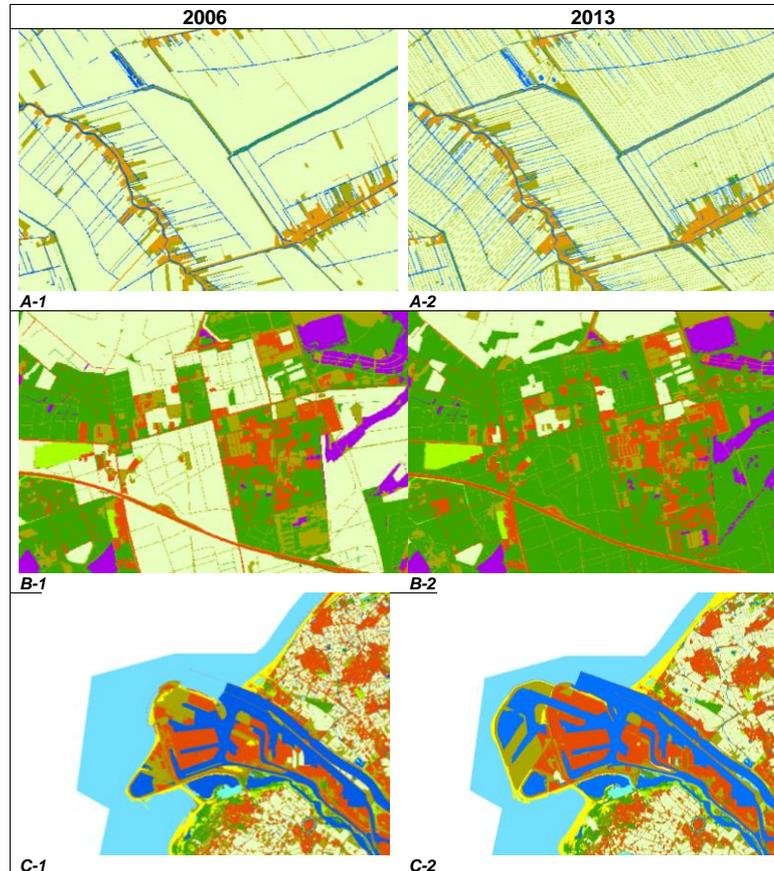
- Extent account
- Carbon account
- ESS supply/use – physical
- Condition account
- Biodiversity account
- ESS supply/use – monetary
- Asset account



Ecosystem Units map



Ecosystem extent: changes 2006 - 2013



Ecosystem extent account, 2006 - 2013

Ecosystem Unit	Area (km2)			Area (percentage)		
	2006	2013	Δ	2006	2013	Δ
Agriculture	19174	18811	-363	46,16	45,29	-0,87
Forest	3207	3216	8	7,72	7,74	0,02
Heath	394	427	33	0,95	1,03	0,08
Sand	356	358	2	0,86	0,86	0,00
Wetlands	461	580	119	1,11	1,40	0,29
Other nature	4061	4007	-54	9,78	9,65	-0,13
Public green areas	710	708	-1	1,71	1,70	0,00
Built-up and paved	5236	5410	175	12,60	13,03	0,42
Inland water	4088	4199	111	9,84	10,11	0,27
Sea	3846	3815	-31	9,26	9,18	-0,08
Unknown/null	6	8	2	0,01	0,02	0,00
The Netherlands	41539	41539	0			0,00

Condition account

Set van indicators

- Quality of ecosystems
- Capacity to supply ecosystem services

Indicators for

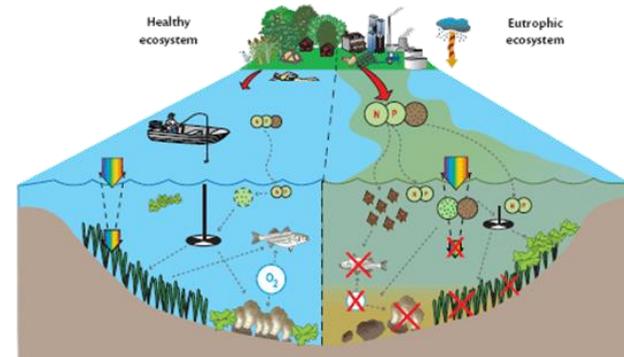
- Extent
- condition
- Pressure

Selection of indicators

- Relevant for policy
- Easy to interpret
- Focus on trends
- 2-5 indicators for most ecosystem types

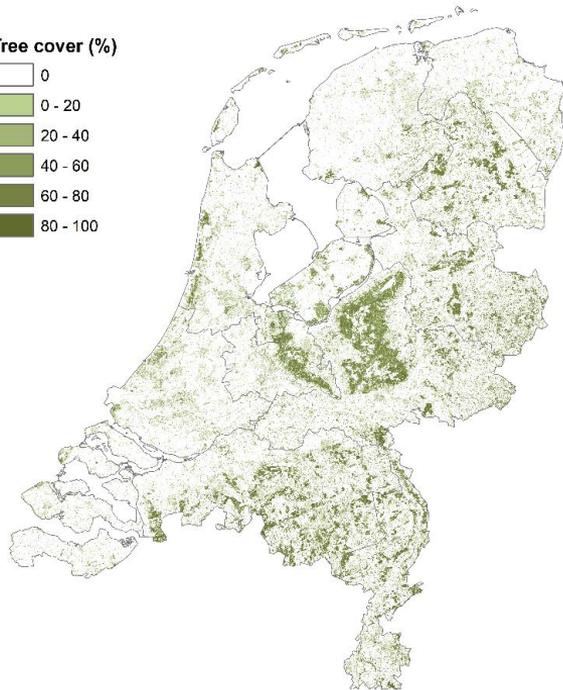
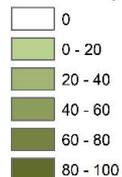


Figure 1.1. Conceptual diagram comparing a healthy system with no or low eutrophic condition to an unhealthy system exhibiting eutrophic symptoms.

