



System of  
Environmental  
Economic  
Accounting

# Valuation of ecosystem services and natural capital in the context of the SEEA Experimental Ecosystem Accounting

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# Outline

- SEEA CF and EEA
- Types of ecosystem accounts
- Valuation
- Example from the Netherlands
- Conclude

# System of Environmental-Economic Accounting (SEEA)

- Environmental-economic accounting describes the interrelationship between economic activities and the environment
- Satellite accounts of the SNA
- Natural Capital Accounting = Environmental-Economic Accounting
- The **SEEA Central Framework** 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



# One Environment: Two Perspectives

## SEEA

### Central Framework:

Individual Environmental  
Assets/Resources

Timber  
Water  
Soil  
Fish



## SEEA

### Experimental Ecosystem Accounts:

Ecosystem Assets  
(spatially based)

Forests  
Lakes  
Agricultural  
areas

*Ecosystem Assets are environmental assets viewed from a systems perspective*

# Types of ecosystem accounts

- Ecosystem extent account
- Ecosystem condition account
- Ecosystem services supply account (physical and/or monetary)
- Thematic accounts
  - Carbon
  - Water
  - Biodiversity
- Integrated presentations
  - Use tables
  - Extended measures of wealth
  - Expenditure on ecosystem protection /rehabilitation or biodiversity

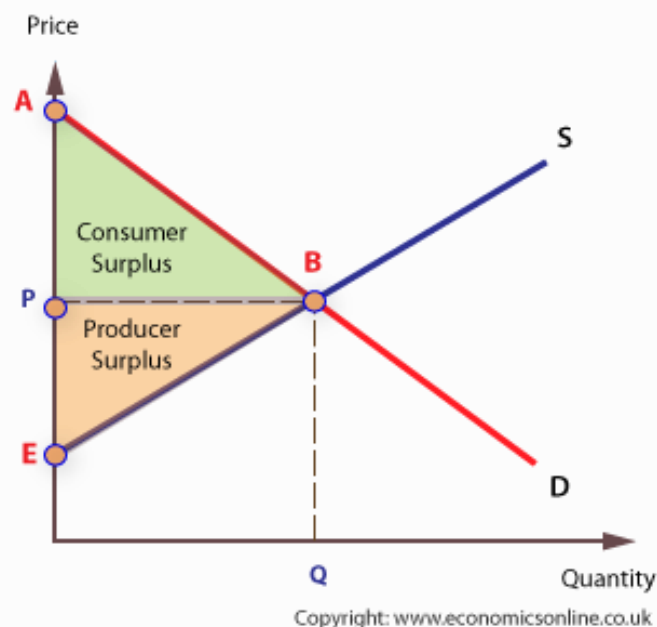
# Valuation in the context of the SIEEA EEA

# The purpose of valuation

- To integrate environmental issues in economic decision making and planning
- Valuation needs to be fit for purpose. Different contexts require different valuation concepts.
  - > 1. Assessment of welfare:
    - E.g. cost benefit analysis, focus on utility
  - > 2. Assessment of economic activity:
    - E.g. National Accounts, focus on exchange value
  - > 3. Other positions exists as well:
    - Intrinsic value
    - Critical value / strong sustainability
- Method and techniques follow the value concept you try to assess

# What are exchange values?

- National Accounts is a transaction based system:
  - > A quadruple based entry system (exchange of product + financial counterpart)
  - > implying that both ends of the transaction require the same entry (supply = use)
  - > Consumer surplus is excluded
  - > Recorded is the exchange value ( $P \cdot Q$ )
  - > Also externalities are excluded -> focus is on actual exchange regardless of institutional setting





# Suitable valuation methods for SEEA

- Methods that identify or generate exchange values:
  - > Price that would have been revealed in most likely institutional arrangement (i.e. the market that would exist if there was an actual market involving ecosystem assets) [not necessarily an ideal market that internalizes externalities]
  - > Should build on physical accounts ( $\text{value} = p * q$ )
- Unsuitable methods:
  - > Include consumer surplus
  - > Unable to value individual services (e.g. restoration)
  - > Simple benefit transfer approaches (“big numbers”)

