System of Environmental Economic Accounting

Overview of the SEEA Experimental Ecosystem Accounting

Bram Edens, PhD

Senior statistician

United Nations Statistics Division

Planning and Stakeholder consultation meeting

Natural Capital Accounting and Valuation of Ecosystem Service Project

United Nations

Outline

- Overview of the SEEA Experimental Ecosystem Accounting
- Examples
  - > Accounting for ecosystem extent
  - > Accounting for ecosystem condition
  - > Accounting for ecosystem services
  - > Thematic accounts
- Valuation
- Lessons learned

Overview of the SEEA Experimental Ecosystem Accounting

SEEA

System of Environmental-Economic Accounting (SEEA)

- The **SEEA Central Framework** was adopted as an international statistical standard by the UN Statistical Commission in 2012
- The **SEEA Experimental Ecosystem Accounting** complements the Central Framework and represents international efforts toward coherent ecosystem accounting

Natural Capital Accounting

Individual environmental **assets & resources:**

Timber
Water
Soil
Fish

Ecosystems: Biotic and abiotic elements functioning together:

Forests
Lakes
Cropland
Wetlands

SEEA Central Framework (SEEA_CF) starts with economy and links to physical information on natural assets, flows and residuals

+

SEEA Experimental Ecosystem Accounting (SEEA-EEA) starts with ecosystems and links their services to economic and other human activity

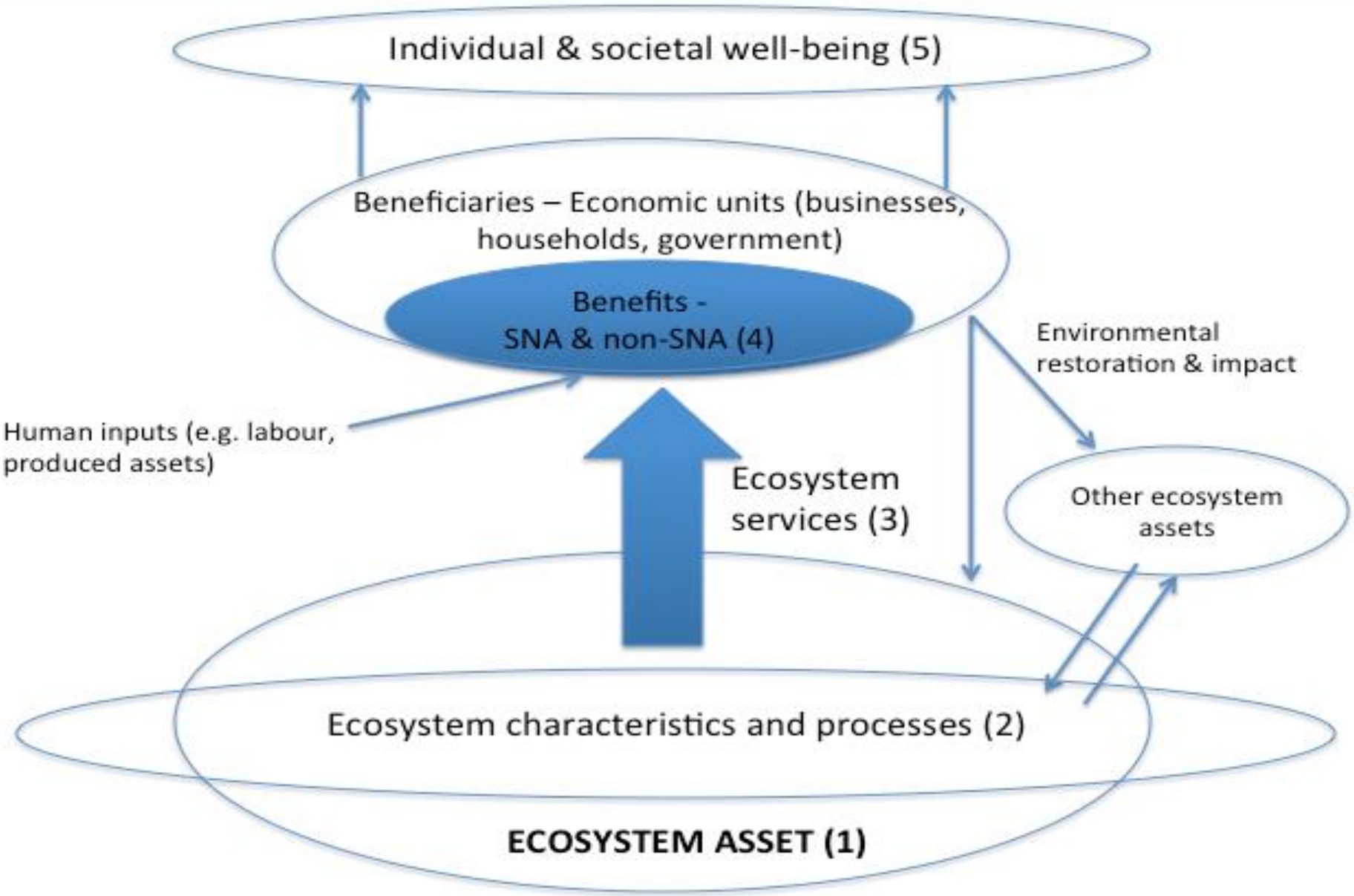
=

Together, they provide the foundation for measuring the relationship between the environment, and economic and other human activity

SEEA

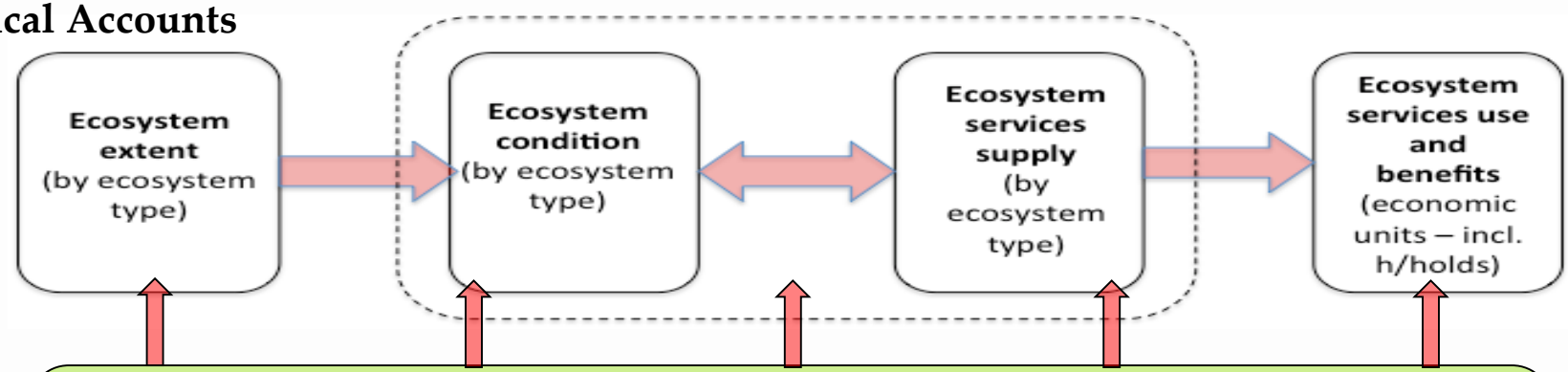
SEEA-CF (Central Framework)	• **Assets** • **Physical flows** • **Monetary flows**	• Minerals & Energy, Land, Timber, Soil, Water, Aquatic, Other Biological • Materials, Energy, Water, Emissions, Effluents, Wastes • Protection expenditures, taxes & subsidies
SEEA Water; **SEEA Energy;** **SEEA Agriculture, Forestry and Fisheries**	Add sector detail	As above for • Water • Energy • Agricultural, Forestry and Fisheries
SEEA-EEA (Experimental Ecosystem Accounting)	Adds spatial detail and ecosystem perspective	Extent, Condition, Ecosystem Services, Thematic: Carbon, Water, Biodiversity

Ecosystem Accounting model



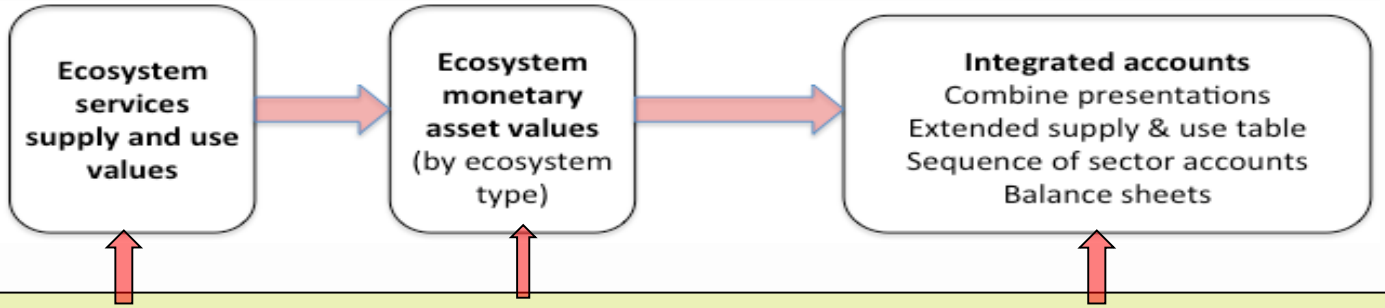
Broad steps in ecosystem accounting

a. Physical Accounts



Ecosystem thematic accounts: Land, Carbon, Water, Biodiversity
Supporting information: Socio-economic conditions and activities, ecological production functions
Tools: classifications, spatial units, scaling, aggregation, biophysical modelling
Source: Official statistics, spatial data, remote sensing data