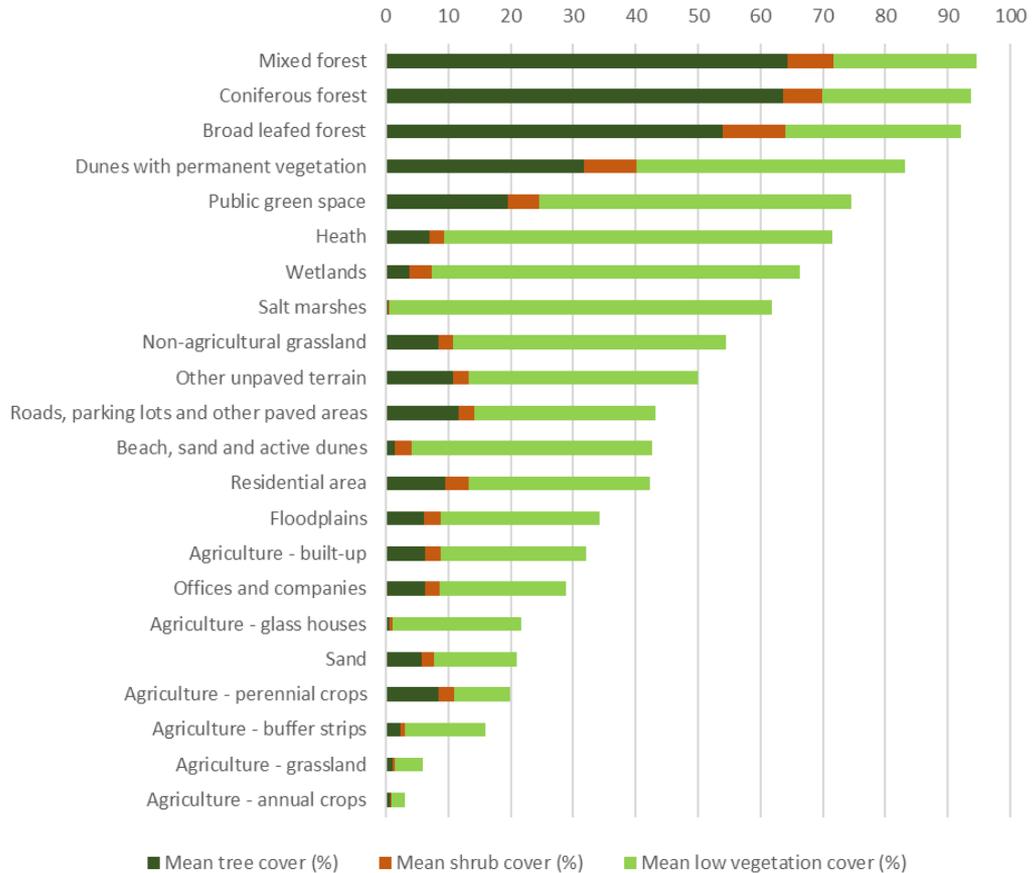


Example: vegetation

Tree cover (%)



Mean vegetation cover (%)



Condition account : extent and condition

	Unit	Year	Urban		Agriculture			Water	Nature					TOTAL NL	
			Built-up area	Urban green area	Crops	Grassland	Built-up	Sea/	Forest	Heath	Semi-natural grasslands	Fresh water wetlands	Dunes and beaches	Other	
								Rivers/Lakes							
Extent															
Extent		2013	539,657	68,416	860,629	927,216	47,281	802,345	309,636	40,813	54,01	34,346	49,889	418,232	4,154,080
Extent (% of NL)	%	2013	13.0	1.6	20.7	22.3	1.1	19.3	7.5	1.0	1.3	0.8	1.2	10.1	100
Condition															
Vegetation															
Tree cover	%	*	9	19	2	1	6		60	7	8	4	11	9	10
Shrub cover	%	*	4	5	0	0	3		8	2	2	3	5	3	2
Low vegetation cover	%	*	26	50	3	4	23		25	62	44	59	40	33	17
Tree height	m	*	7.5	9.1	8.8	8.3	6.9		12.8	7.4	9.0	5.7	7.9	8.7	9.9
Carbon stock in above ground biomass	Mton C	2013	0	0.34	0.95	1.85	0		19.2	0.33	0.11	0.03	0.99	0.94	24.74
NPP	ton C/ha			4.6	4.9	4.1			4.4	3.2	4.7	4.0	3.5	3.4	4.3
Biodiversity															
% Protected areas - Natura2000 and EHS					2.0	6.7	0.3		32.1	76.0	46.7	73.5	96.1	20.6	12.0
LPI	Index (1990=100)	2013	68		60			Coast 98 Wadden 118 Fresh 149	97	40		149	57		108.1
Characteristic species	Index (intact=100)	2013							33.1	34.2	31.8	47.6	46.0		
Structure and function (Habitat Directive)	% of HD area in excellent condition	2013							75.2	25.9	56.8	47.6	40.3		
Soil															
Soil organic matter	% of area >3% SOM	1990 - 2000		92	96	99			76	80	97	91	35	94	93

