System of Environmental Economic Accounting

Session 7: Valuation of Ecosystem Services

Regional Training Workshop on the SEEA Experimental Ecosystem Accounting for African countries

28-31 October 2019, Pretoria, South Africa

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Outline: Valuation

1. Why do we conduct valuation?
2. Critiques and challenges
3. Welfare vs. exchange values
4. Key methods and techniques
5. Exercise: resource rent calculation
6. Valuation of ecosystem assets and degradation
7. Country examples
8. Integration with the national accounts
9. Questions and discussion

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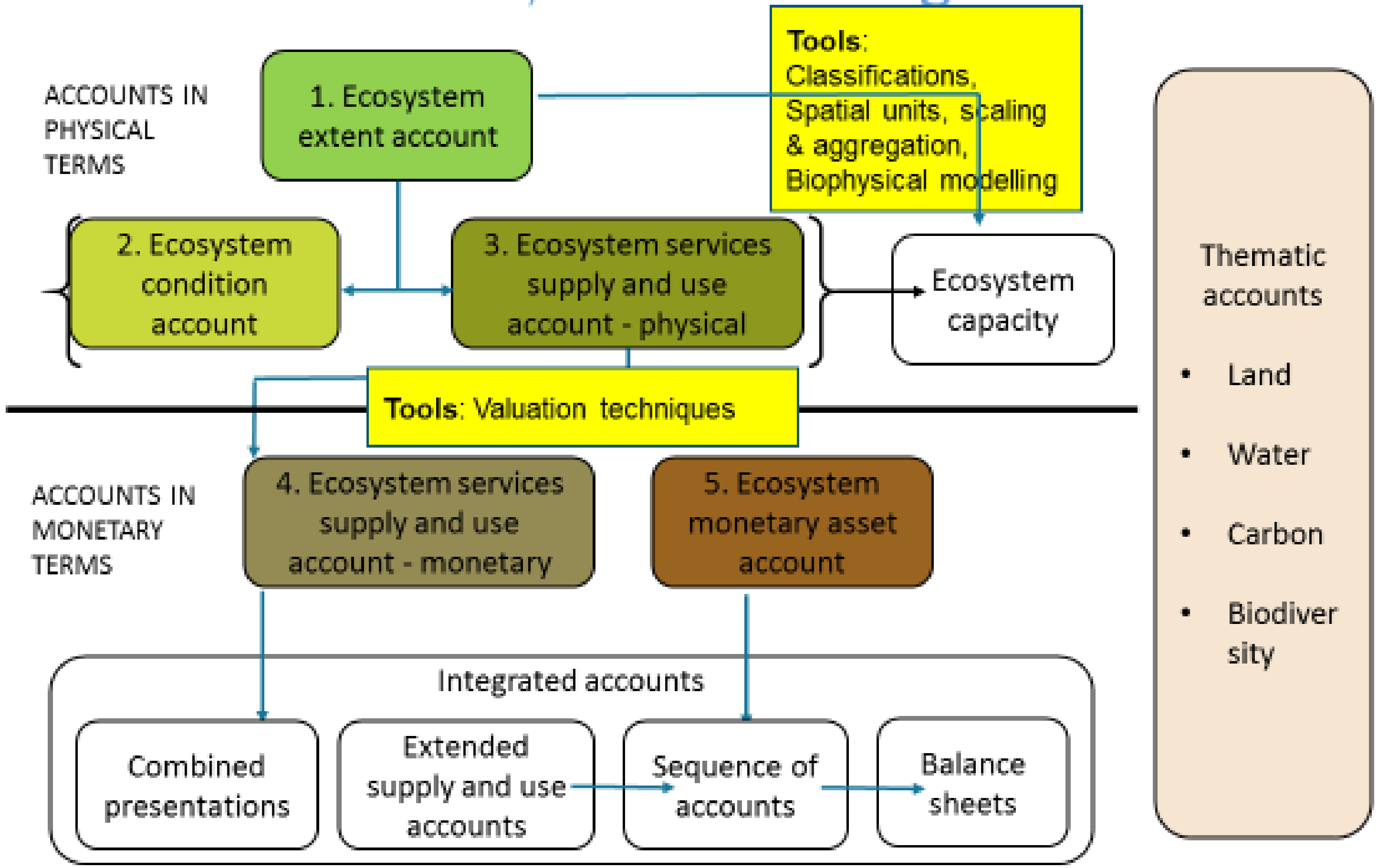
SEEA-EEA accounts, tools and linkages



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Why do we conduct valuation?