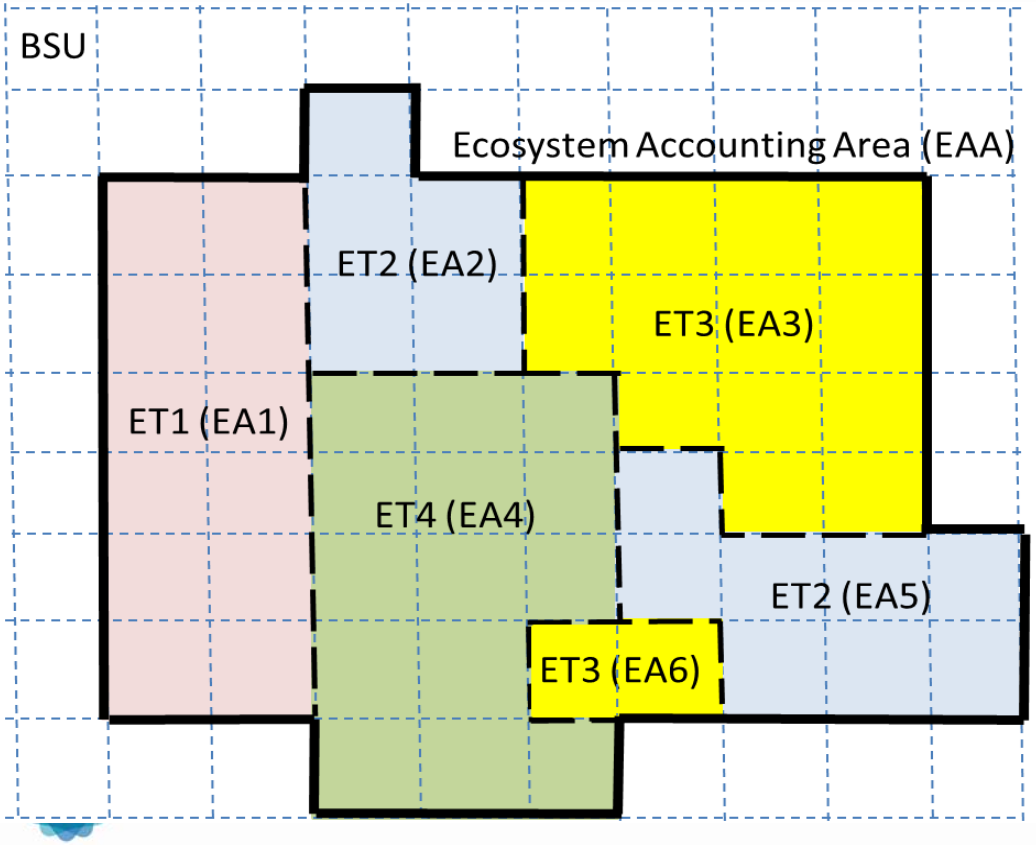
b. Monetary Accounts



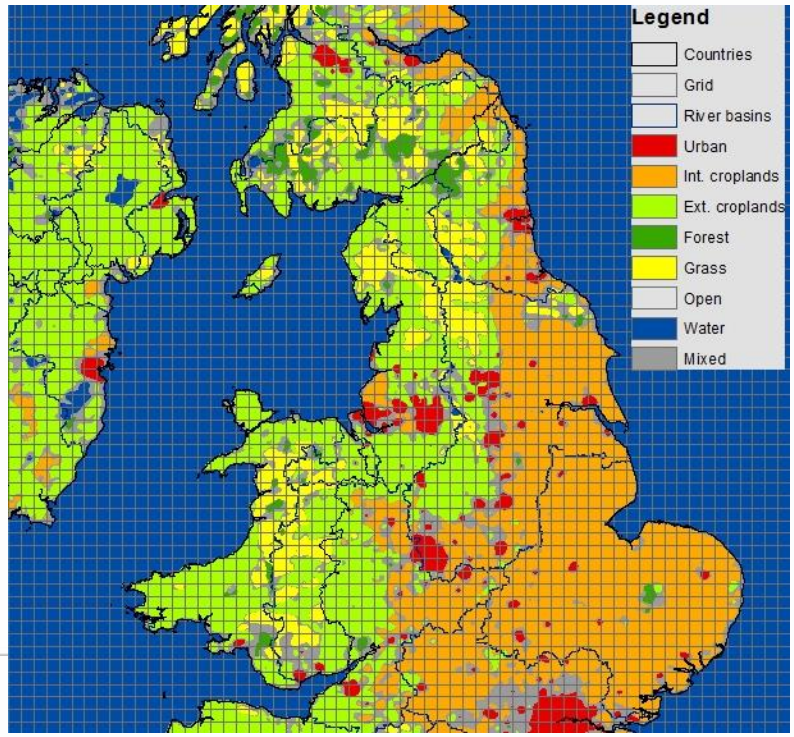
Supporting information: SNA accounts, I-O tables
Tools: Valuation techniques

Spatial areas for ecosystem accounting

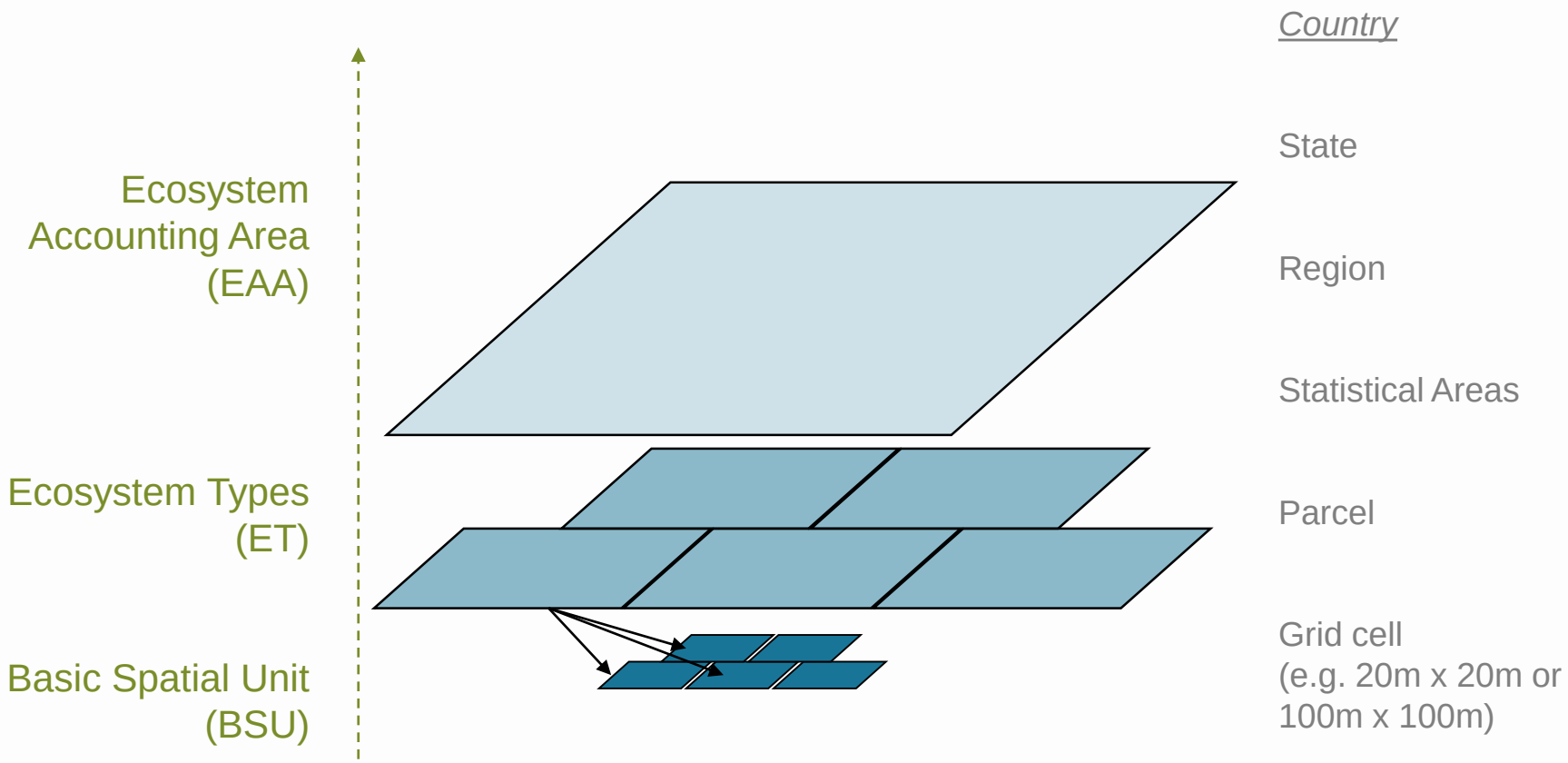
- Basic spatial units (BSU): small spatial area, a geometrical construct.
- Ecosystem Assets (EA): individual and contiguous ecosystems.
- Ecosystem Types (ET): aggregation of EAs of the same type.
- Ecosystem Accounting Area (EAA): aggregation of EAs and ETs relevant for policy at a scale fit for a specific purpose.