Condition account : pressures

	Unit	Year	Urban		Agriculture			Water	Nature						TOTAL NL
			Built-up area	Urban green area	Crops	Grassland	Built-up	Sea/ rivers/ lakes	Forest	Heath	Semi-natural grasslands	Fresh water wetlands	Dunes and beaches	Other	
Eutrophication – deposition	<i>mol N/ha/yr</i>	2013	2,02	1,898	1,528	1,559	1,63	821	1,899	1,594	1,531	1,297	1,022	1,599	1,662 / 1,500
	<i>% area with eutrophication</i>	2013							99.6	100	99.9	100	42.6		
Acidification – deposition	<i>mol H⁺/ha/yr</i>	2013	2,706	2,592	2,14	2,169	2,277	1,415	2,575	2,242	2,171	1,919	1,645	2,25	2,300 / 2,129
	<i>% area with acidification</i>	2013							76.8	100	94.4		81.6		
Drainage organic soils	<i>cm</i>		66	71	81	61	75		82	64	52	49	26	63	66
	<i>% area >60 cm (of peat soils)</i>		68	60.6	88.8	46.5	54		65.0	70.0	33.7	35.9	0.0	52.3	56
Urbanisation – % paved surfaces	<i>% paved surface in 1 km²</i>	2013	42	34	9	10	28	12	9	4	10	5	8	17	17 / 16
	<i>% increase in paved surfaces</i>	2006 - 2013	1.3	1.5	0.8	0.7	2.2	0.09	0.7	0.4	0.6	0.06	0.3	1.4	0.9 / 0.7
Urban Heat Island	<i>°C increase</i>	*	0.63	0.42	0.06	0.06	0.4		0.06	0.02	0.08	0.03	0.03	0.19	0.18
	<i>% area > 1.5 °C increase</i>	*	7.7	0.5	0.0	0	6.6		0.0	0	0	0	0.0	0.2	1.4

Physical ecosystem services

- 13 ecosystem services have been selected
- Development of ecosystem service models
- Spatial explicit information and statistics
- Output
 - Maps
 - Accounts

Ecosystem services
Provisioning services
Crop production
Fodder production
Wood production
Biomass from non-agricultural sources
Drinking water
Regulating services
Carbon sequestration in biomass and soil
Pollination
Natural pest control
Erosion control
Air filtration
Protection against flooding due to heavy rainfall
Cultural services
Nature recreation (hiking)
Nature tourism



Fodder production

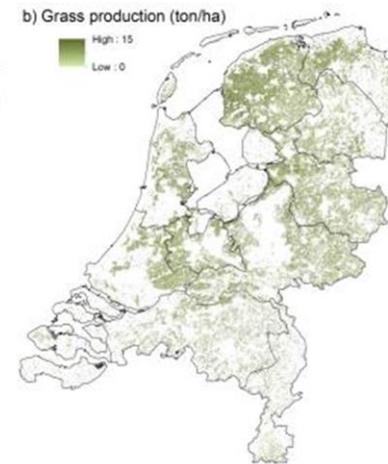


	Total area (1000ha)			Mean production (ton/ha)			Total production (kton)		
	Total	Maize	Grass	Total	Maize	Grass	Total	Maize	Grass
Groningen	70	9	61	11	41	7	786	388	398
Friesland	187	16	171	10	43	7	1.839	712	1.127
Drenthe	86	22	64	15	39	6	1.258	851	407
Overijssel	174	41	133	15	44	6	2.657	1.810	846
Flevoland	13	3	10	16	46	6	216		
Gelderland	193	45	148	15	43	6	2.879		
Utrecht	57	6	51	10	39	6	557		
Noord-Holland	66	4	62	9	41	7	591		
Zuid-Holland	70	4	66	8	41	6	562		
Zeeland	20	6	14	16	41	5	330		
Noord-Brabant	151	64	87	22	44	6	3.353		
Limburg	51	22	28	20	38	6	1.012		
Netherlands	1.139	245	895	14	42	6	16.039		