# Suitable methods (2)

Method	Appropriate for exchange value	Applicability for which ES?
Resource rent	Yes (already used in SNA)	Provisioning (and cultural)
Production function	Yes	Provisioning (and regulating)
PES schemes	Yes	E.g. carbon sequestration
Hedonic pricing	Yes (already used in SNA)	Amenity values
Replacement cost	When conditions apply	Regulating
Damage cost avoided	When conditions apply	Regulating
Averting behaviour	Likely no	
Restoration cost	No	
Travel cost	Possibly	Recreational services
Stated preference	Not direct values, but demand curve usable	Cultural
Marginal values from revealed demand functions	Yes	Regulating Cultural

Based on: SEEA TR Table 6.1

# Valuing what - object of valuation

- Stocks and flows: natural capital conceived as asset that provides a basket of services
- How to value the ecosystem assets?
  - > In the absence of direct valuation of the asset
  - > or a market that recognizes the full suite of services being provided (with an expanded production boundary),
  - > Value = NPV of sum of services
- Various values conceivable:
  - > NPV of expected ecosystem services (given current use and management of the ecosystem)
  - > NPV of services provided at capacity (i.e. at sustainable use)
    - More experimentation is required....

# Valuing degradation

- Degradation is not simply the change in value of the asset in two points in time
- In an asset account, change in value is decomposed in various elements
  - > Important to identify the part that is due to using up of the asset -> exclude changes in value due to price changes
  - > Distinguish between human and non-human induced degradation
  - > Link also to deterioration of capacity and condition of the ecosystem to supply services

Important part of the research agenda

# The Netherlands experience with ecosystem accounting

# NL experience with SEEA EEA

Land use account

Ecosystem extent account

Ecosystem services supply and use account (physical and monetary)

Carbon account

# Integration of multiple data sources

Data source	Owner	Version 2006
Digital Cadastral map	Gedastre	2004
Crop plots (BRP)	Netherlands Enterprise Agency	May 2006
Statistics Netherlands Regiobase	Statistics Netherlands	1 Jan–31 Dec 2006
Statistics Netherlands Dwelling register (WRG)	Statistics Netherlands	1 Jan 2006
Statistics Netherlands Addresses Geographical Base register (GBR)	Statistics Netherlands	Jan 2006
Coupling Object-ID and coordinate	Statistics Netherlands	1998–2016
Base register Addresses en Buildings (BAG)	Dutch Communities	–
Base register Topography / Top10vector (BRT/Top10vector)	Gedastre	2003–2007
Statistics Netherlands Land Use map (BBG)	Statistics Netherlands	2006
Boundary dunes		Natura2000
Ecological network	PBL; Netherland Environmental Assessment Agency	Nota Ruimte
Boundary riverbed	PBL; Netherland Environmental Assessment Agency	BARRO 2011