Overlay of units (UK)



Hierarchical (nested-grid) aggregation



Examples – Accounting for ecosystem extent

Ecosystem extent account

	Type of Ecosystem Unit															
	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	TOTAL
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
Opening extent																
Additions to extent																
Managed expansion																
Natural expansion																
Upward reappraisals																
Reductions in extent																
Managed regression																
Natural regression																
Downward reappraisals																
Net change in extent																
Closing extent																

SEEA

Europe

- 12 Ecosystem types, with further disagregation
- Starting point Corine land cover (CLC) data set for 2006
- Enhanced with additional data sets (e.g. on forest cover, water bodies and roads.)
- Combined with EU Nature Information System categorisation of habitat types.
- Provides insights into the biodiversity per ecosystem type, and allows integration of national and local classifications that vary

5.2 Correlation between ecosystem map legend and MAES ecosystem types on EUNIS habitats

MAES categories		Units in legend of ecosystem map (Map 3.1, version 2.1)	
vel 1	Level 2	EUNIS level 1	EUNIS level 2
	Urban	J Constructed, industrial and other artificial habitats	
	Cropland	I Regularly or recently cultivated agricultural, horticultural and domestic habitats	
	Grassland	E Grassland and land dominated by forbs, mosses and lichens	
	Woodland and forest	G Woodland, forest and other wooded land	Broadleaved deciduous and evergreen woodland
			Mixed deciduous and coniferous woodland
			Coniferous and broadleaved evergreen woodland
	Heathland and shrub		Tundra
ial			Arctic, alpine and subalpine scrub and grassland
			Mediterranean scrub and bushes
			Heathland scrub
	Sparsely vegetated or unvegetated land	H Inland unvegetated or sparsely vegetated habitats	Screes, inland cliffs
			Snow- and ice-dominated habitats
			Miscellaneous inland habitats with no or very sparse vegetation
	Attributed to sparsely vegetated land	B Coastal habitats (land)	Coastal dunes and sandy shores
			Coastal shingle
			Rock cliffs, ledges and shores including supralittoral
	Wetlands	D Mires, bogs and fens	
ater	Rivers and lakes	C Inland surface waters	Inland waters and shores
	Marine inlets and transitional waters	A Marine habitats B Coastal habitats (water)	Legend related to EUNIS and bathymetry data (see Table 3.1)
	Coastal		
	Shelf		
	Open ocean		

Source: European Commission, Mapping and Assessment of Ecosystems and their Services, 3rd Report – Final, March 2016.

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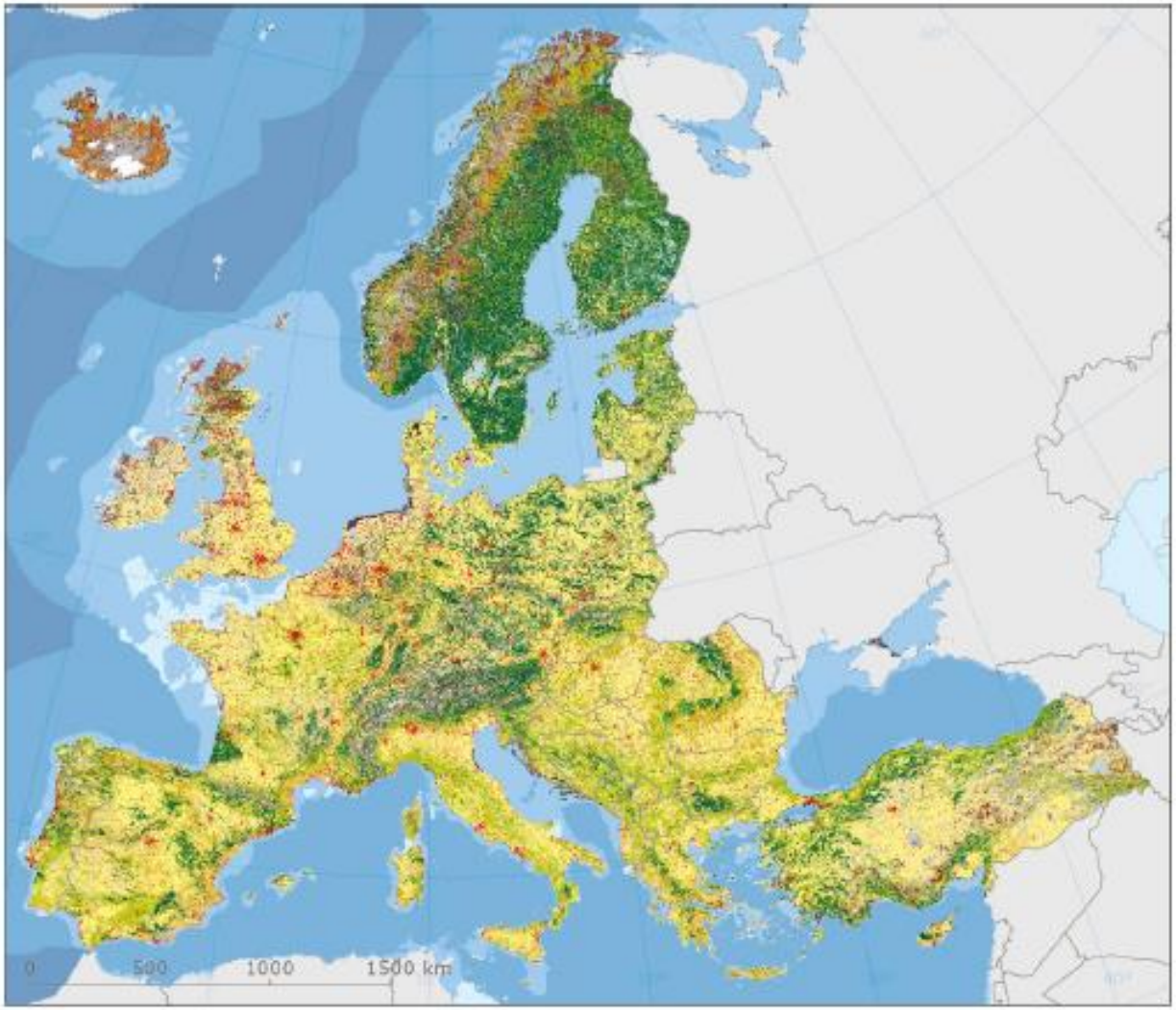
EU - Ecosystem extent map



Ecosystem map (aggregated)

Marine waters
- Open waters
- European regional seas

Marine seabed and coastal habitats
- Sublittoral sediment
- Infralittoral and circalittoral rock and other hard substrata
- Marine habitats
- Coastal habitats

Inland surface waters
- Inland waters and shores

Inland vegetation and habitats
- Tundra
- Arctic, alpine and subalpine scrub and grassland
- Mediterranean-mountain scrub and brushes
- Heathland scrub
- Grasslands and land dominated by forbs
- Regularly or recently cultivated agricultural, horticultural and domestic habitats
- Broad leaved deciduous and evergreen woodland
- Mixed deciduous and coniferous woodland
- Coniferous and broad leaved evergreen woodland
- Wetlands - mires, bogs and fens

Inland unvegetated or sparsely vegetated habitats
- Screes, inland cliffs
- Snow or ice-dominated habitats