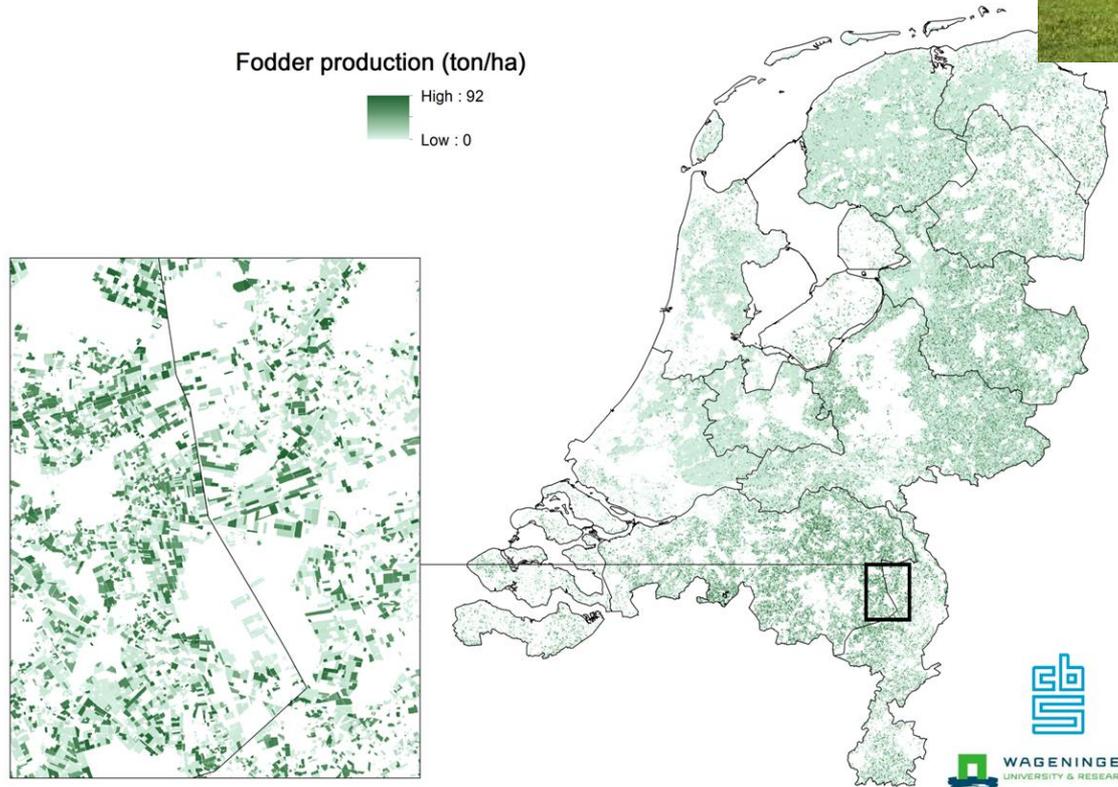
a) Maize production (ton/ha)



b) Grass production (ton/ha)



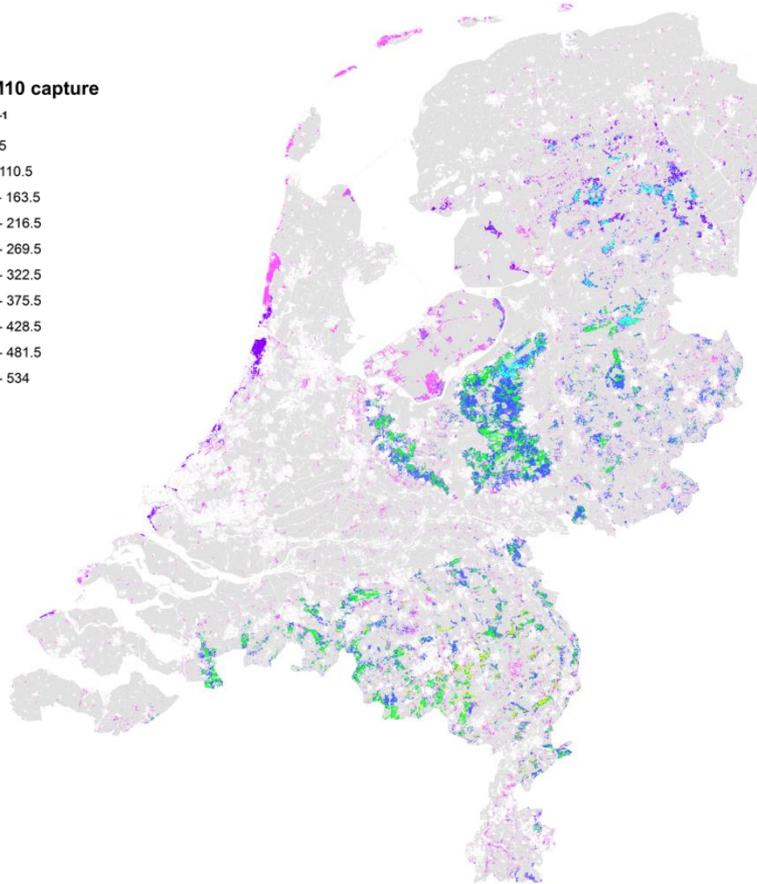
Fodder production



Air filtration

Yearly PM₁₀ capture

kg PM₁₀ ha⁻¹



- Largest contribution by pine trees
- Average capture: 27 kg PM₁₀ jr⁻¹ ha⁻¹
- Total capture: 72,500 tonne PM₁₀ yr⁻¹