# Combining maps with dominance strategy

OverAerial  
photo Roerdalen

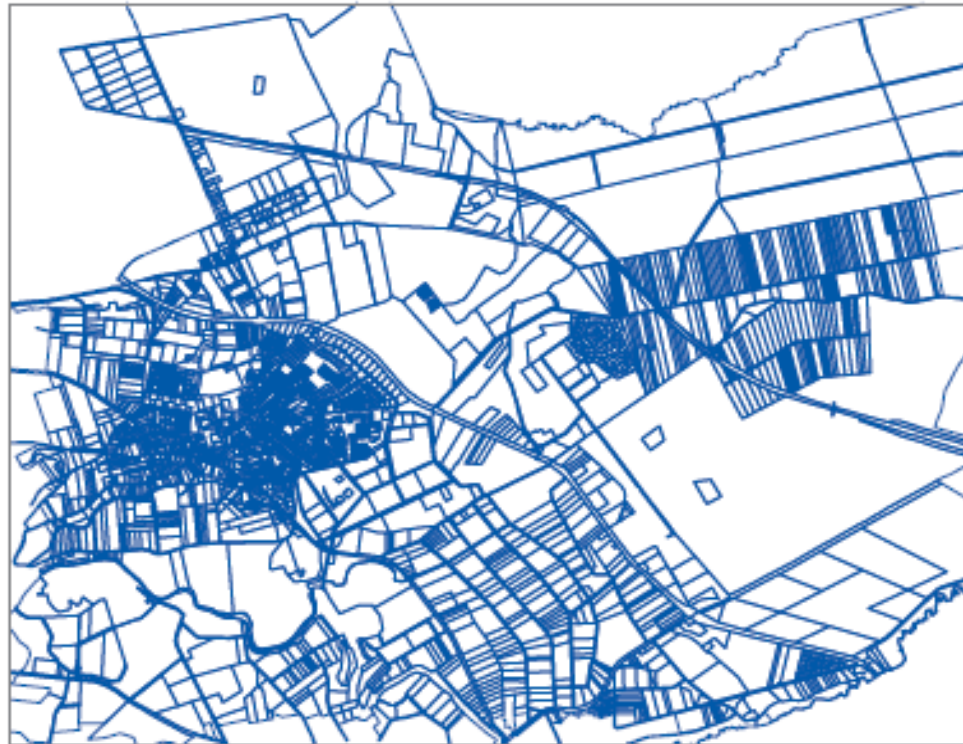




# Combining maps with dominance strategy

## OverAerial photo Roerdalen

7.2.2 Cadastral map Roerdalen (excerpt of 4.5 x 3.5 kilometres)



Source: Cadastre

# Combining maps with dominance strategy

OverAerial  
photo Roerdalen

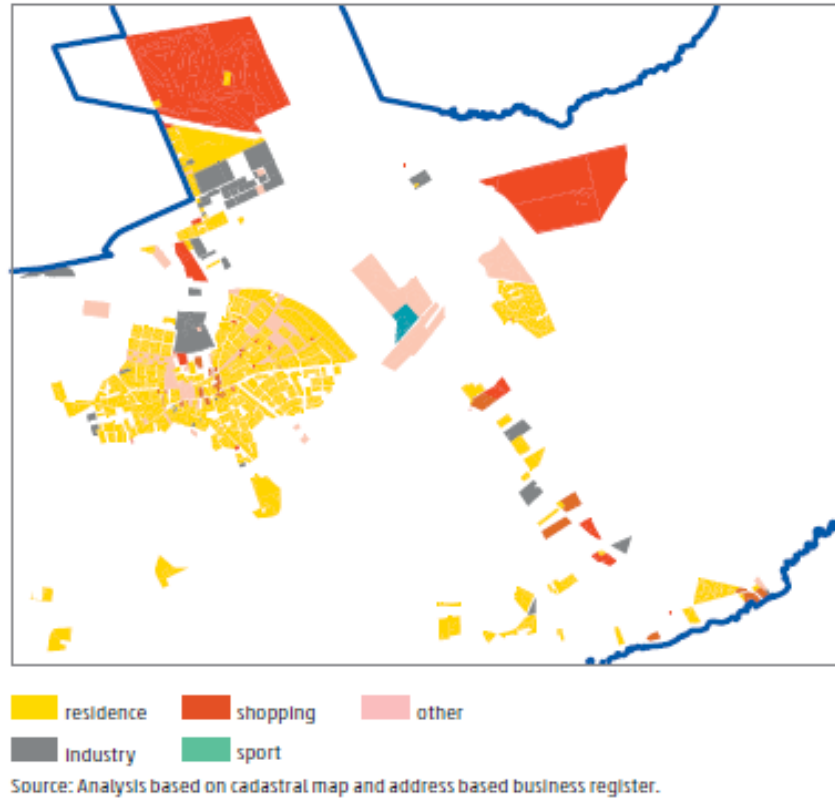
## 7.2.3 Cadastral parcels linked to business register