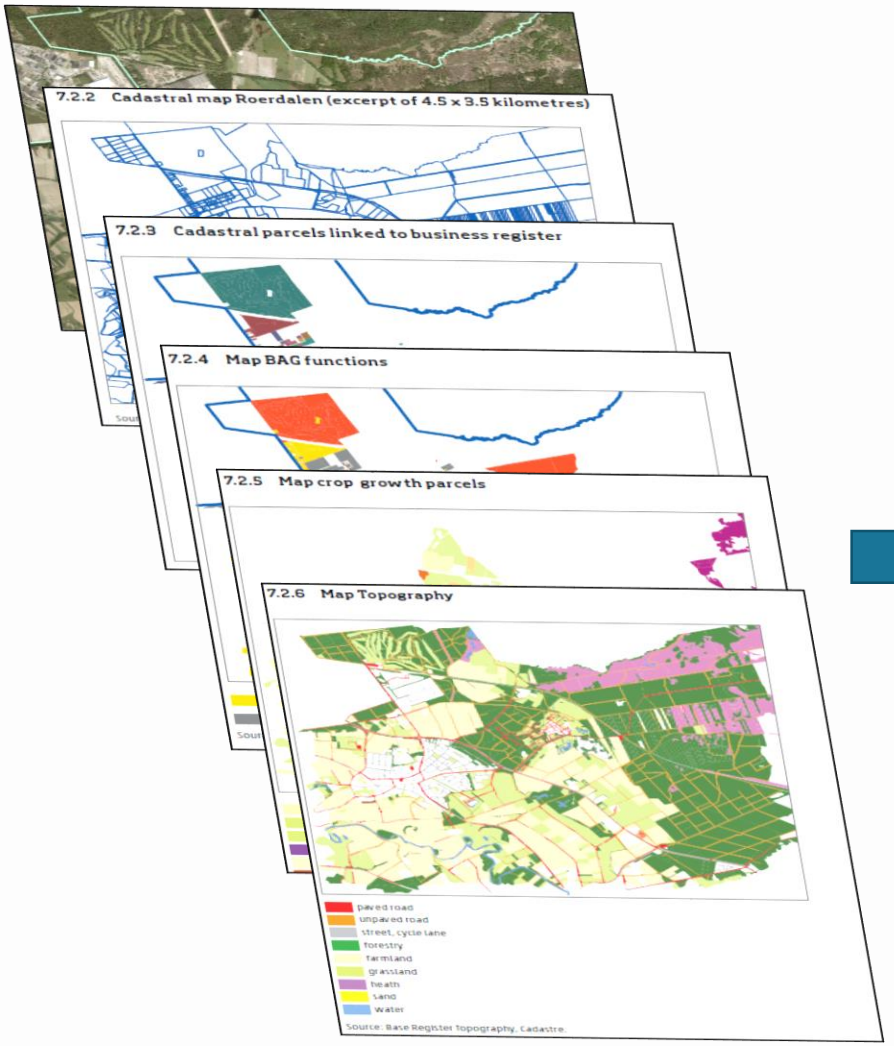
Human made constructions and habitats
- Constructed, industrial and other artificial habitats

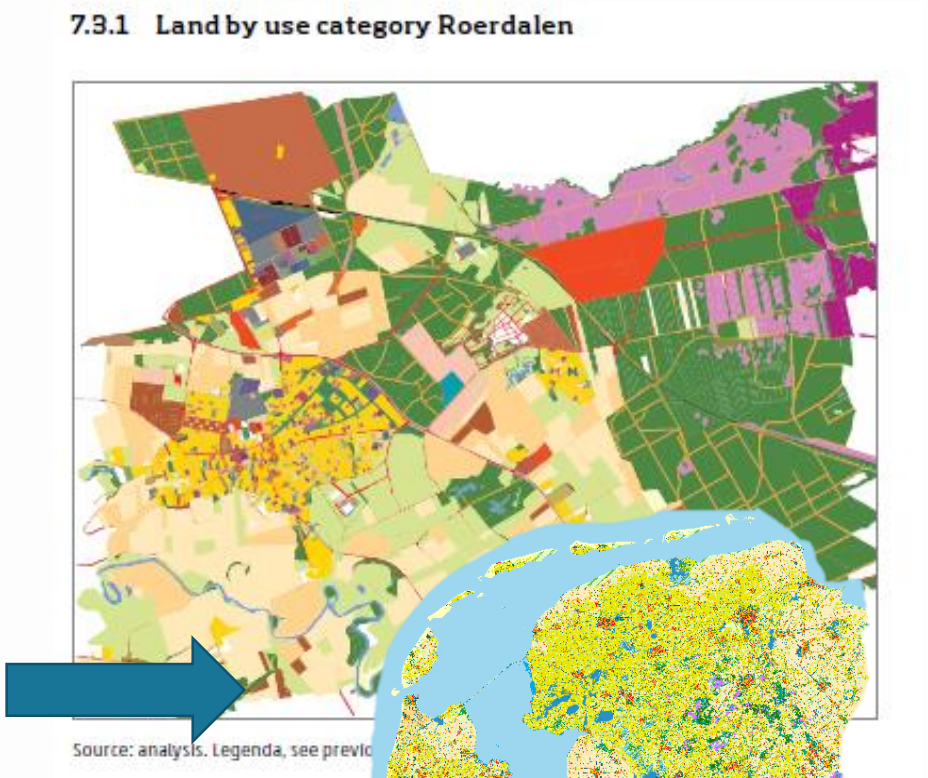
Non classified areas
- Unclassified areas
- Outside area of interest

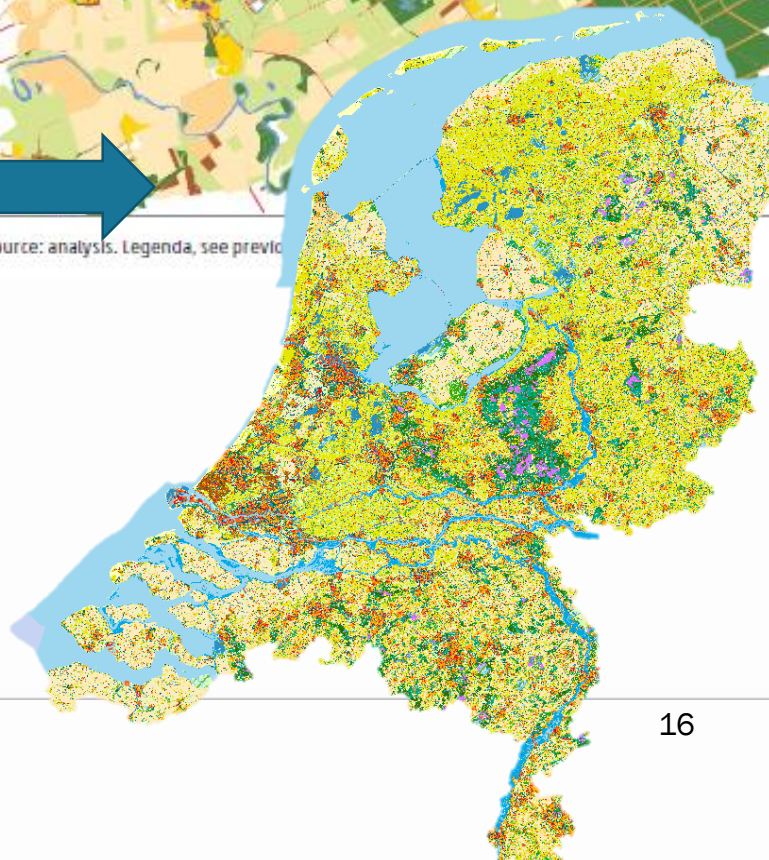
SEEA

Source: European Commission, Mapping and Assessment of Ecosystems and their Services, 3rd Report – Final, March 2016.

Netherlands







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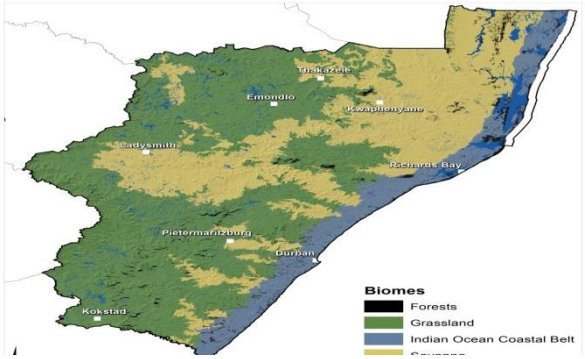
South African pilot study - Ecosystem extent accounts (by biome) for KZN



Hectares	Grassland	Savanna	Indian Ocean Coastal Belt	Wetland	Forest
Opening balance 1840	4 581 933	3 259 059	893 967	393 718	202 822
Total reductions in stock	1 651 736	840 380	528 754	107 567	18 208
Total reductions as a % of 1840	36	26	59	27	9
Opening balance 2005	2 930 197	2 418 679	365 213	286 151	184 614
Total reductions in stock	277 108	208 607	59 723	18 276	9 792
Total reductions as a % of 1840	6	6	7	5	5
Opening balance 2008	2 653 090	2 210 072	305 490	267 875	174 822
Total reductions in stock	68 092	34 757	11 782	9 082	3 128
Total reductions as a % of 1840	1	1	1	2	2
Opening balance 2011	2 584 998	2 175 315	293 708	258 793	171 694

SEEA

Source: Driver, A., Nel, J.L., Smith, J., Daniels, F., Poole, C.J., Jewitt, D. & Escott, B.J. 2015. Land and ecosystem accounting in KwaZulu-Natal, South Africa. Discussion document for Advancing SEEA Experimental Ecosystem Accounting Project, October 2015. South African National Biodiversity Institute, Pretoria.