Nature tourism

Source data: CVO, Logiesaccommodatie,
data Statistics NL



Province	Active and nature tourists (x1000)	Beach tourism (x1000)	Water sports tourism (x1000)	Average length of stay (days)
Groningen	66	0	1	2,5
Friesland	263	129	66	3,1
Drenthe	378	0	0	3,8
Overijssel	353	0	5	3,4
Flevoland	61	0	8	3,7
Gelderland	797	0	0	3,3
Utrecht	151	0	0	2,3
Noord Holland	293	327	6	2,3
Zuid Holland	151	126	18	2,2
Zeeland	145	386	16	4,5
Noord Brabant	278	0	0	3,3
Limburg	446	0	9	3,1
The Netherlands	3382	968	129	3,0

Tourism region



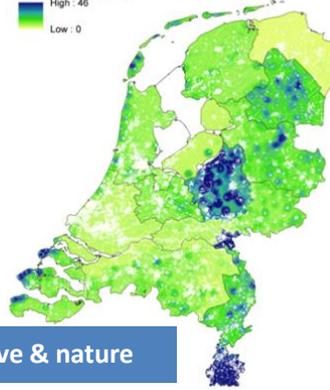
Nature tourism

Beach tourism
Overnight stays/ha/yr
High : 922
Low : 0



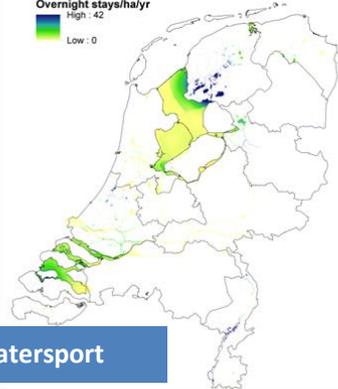
Beach recreation

Active and nature tourism
Overnight stays/ha/yr
High : 46
Low : 0



Active & nature

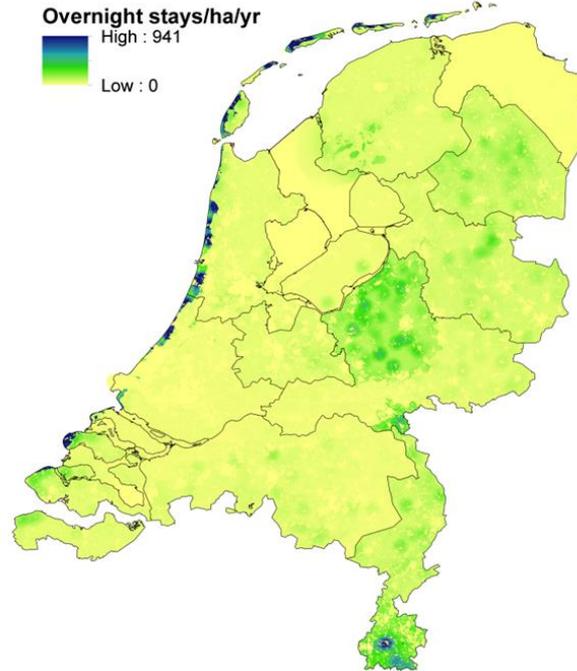
Water sports tourism
Overnight stays/ha/yr
High : 42
Low : 0



Watersport

=

All nature tourism
Overnight stays/ha/yr
High : 941
Low : 0



Physical Supply table

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 leaved 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

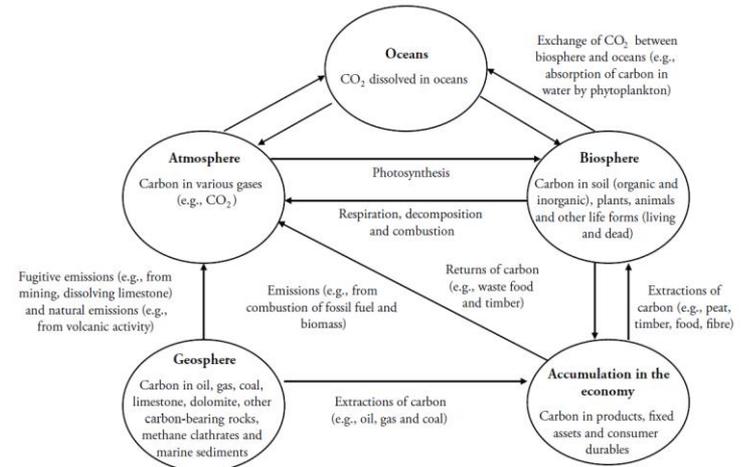


Physical use tables for ecosystem services

Ecosystem service	Unit	A - Agriculture, forestry and fishing	B,C - Mining and manufacturing	D - Electricity	E - Water supply	F-H - Construction, wholesale and retail trade, 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

Carbon account

- Carbon account is a thematic account part of NCA project Netherlands
- **Aim:** to compile a comprehensive carbon account for the Netherlands for one year (2013)
- Comprehensive: Geocarbon, Biocarbon, Carbon in the economy, Carbon in the atmosphere
- For biocarbon **spatially explicit data**