# Combining maps with dominance strategy

## OverAerial photo Roerdalen

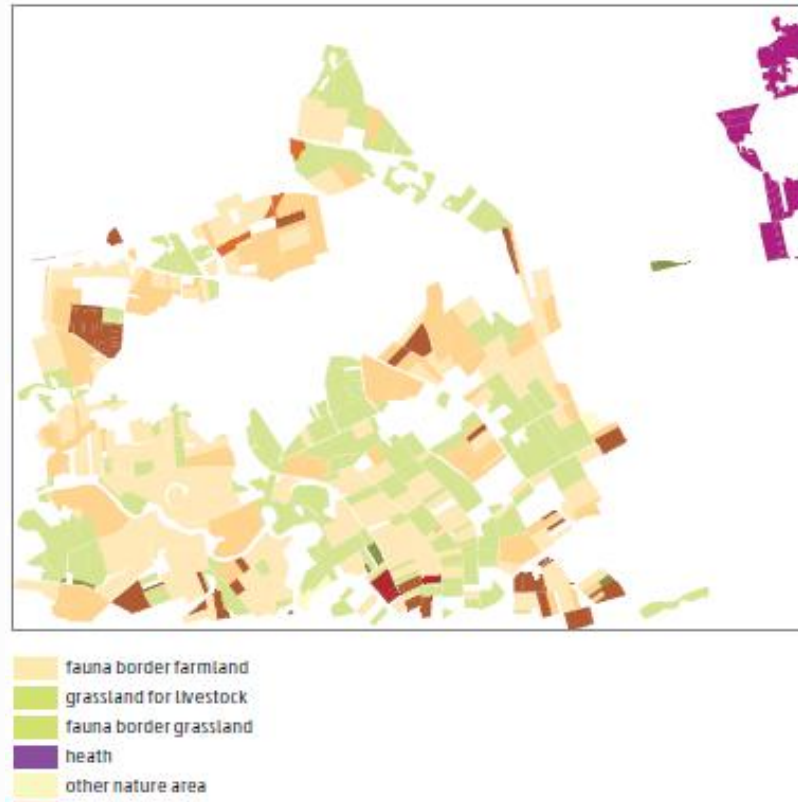
### 7.2.4 Map BAG functions



# Combining maps with dominance strategy

OverAerial  
photo Roerdalen

## 7.2.5 Map crop growth parcels