Examples
– Accounting for ecosystem condition

SEEA

Ecosystem condition account

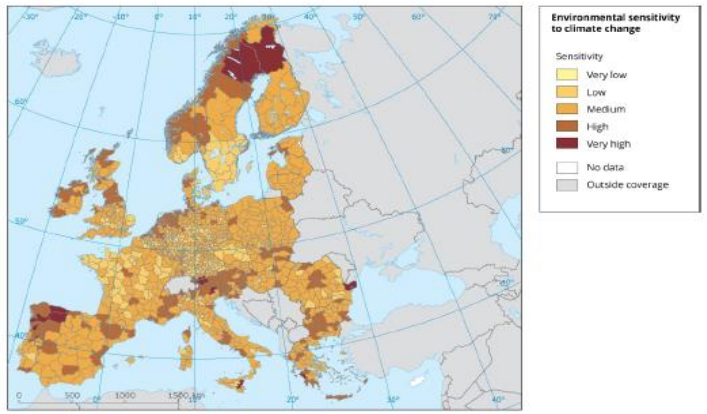
(End of accounting period)

Type of Ecosystem Unit	Ecosystem characteristics						
	Vegetation	Water resources	Soil	Carbon	Biodiversity	Air	...
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							

Europe

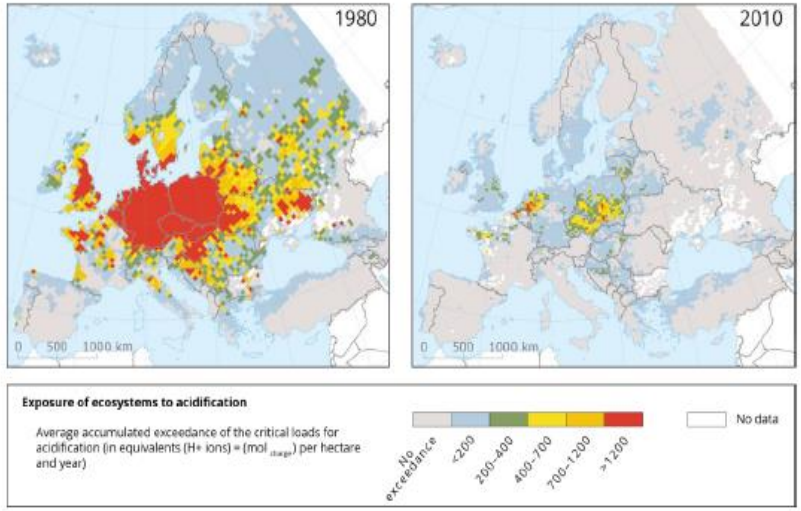
- MAES 3rd report: 2 complementary approaches towards condition
  - > An indirect approach through pressures exerted on ecosystems
    - Habitat change
    - Climate change
    - Overexploitation
    - Invasive alien species
    - Pollution and nutrient enrichment
  - > A direct assessment of condition
    - biodiversity
    - environmental quality
    - Etc.

Map 4.3 Environmental sensitivity to climate change



Source: ESPON Climate, 2011.

Map 4.6 Exceedance of critical loads of acidification in 1980 and 2010

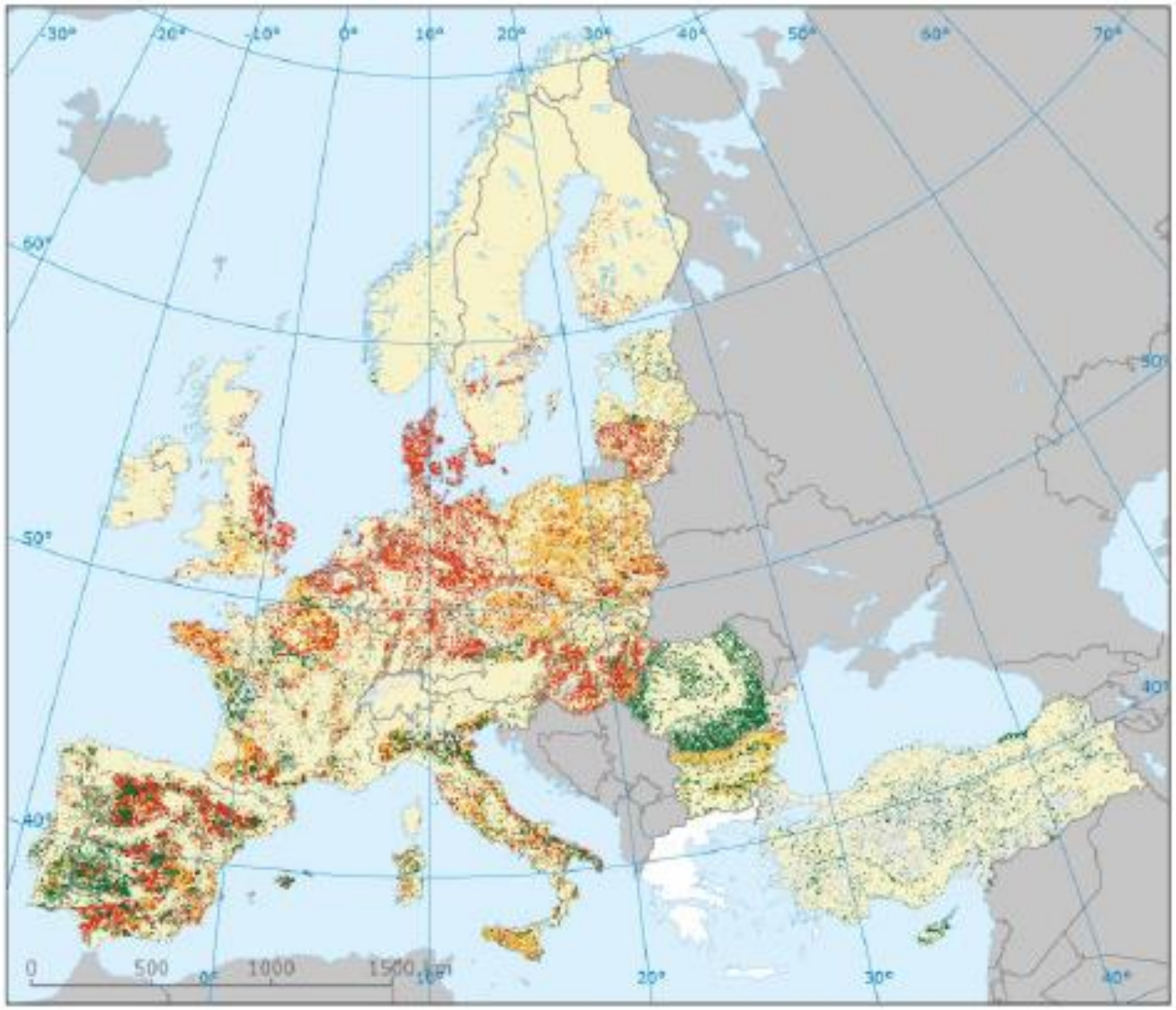


Source: EEA, 2015e.

SEEA

Source: European Commission, Mapping and Assessment of Ecosystems and their Services, 3rd Report – Final, March 2016.

Europe: aggregated assessment of cropland condition



Aggregated assessment of cropland condition

Condition

- Good
- Favourable
- Unfavourable
- No cropland
- No data
- Outside coverage

Source: European Commission, Mapping and Assessment of Ecosystems and their Services, 3rd Report – Final, March 2016.