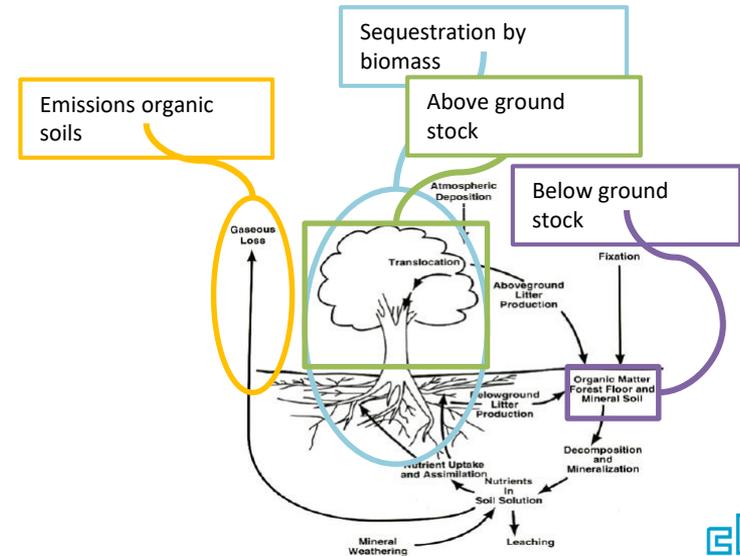


Biocarbon



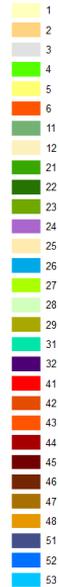
Carbon stocks: above and below ground

Carbon flows: timber harvest, carbon sequestration and carbon emissions



Data sources and methods

Ecosystem units

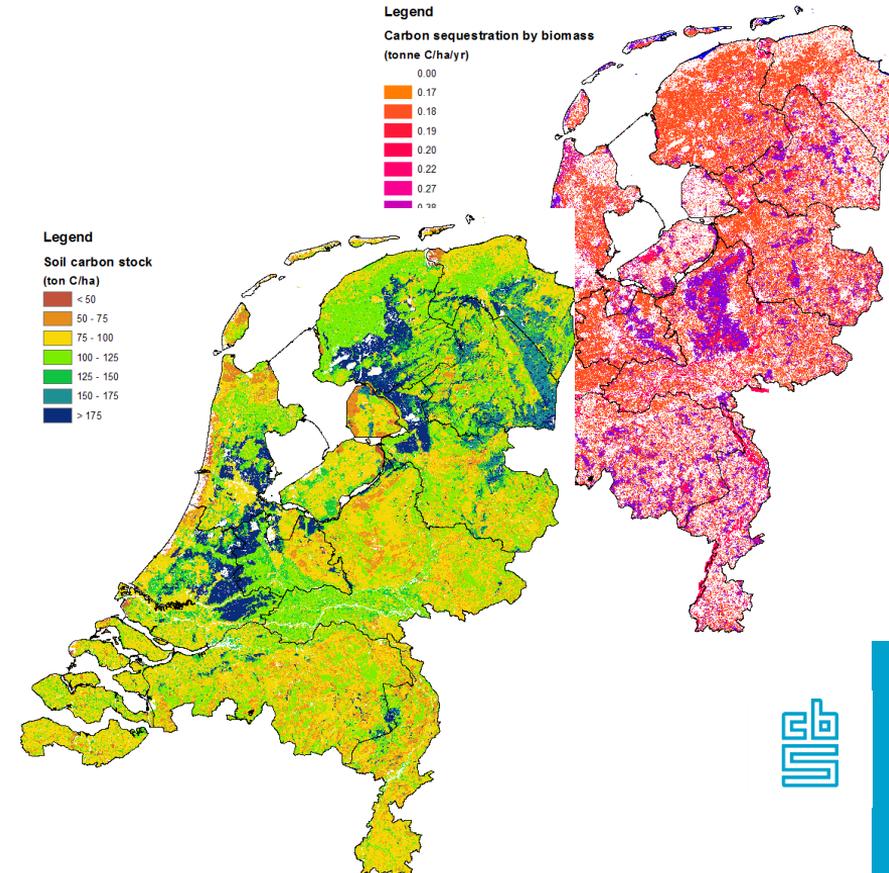


	EU	Vastlegging (tonC/ha/jr)	Voorraad (tonC/ha)
Eenjarig gewas	1	0	0
Meerjarig gewas	2	0.38	12
Kassen	4	0	0
Weiland	5	0.18	2
Faunarand	6	0.17	2
	:		
Loofbos	21	1.89	62
Naaldbos	22	1.89	62
Gemengd bos	23	1.89	62
Heide	24	0.19	8
	:		
Uiterwaarden	31	0.2	2
Kwelders	32	4	12
	:		

- Combining EU_NL kaart met look-up tables
- Soil map of the Netherlands
- Map of carbon stock in upper 30 cm Dutch soil

Carbon stock and carbon sequestration

Ecosystem unit	Netherlands (1000 ha)	Sequestration (ktonne C/yr)	Carbon stock (ktonne C)
Non-perennial plants	781	0	0
Perennial plants	79	30	951
Greenhouses	12	0	0
Meadow	927	167	1,854
Hedgerows	36	6	73
Farmyards and barns	35	0	0
Dunes with permanent vegetation	16	30	988
Active coastal dunes	34	0	0
Beaches	0	0	0
Deciduous forest	109	206	6,767
Coniferous forest	82	155	5,079
Mixed forest	119	224	7,351
Heath land	41	8	327
Inland dunes	2	0	0
Fresh water wetlands	34	8	34
Natural grassland	54	10	108
Public green space	68	18	342
Other unpaved terrain	295	53	590
River flood basin	73	15	147
Tidal salt marshes	11	45	134
Paved surfaces	540	0	0
Sea	382	0	0
Lakes and ponds	123	0	0
Rivers and streams	298	0	0
Total	4,153	975	24,745