# Combining maps with dominance strategy

## 7.2.6 Map Topography

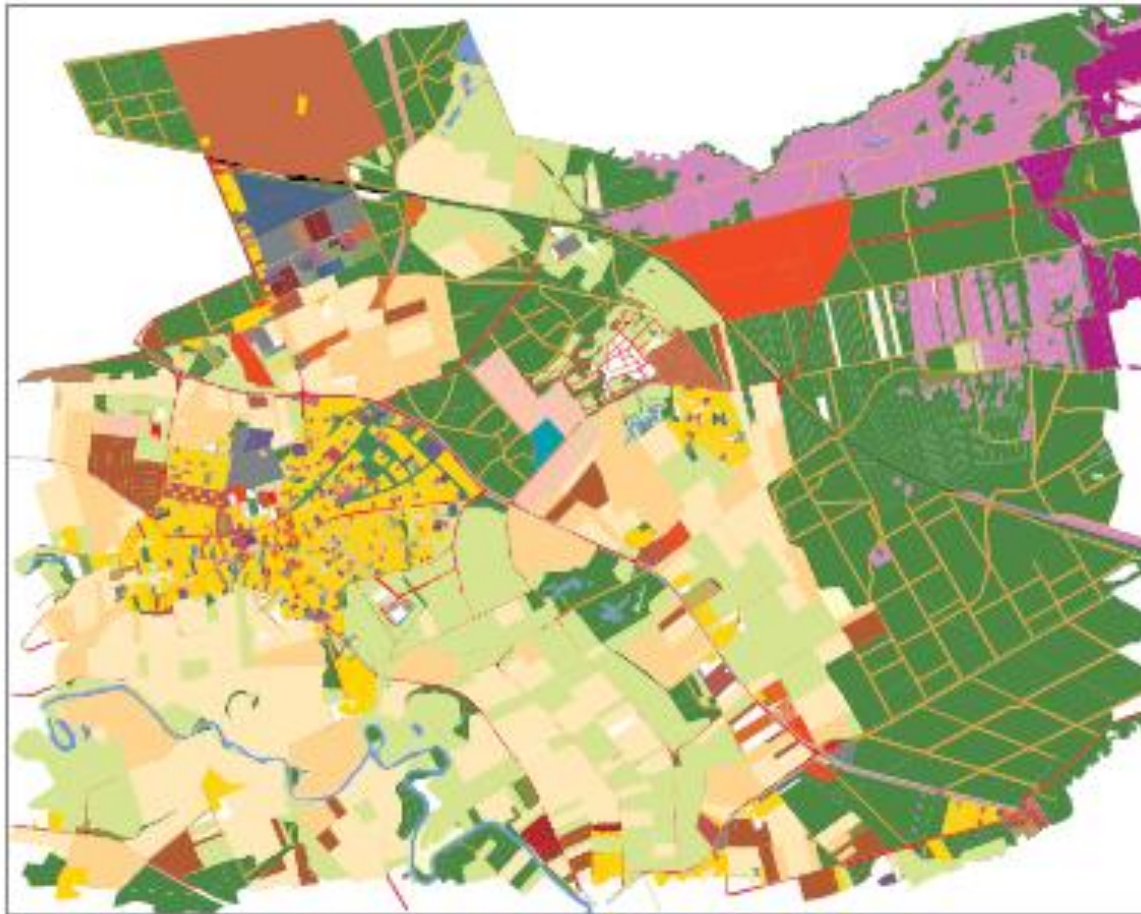


- paved road
- unpaved road
- street, cycle lane
- forestry
- farmland
- grassland
- heath
- sand
- water

Source: Base Register Topography, Cadastre.