1. Why do we conduct valuation?

- Conventional economics is concerned with "the efficient allocation of scarce resources in society":
  - 'scarcity' implies finite supply and opportunity cost
  - use of the 'price mechanism' to determine what, how and for whom to produce?
- 'Market failures' exist, in that the natural environment as a 'public good':
  - **non-excludable** – individuals cannot be effectively excluded – people can use a resource without paying for it
  - **non-rivalrous** - use by one individual does not reduce availability to others
    - Clean air, climate change mitigation, clean water.
- Or 'common pool resources' – non-excludable and rivalrous e.g. fisheries, forestry
- **Under-valuation (often zero) of the natural environment → need for intervention to correct the incentives for misuse / over-exploitation.**

1. Why do we conduct valuation?

- What are we trying to value when we 'value nature'?
  - Ecosystem services
    - Flows: during the year
  - Ecosystem capital
    - Assets: value at beginning/end of year and changes therein
  - Degradation of ecosystems
    - The decline in the condition of ecosystem assets as a result of economic and other human activity

1. Why do we conduct valuation?

- What is the purpose of valuing the natural environment?
  - To integrate environmental issues in economic decision making and development planning – to do so the valuation must be purposeful
    - To raise awareness about the intangible, non-marketed benefits that nature provides
    - To illustrate the kinds of economic damage done to society by resource depletion and pollution
    - Inputs to Evaluation frameworks such as Cost-Benefit analysis, Multi-Criteria Decision-Making, to determination of environmental taxes/subsidies and other policy decisions

"To make nature's value visible."

2: Critiques and challenges

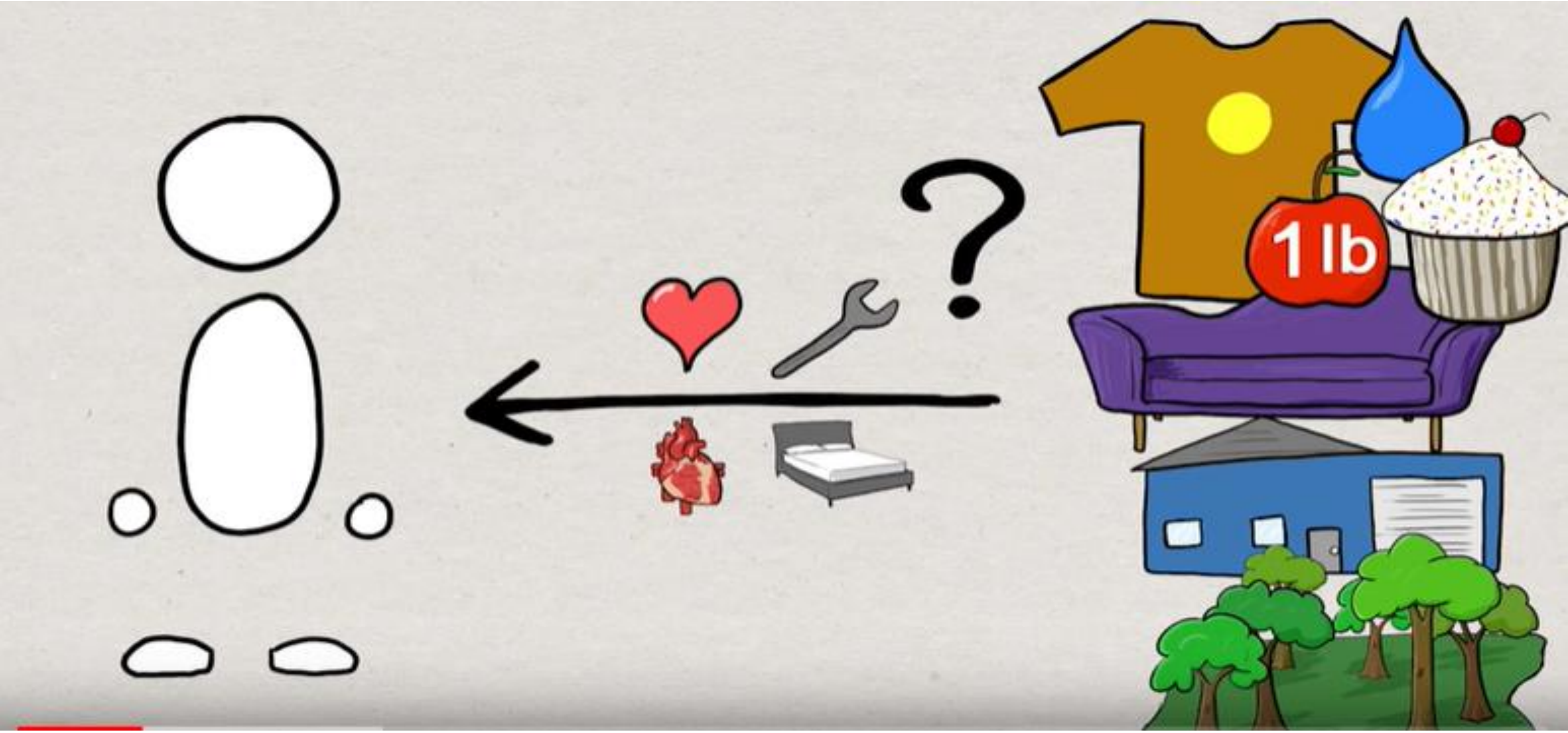
What objections might there be to the (monetary) valuation of the environment?