Biocarbon account, 2013

	Meadow	Other agricultural land	Forrest	Dunes / beaches	Fresh water wetlands	Natural grassland	Public green space	Other unpaved terrain	Paved surfaces	Other	TOTAL
Opening stock	112.0	94.1	48.2	5.3	0.0	5.0	6.1	30.6	52.0	23.6	376.9
Additions to stock											
Natural expansion	0.2	0.0	0.6	0.0	0.0	0.0	0.0	0.1	0.0	-0.9	0.0
Managed expansion											
Upwards reappraisals											
Reductions in stock											
Natural contraction	0.9	0.4	0.1	0.0	0.0	0.0	0.1	0.1	0.2	-1.8	0.0
Managed contraction			0.5								0.5
Downwards reappraisals											
Net carbon balance	-0.7	-0.3	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2	0.9	-0.5
Closing stock	111.3	93.7	48.2	5.3	0.0	5.0	6.1	30.5	51.8	24.5	376.4

← Carbon stock above ground and in soil

← Carbon sequestration

← Emissions from peat
← Timber harvest



Carbon account NL voor 2013

	Geocarbon					Biocarbon				Carbon in the economy			Carbon in the atmosphere	Total	
	oil	gas and shalgas	coal	limestone and marl	total geocarbon	Forests	Cropland / meadows	Other ecosystems	Total biocarbon	Inventories	fixed assets, consumer durables	Waste	Total		
Opening stock	54	627	12717		13398	48	206	123	377	24		24	3193	16993	
Additions to stock	0	0	0	0	0	0.6	0.2	0.2	1.0	251	2	10	263	64.2	329
Natural expansion						0.6	0.2	0.2	1.0					1.8	3
Managed expansion										50		50		62.4	113
Discoveries	0	0	0		0										0
Upwards reappraisals	0	0	0		0										0
Reclassifications										15	2	6	23		23
Imports										186		4	190		190
Reductions in stock	1	51	0	0	52	0.6	1.3	0.6	2.4	246	0	10	256	9.4	320
Natural contraction						0.1	1.3	0.5	1.9					1.0	3
Managed contraction	1	40	0	0	41	0.5	0.0	0.0	0.5	60		3	62	8.5	113
Downwards reappraisals	0	11	0		11										11
Reclassifications										19	0	5	23		23
Exports										168		3	170		170
Net carbon balance	-1	-51	0	0	-52	0.0	-1.1	-0.4	-1.4	5	2	0	7	54.8	9
Closing stock	53	587	12717		13356	48	205	122	376	30		32	3248	17012	

Valuation of ecosystem services

- **Aim:** *to provide experimental monetary values for ecosystem services and ecosystem assets in the Netherlands*
- Selection of valuation methods
- Calculate values for ecosystem services using different methods
- Compile spatial explicit data
- Calculate asset values using the NPV method
- Integrate values in SNA tables (monetary supply use tables, asset account)



Four categories of value

1. Exchange values incorporated in GVA of the SNA
2. Exchange values not incorporated in GVA of the SNA
3. Values of the benefits
4. Welfare values

	Exchange values incorporated in GVA of the SNA	Exchange values not incorporated in GVA of the SNA	Value of the benefits	Welfare values
Provisioning services	X		X	
Regulating services		X		X
Cultural services	?	?	X	X

Valuation methods

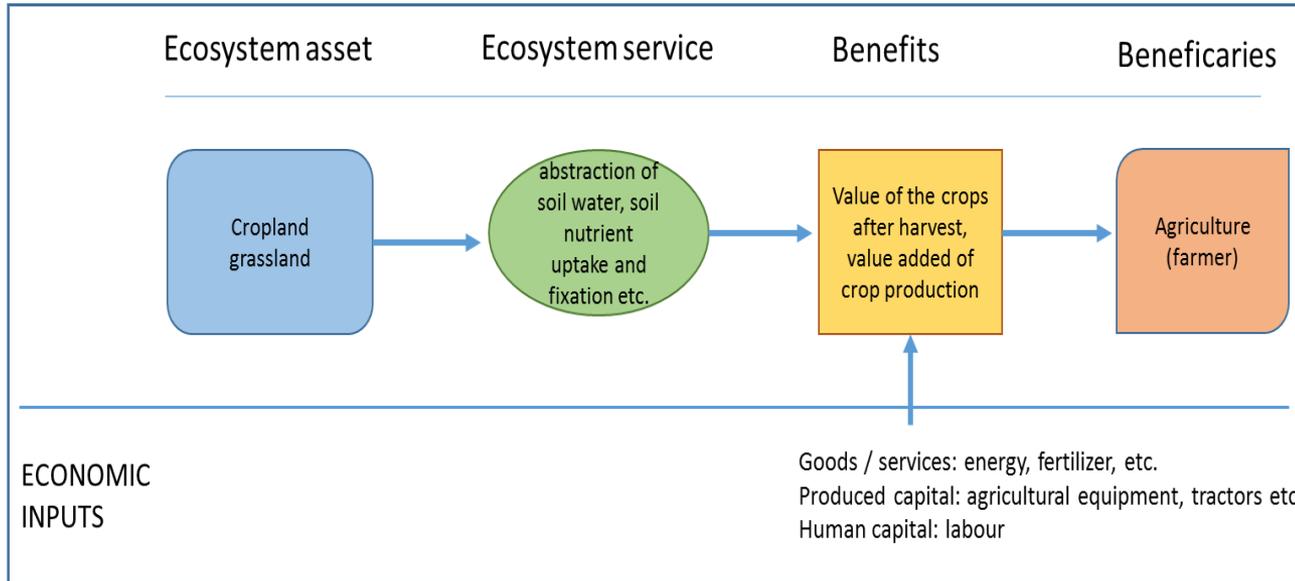
Type	Method	Exchange values incorporated in GVA of the SNA	Exchange values not incorporated in GVA of the SNA	Value of the benefits	Welfare values
market-based	resource rent	X			
	rent prices	X			
	user costs	X			
	payments for ecosystem services	X			
	production function method	X			
	GVA method			X	
cost-based	replacement costs		X		
	avoided damage		X		
	social cost of carbon		X		x
revealed preference	Consumer expenditure (including travel costs)			X	
	hedonic pricing	X			
stated preference	Contingent valuation				X
	Choice modelling				X