# Combining maps with dominance strategy OverAerial

## 7.3.1 Land by use category Roerdalen

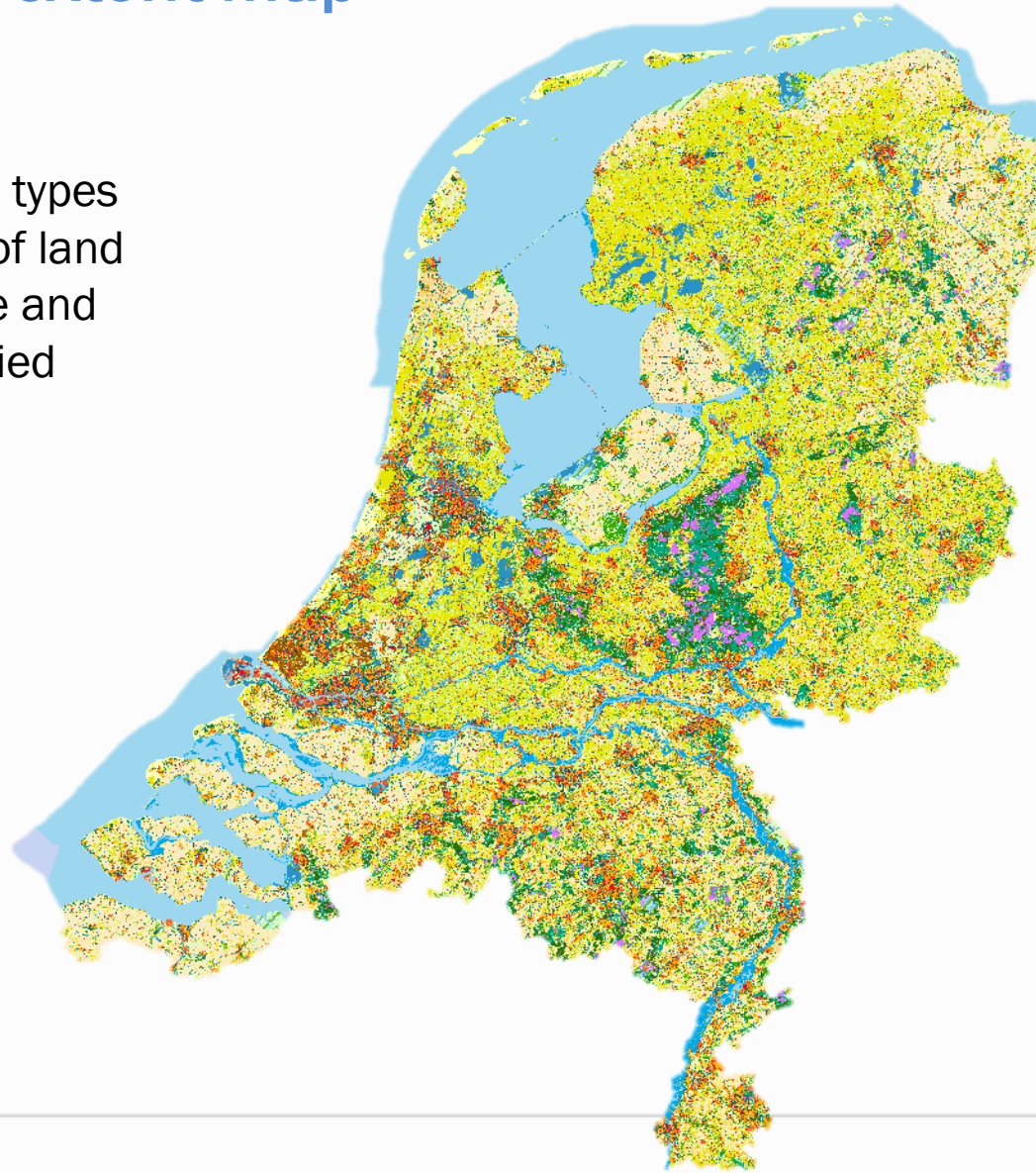


Source: analysts. Legenda, see previous figures.



# Ecosystem extent map

- 31 Ecosystem types
- Combination of land cover, land use and services supplied



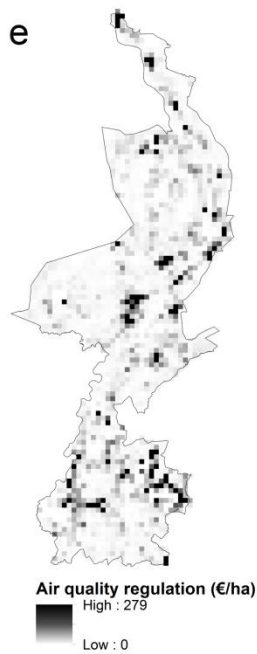
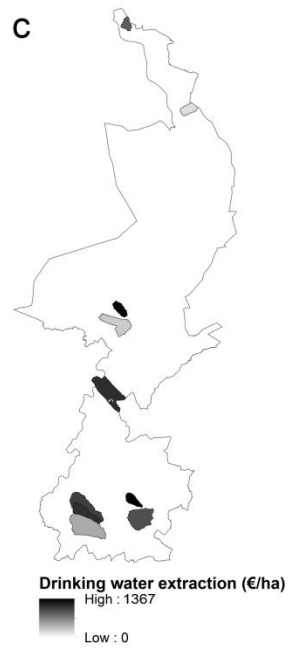
# Ecosystem types