South African pilot study – National river ecosystem condition accounts

Kilometres	Degree of modification from natural					Total
	Natural	Moderately modified	Heavily modified	Unaccept-ably modified	No Data	
MAIN RIVERS						
Opening stock 1999	**46 541**	**22 315**	**2 791**	**1 026**	**3 637**	**76 310**
Opening stock as a % total river length	61	29	4	1	5	100
Increase/decreases	-24 100	9 467	13 168	1 465		
Increases/decreases as % opening stock	-52	42	472	143		
Opening stock 2011	**22 441**	**31 782**	**15 960**	**2 492**	**3 637**	**76 310**
Opening stock as a % total river length	29	42	21	3	5	100
TRIBUTARIES						
Opening stock 1999	**40 294**	**7 470**	**2 084**	**328**	**37 047**	**87 223**
Opening stock as a % total river length	46	9	2		42	100
Increase/decreases	-17 062	11 339	4 766	957		
Increases/decreases as % opening stock	-42	152	229	292		
Opening stock 2011	**23 232**	**18 809**	**6 850**	**1 285**	**37 047**	**87 223**
Opening stock as a % total river length	27	22	8	1	42	100
ALL RIVERS						
Opening stock 1999	**86 835**	**29 784**	**4 875**	**1 354**	**40 684**	**163 533**
Opening stock as a % total river length	53	18	3	1	25	100
Increase/decreases	-41 163	20 806	17 935	2 422		
Increases/decreases as % opening stock	-47	70	368	179		
Opening stock 2011	**45 673**	**50 591**	**22 810**	**3 776**	**40 684**	**163 533**
Opening stock as a % total river length	28	31	14	2	25	100

Accounting for ecosystem services

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Source: PBL, RIVM, WUR, CICES 2014

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															

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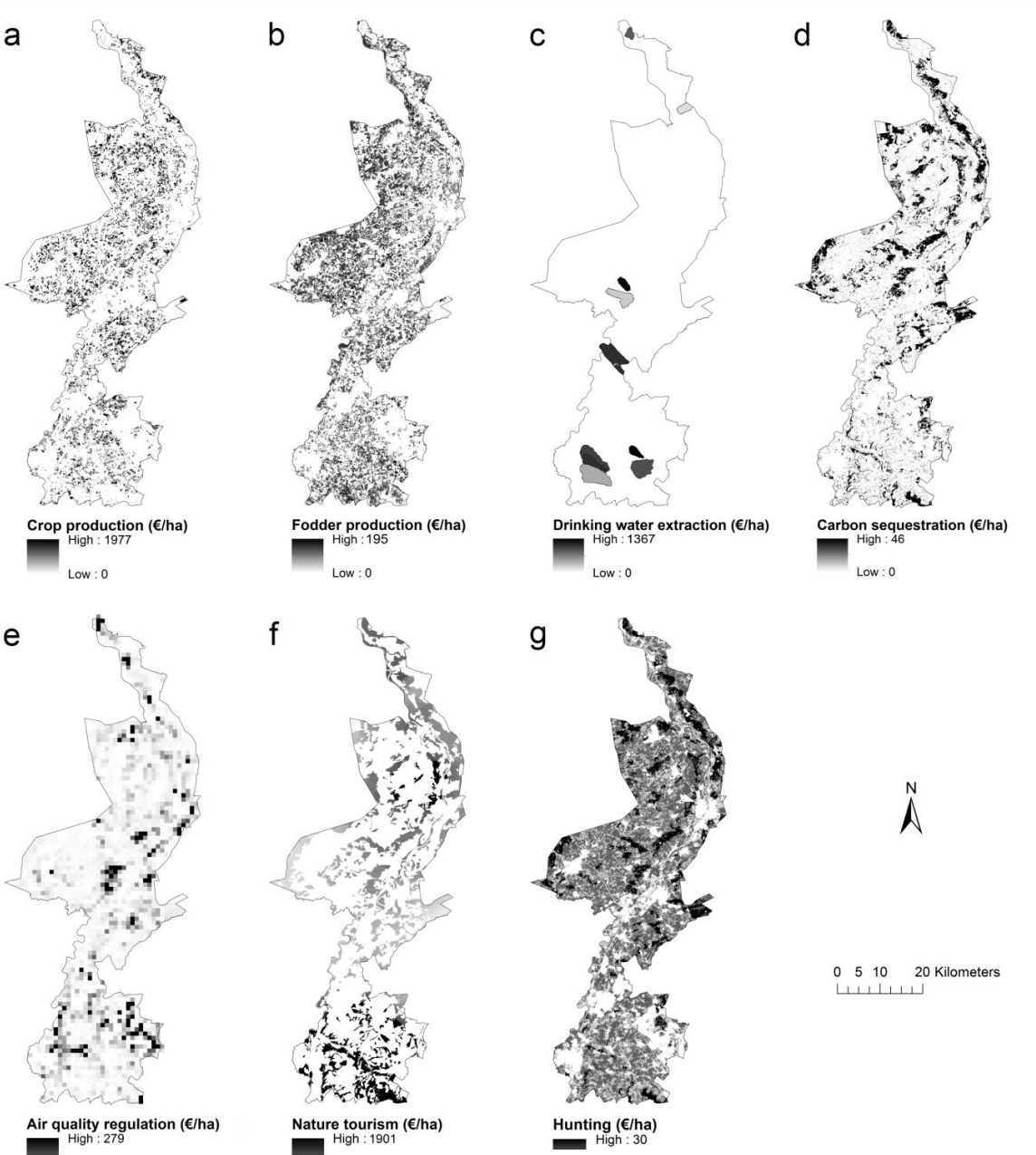
Netherlands

- Limburg province:
- Biophysical model for 7 ecosystem services
- Spatially explicit!

(although resolution differs)



R.P. Remme et al. / Ecological Economics 112 (2015) 116–128

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Physical Supply Table (example Netherlands)

Physical supply, totals

Ecosystem services	Ecosystem Units	1 Non-perennial plants	2 Perennial plants	4 Meadows (for grazing)	5 Hedgerows	21 Deciduous forest	22 Coniferous forest	23 Mixed forest	24 Heath land	26 Fresh water wetlands	27 Natural grassland	28 Public green space	31 River flood basin	Totals
	extent (ha)	53.600	8.100	27.100	2.900	11.400	7.100	10.400	2.100	900	3.100	4.800	14.100	**220.900**
Crops	tonnes/yr	1.427.300	65.000	-	-	-	-	-	-	-	-	-	-	**1.492.400**
Fodder	tonnes/yr	140.800	4.700	328.700	-	-	-	-	-	-	-	-	66.900	**541.100**
Meat (from game)	kg/yr	11.500	1.500	5.900	800	2.500	1.700	2.900	600	200	800	900	2.400	**36.800**
Ground water (drinking water only)	in 1000 m3/yr	9.000	1.400	4.200	500	1.900	100	500	100	-	700	400	1.300	**27.000**
capture of PM10	tonnes/yr	400	100	200	-	300	400	500	-	-	-	100	100	**2.300**
Carbon sequestration	tonnes C/yr	-	2.400	4.900	500	16.500	10.300	15.100	400	200	600	1.200	2.800	**59.000**
Recreation (cycling)	1000s of bike trips/yr	1.800	300	1.000	100	600	200	400	-	-	100	200	600	**9.100**
Nature tourism	# tourists/yr	94.000	22.000	136.800	57.000	160.300	93.800	147.400	22.700	11.600	55.400	11.800	94.500	**974.300**

Physical Supply per Hectare

Ecosystem services	Ecosystem Units	Non-perennial plants	Perennial plants	Meadows (for grazing)	Hedgerows	Deciduous forest	Coniferous forest	Mixed forest	Heath land	Fresh water wetlands	Natural grassland	Public green space	River flood basin
Crops	tonnes/ha/yr	26,63	8,02	-	-	-	-	-	-	-	-	-	-
Fodder	tonnes/ha/yr	2,63	0,58	12,13	-	-	-	-	-	-	-	-	4,74
Meat (from game)	kg/ha/yr	0,21	0,19	0,22	0,28	0,22	0,24	0,28	0,29	0,22	0,26	0,19	0,17
Ground water (drinking water only)	1000m3/ha/yr	0,17	0,17	0,15	0,17	0,17	0,01	0,05	0,05	-	0,23	0,08	0,09
capture of PM10	tonnes/ha/yr	0,01	0,01	0,01	-	0,03	0,06	0,05	-	-	-	0,02	0,01
Carbon sequestration	tonnesC/ha/yr	-	0,30	0,18	0,17	1,45	1,45	1,45	0,19	0,22	0,19	0,25	0,20
Recreation (cycling)	1000s of bike trips/ha/yr	0,03	0,04	0,04	0,03	0,05	0,03	0,04	-	-	0,03	0,04	0,04
Nature tourism	#tourists/ha/yr	1,75	2,72	5,05	19,66	14,06	13,21	14,17	10,81	12,89	17,87	2,46	6,70

SEEA

R.P. Remme et al. / Ecological Economics 112 (2015) 116–128

Valuation of ES – South Africa

- 10 individual services were modelled and valued
- Using a range of techniques, but always local/national data