Valuation methods

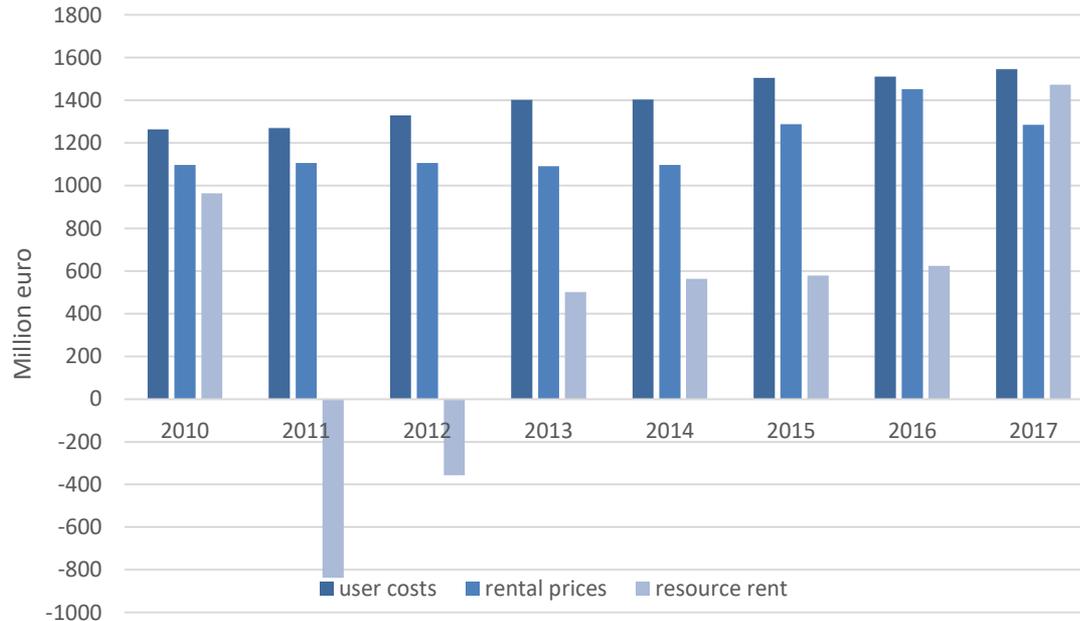
Type	Ecosystem service	Method
Provisioning services	Crop production	resource rent
		rent proces
		user costs
	Fodder production	resource rent
		rent proces
		user costs
	Wood production	resource rent (stumpage price)
	Biomass from non-agricultural sources	<i>excluded</i>
	Fishing	<i>excluded</i>
Regulating services	Air filtration	avoided damage
	Carbon sequestration in biomass	avoided damage (social cost of carbon)
	Drinking water	replacement cost
	Pollination	avoided damage
	Natural pest control	avoided damage
		replacement cost
	Erosion prevention	<i>excluded</i>
Protection against heavy rainfall	<i>excluded</i>	
Cultural services	Nature recreation	household expenditure
	Tourism	household expenditure
		resource rent
Amenity services	hedonic prices	



Definition of the ecosystem service and benefits for crop and fodder production



Value of provisioning services for crop and fodder production



Policy applications of ecosystem accounts

- Understanding the **contribution of ecosystems to economic activities** (and the monetary value of these ecosystems)
- Measuring and monitoring **sustainability**: what are the changes in ecosystem capital / ecosystem assets from one year to the next
- **Identifying ecosystem types/ areas / services** under particular threat
- The spatial approach of ecosystem accounting makes it also suitable **to support resource management and land use planning**

Future plans

- Finalising project 2018
- 2019-2020: Update and further improvement of the different SEEA EEA accounts
- Application and testing of the new guidelines
- Pilot for marine accounts (North Sea) (?)

A close-up photograph of a branch with white cherry blossoms and green buds against a dark background. The text "Thank you!" is overlaid in white. A solid blue vertical bar is on the right side of the image.

Thank you!