Highest level of legend	Highest level map	EU code1	EU code2
Agriculture	Non-perennial plants	1	
	Perennial plants	2	
	Greenhouses	3	
	Meadows (grazing)	4	
	Bushes and hedges bordering fields	5	
	Farmyards and barns	6	
Dunes and beaches	Dunes with permanent vegetation		11
	Active coastal dunes		12
	Beach		13
Forests and other (semi) natural, environments incl. unpaved terrain	Deciduous forest	21	
	Coniferous forest	22	
	Mixed forest	23	
	Heath land	24	
	Inland dunes	25	
	Fresh water wetland	26	
	(semi) Natural grassland	27	
	Public green space	28	
	Other unpaved terrain	29	
Temporarily inundated lands	River flood basin		31
	Salt marsh		32
Built up and paved areas	Residential area	41	
	Industry: offices and businesses	42	
	Services: offices and businesses	43	
	Public administration: offices and businesses	44	
	Roads, parking lots, runways, other	45	
	Forestry: offices and businesses	46	
	Fishery: offices and businesses	47	
	Non-commercial services: offices and businesses	48	
Water	Sea	51	
	Lakes and ponds	52	
	Rivers and streams	53	









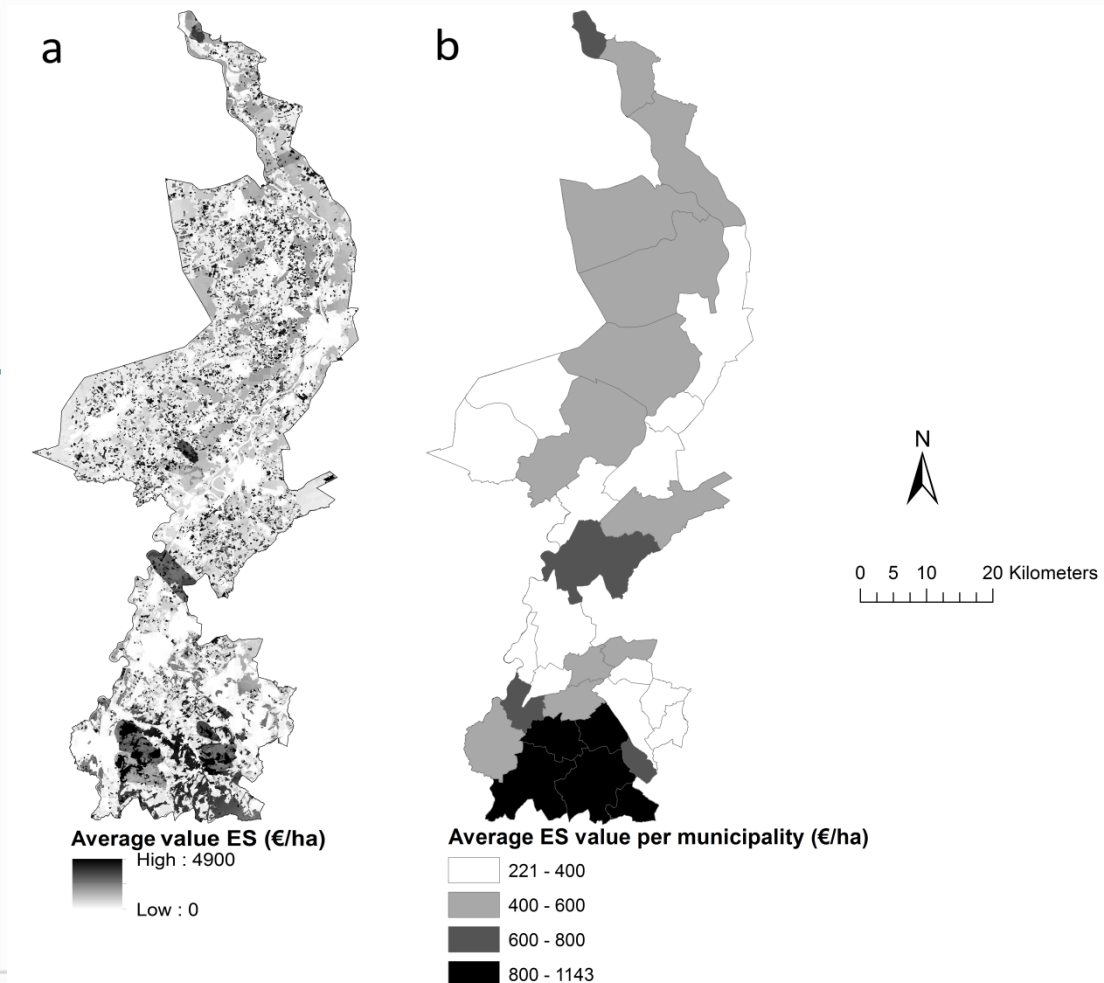
0 5 10 20 Kilometers

-biophysical  
modelling of  
each service



# Monetary ecosystem accounting

- Each ES mapped separately based on biophysical models
- Annual flow
- Comparable indicator (€/ha)
- Aggregation of ES possible



# Physical Supply (summ.)

## Physical supply, totals

Ecosystem Units		1	2	4	5	21	22	23	24	26	27	28	31	
		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	Totals
Ecosystem services	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 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
Ecosystem services	Ecosystem Units												
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