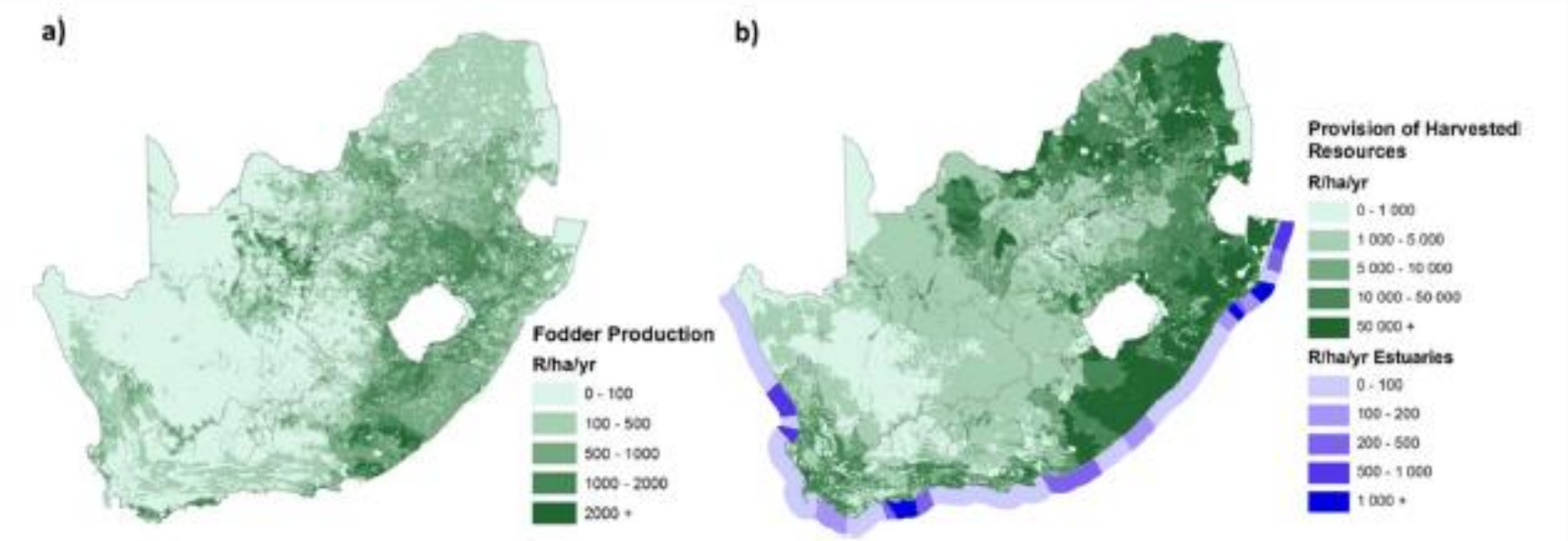
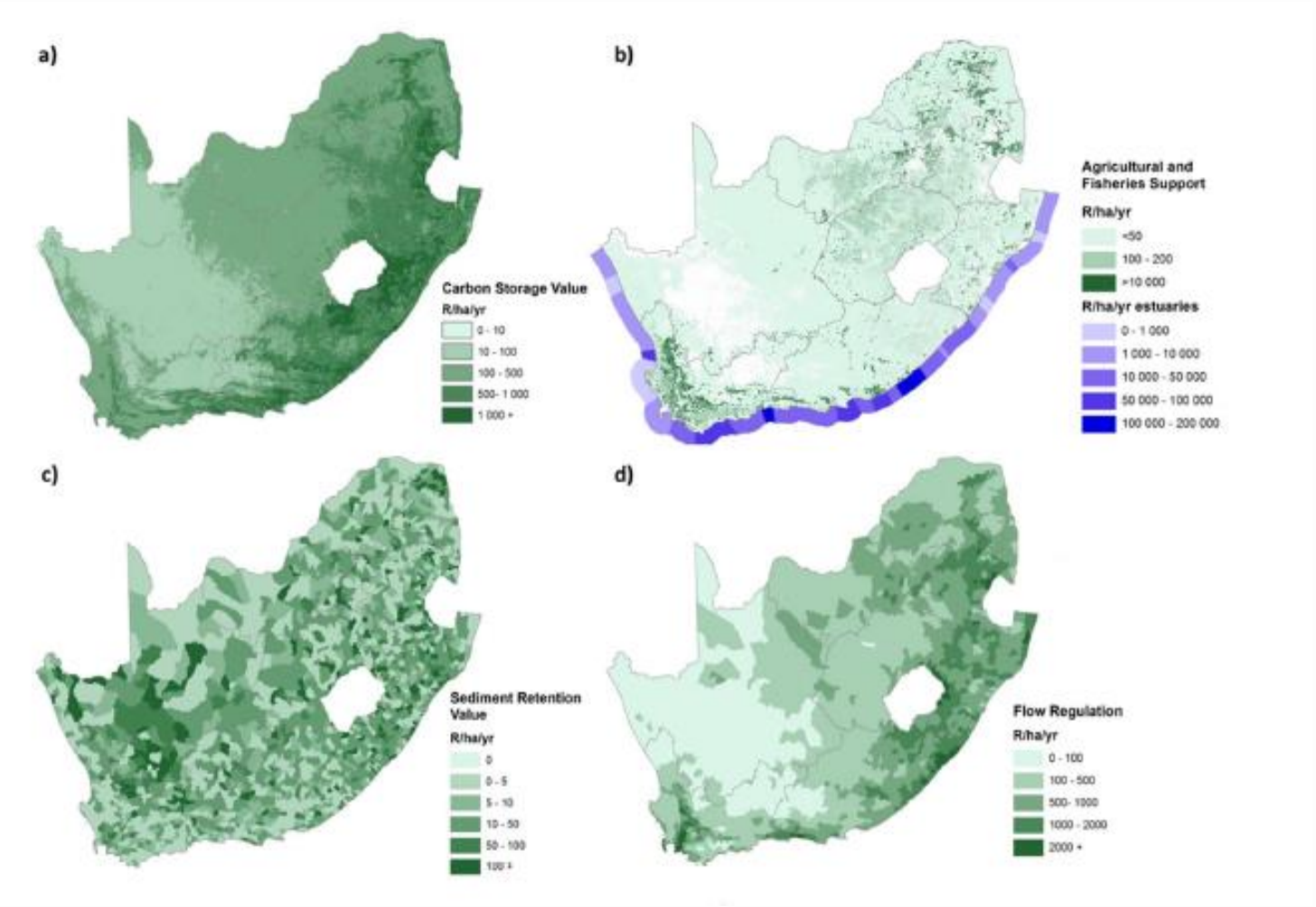


Fig. 3. Value of provisioning services in the form of (a) fodder production and (b) harvested natural resources, including instream water and estuarine/coastal resources.

Source: Turpie et al., 2017

SA - continued



Source: Turpie et al., 2017

Thematic accounts

SEEA

Thematic accounts

- Standalone accounts on topics of interest in their own right
- Direct relevance in the measurement of ecosystems and in assessing policy responses.
- Thematic accounts include accounts for land, carbon, water and biodiversity.

Example: Carbon Accounting in Australia

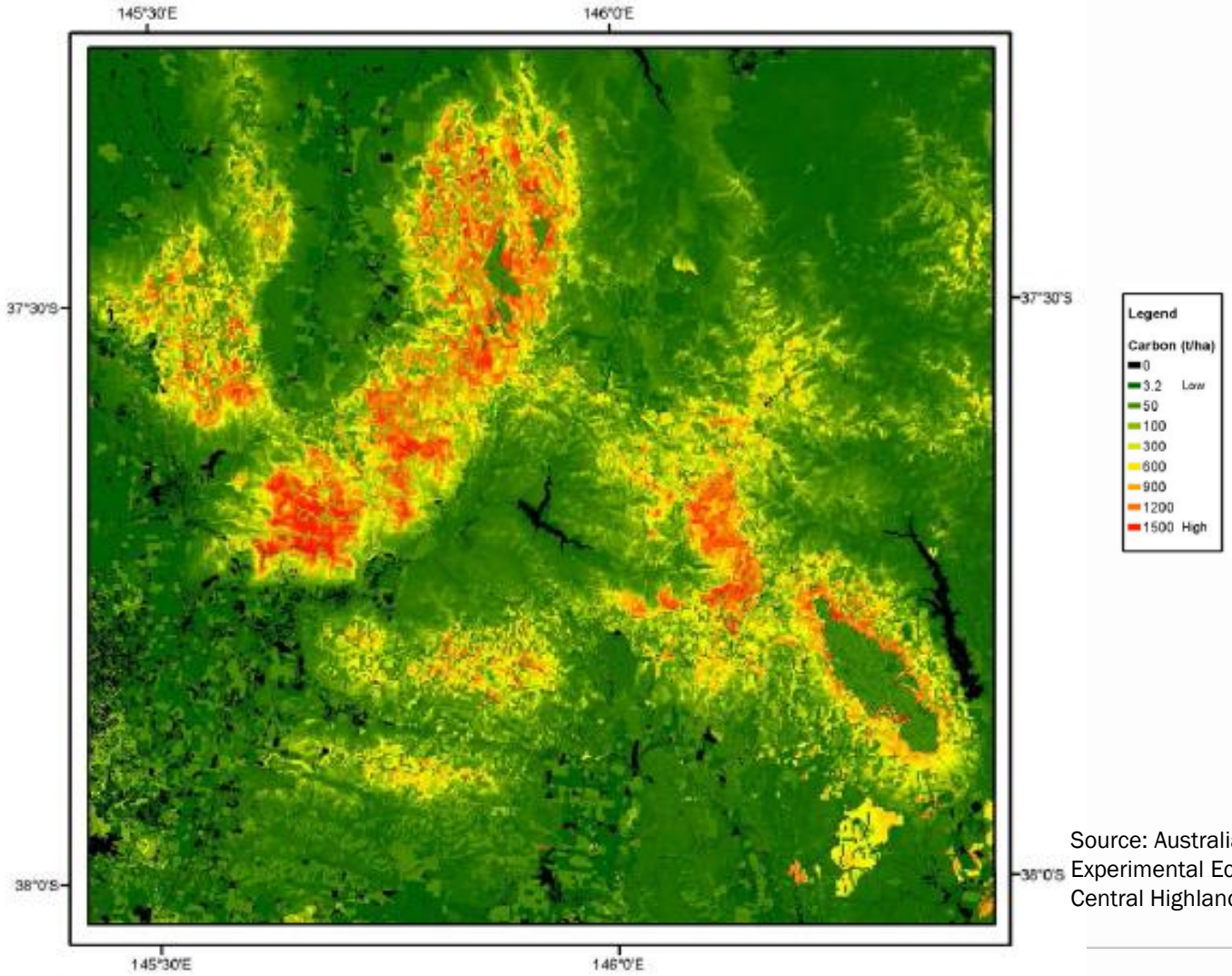
Primary reservoir	Geocarbon (Mt C)	Hectares (million)	Biomass carbon (Mt C)	Soil organic carbon (Mt C)	Total biocarbon (Mt C)
Biocarbon					
Natural ecosystems					
Rangelands		596.3	6,374	6,603	12,977
Non rangelands:					
Eucalypt native forests		16.7	4,671	3,753	8,424
Shrub lands & woodlands		14.7	500	636	1,137
Grass, shrub & heath lands		1.6	37	51	87
Rainforests		2.3	1,225	252	1,477
Other		0.7	15	16	32
Marine ecosystems		1.8	114	1,084	1,198
Fresh water ecosystems		9.9	4	7	11
Total Natural ecosystems		**644.0**	**12,941**	**12,402**	**25,343**
Semi-natural ecosystems					
Highly modified rangelands		50.0	750	1,500	2,250
Grazing in modified pastures outside rangelands		32.9	132	1,315	1,447
Total Semi-natural ecosystems		**82.9**	**882**	**2,815**	**3,697**
Agricultural ecosystems					
Cropping		25.5	102	1,022	1,124
Irrigated agriculture		2.6	12	105	117
Plantation wood		2.4	177	120	296
Reservoir/dam		0.6	1	6	7
Other		6.3	120	244	363
Total Agriculture ecosystems		**37.4**	**412**	**1,497**	**1,907**
Settlements		2.6	30	79	108
Other		0.5	7	19	26
Total Settlements and Other		**3.1**	**37**	**98**	**134**
Total biocarbon[d]		**767.4**	**14,270**	**16,811**	**31,081**

SEEA

Source:
https://coombs-forum.crawford.anu.edu.au/publication/hc-coombs-policy-forum/4708/carbon-accounting-australia

Australia: carbon account

Figure 5.1 Spatial distribution of carbon stock density in the Central Highlands study area in 2015



Source: Australian National University, Experimental Ecosystem Accounts for the Central Highlands of Victoria, 2016.

Valuation

Valuation

- Valuation is always fit for purpose, different valuation notions exist
  - Welfare based (e.g. cost-benefit analysis)
  - Exchange values (national accounts, exclude consumer surplus)
- Why? Nat accounts is transaction based system, supply = use
- Welfare based valuation result in far bigger numbers!
  - (e.g. Costanza et al 1997, in the order of GDP) Why?
    - benefit transfer may results in biases (derived from WTP in wealthier countries + for more productive systems
    - Includes consumer surplus
    - Assumes there is demand for provided services
- Ecosystem accounting does not rule out welfare based valuation, but need to be careful when integrating.
- Exchange values may be derived from welfare based valuations

Lessons learned

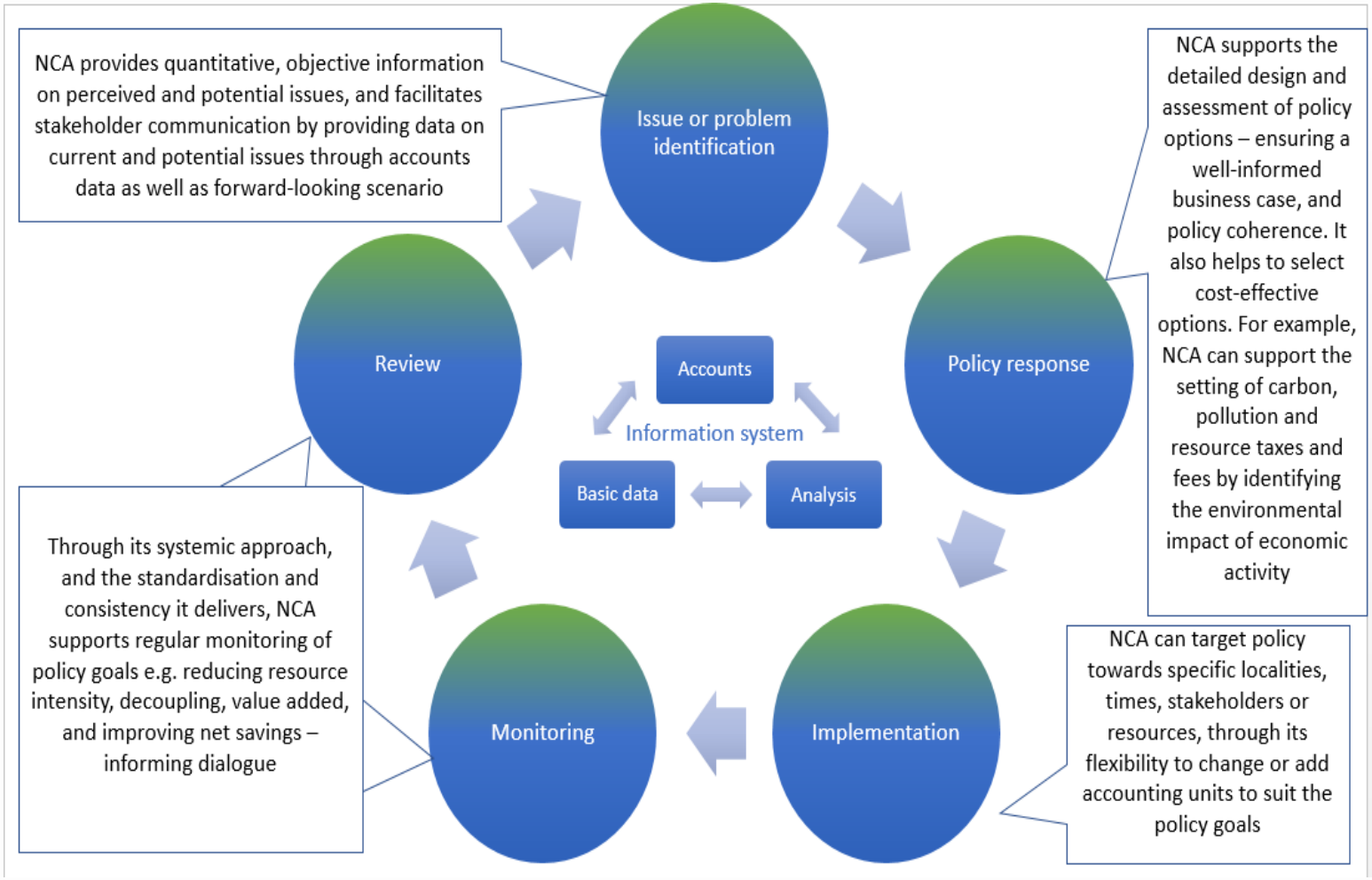
Lessons learned from NCA project

- Essential to take a gradual approach (from local/municipal to national) and manage expectations, although some accounts (e.g land) can be done at national level.
- Important to clarify the role of the national statistics office
  - - > integration existing data sets
  - -> what sets it apart from other approaches: links with economic statistics
- Crucial to engage with policy makers right from the start
  - At national level (e.g. fiscal policy, land use planning and monitoring environmental regulations) and at regional and municipal level (e.g. land use planning/zoning, monitoring of regulations)
- Imperative to set up win-win institutional partnership with statistics, policy and science interface with joint capacity building
  - Multidisciplinary undertaking (statisticians/accountants, academics/economists and ecologists, policy makers)
- Essential to develop communication strategy with users on mainstreaming natural capital accounting

THANK YOU

seea@un.org

Links to policy



Source: "Better Policy through Natural Capital Accounting: Stocktaking and Ways Forward"

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