# Monetary Supply (summ.)

		Non-perennial plants	Meadows (for grazing)	Hedgerows	Deciduous forest	Coniferous forest	Mixed forest	Heath land	Fresh water wetlands	Natural grassland	Public green space	Other unpaved terrain	River flood basin	Totals
extent	ha	53.629	27.066	2.940	11.414	7.091	10.437	2.149	936	3.121	4.761	22.591	14.126	220.922
Crops	€	35.303.100	-	-	-	-	-	-	-	-	-	-	-	37.908.400
Fodder	€	1.960.900	4.587.100	-	-	-	-	-	-	-	-	-	942.300	7.556.200
Meat (from game)	€	817.700	223.400	-	186.800	192.700	261.100	35.600	12.700	32.900	14.700	211.200	136.000	2.249.400
Ground water	€	3.861.200	1.802.300	193.900	824.200	63.500	218.700	57.300	11.200	295.700	192.600	1.041.100	545.700	11.602.800
Capture of PM10	€	301.200	173.700	30.400	200.200	185.700	200.700	27.200	2.400	46.700	78.100	258.200	85.900	2.275.900
Carbon sequestration	€	300	165.700	18.000	562.500	350.300	515.000	13.200	6.400	19.300	40.500	139.000	95.600	2.006.100
Nature tourism	€	4.410.000	6.349.100	2.357.700	6.930.100	3.162.500	5.443.100	917.000	392.800	2.488.900	625.900	2.870.600	3.162.100	41.816.200
Recreation (cycling)	€	NA												NA
	€	46.654.400	13.301.400	2.600.000	8.703.800	3.954.700	6.638.800	1.050.400	425.400	2.883.500	951.700	4.520.200	4.967.500	105.415.000
value per ha (excl. Amenity)	€/ha	870	491	884	763	558	636	489	454	924	200	200	352	477
value per ha (incl. Amenity)*	€/ha	870	491	884	1.193	988	1.066	489	454	924	688	220	352	553



# Conclusions

- In Mexico, as elsewhere, a lot of valuation studies have been already conducted
- Opportunity: build on existing materials and studies
- Challenge: ensure consistency with accounting principles
- Valuation is important element of the SEEA EEA research agenda
- Mexico is well placed to provide an important contribution in this area during the project!



# THANK YOU

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