2: Critiques and challenges

- ‘Commoditization’ of nature actually promotes exploitation
- “It is priceless”
- Feeds into dominant economic discourse which focuses on efficiency but not distributional equity
- Valuation methods invariably capture a subset of the benefits of nature

‘

2: Critiques, challenges and defenses



We continually make decisions based on values. Valuation makes explicit what is often implicit, and allows an assessment of the trade-offs we are making.

Image: Conservation Strategy Fund

Making Nature's Value Visible

If nature is being appreciated in any way by humans (direct use, indirect use, and non-use "existence" value), then it has already been "commodified". Valuation is simply revealing the money-equivalent benefit of the commodity (ecosystem service).

Valuing nature is not the same as putting a price on nature.

2: Critiques and challenges

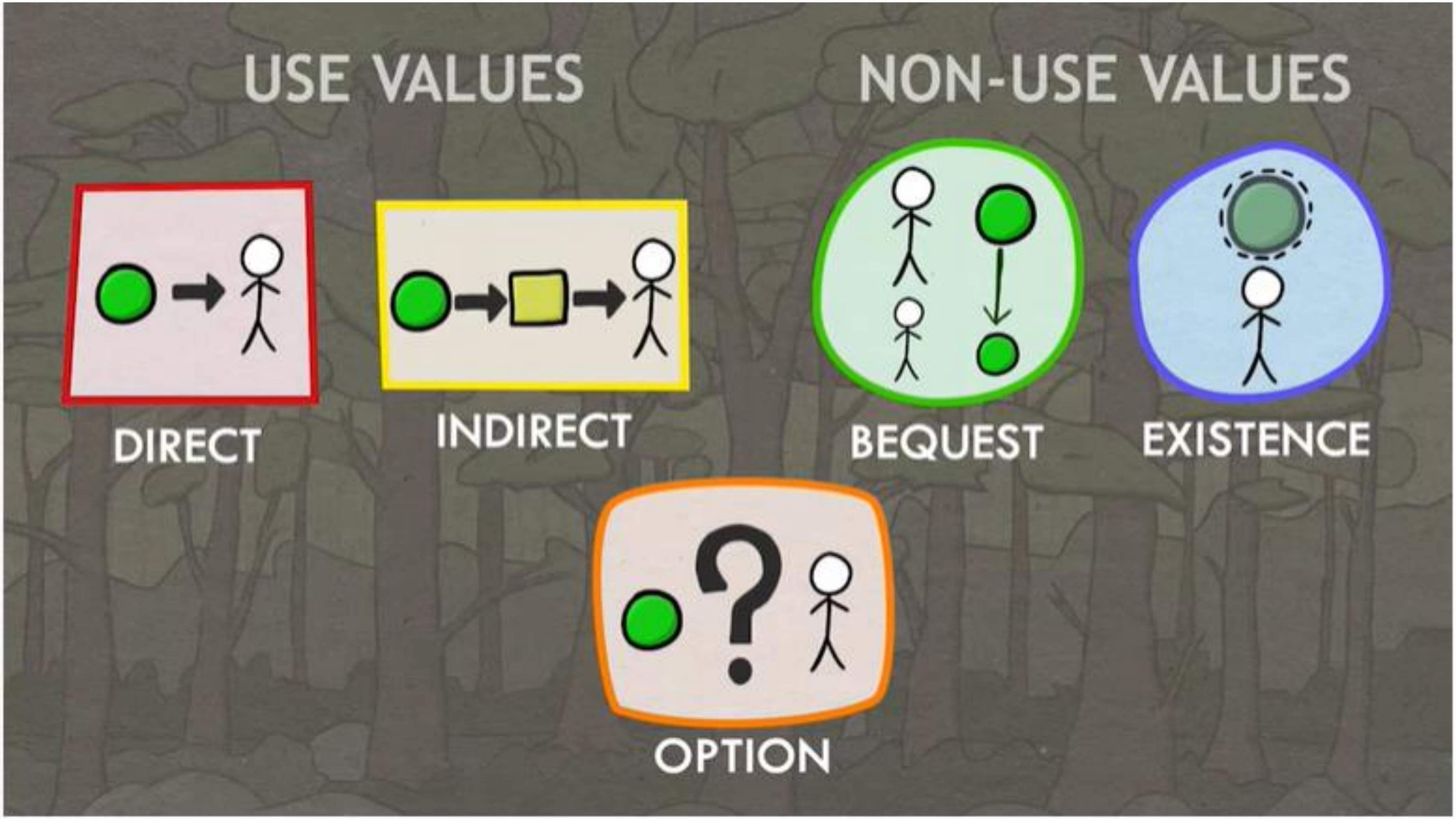


Image: Conservation Strategy Fund

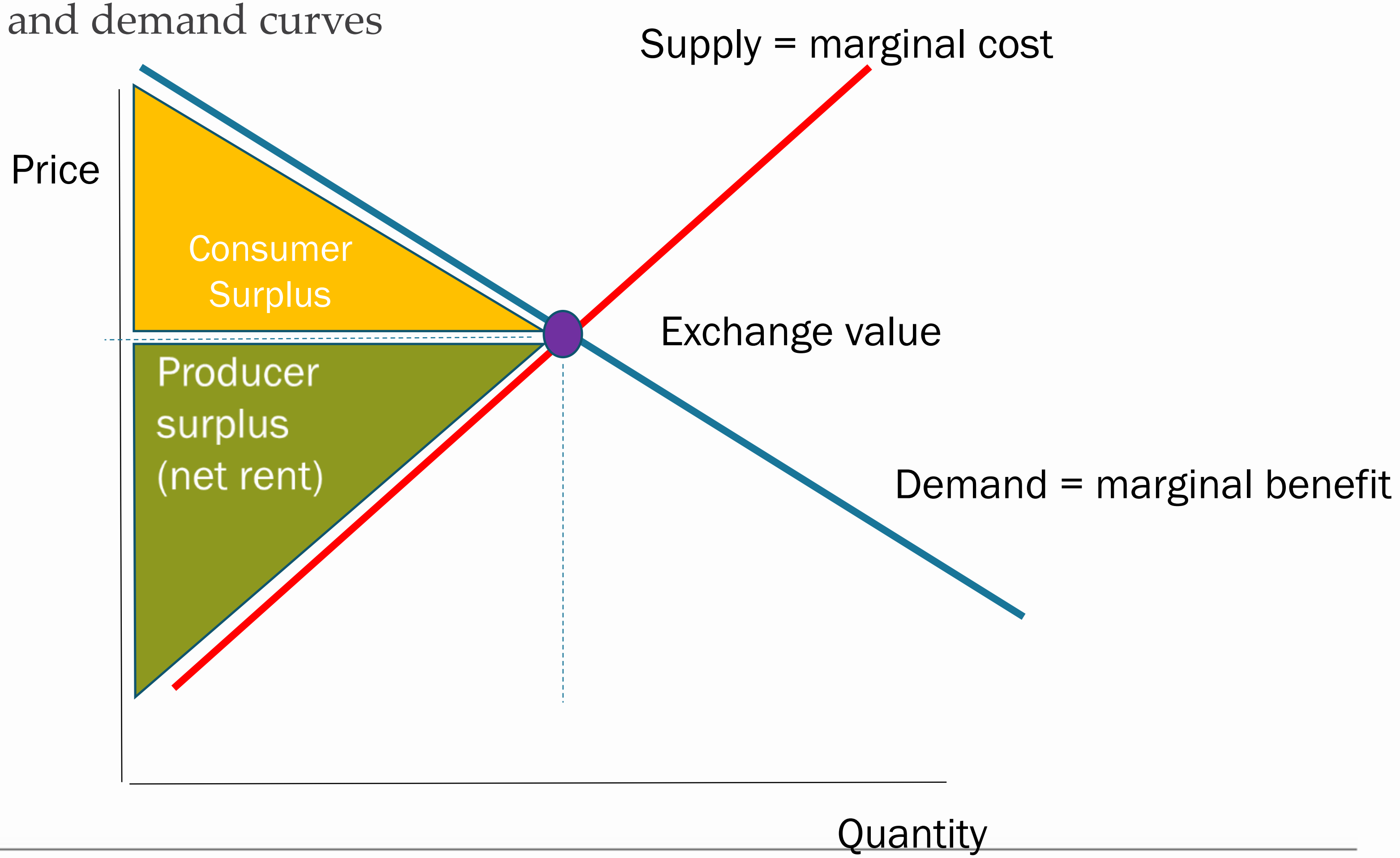
2: Critiques and challenges

Measurement challenges

- Non-linear responses: thresholds/resilience, climate change, refuge areas
- Aggregating values of different services: services can be competing, complementary or independent (but typologies attempt to address this)
- Transferring measured values from one site to another
- How to measure monetary value of regulating services?
  - *Spatial dependencies* (downstream, species/habitat)
  - *Multiple beneficiaries* (local, national, global)
  - *Risks* (e.g. probabilistic estimate of flood control)
- Cultural services

3: Market vs. Exchange values

- Supply and demand curves



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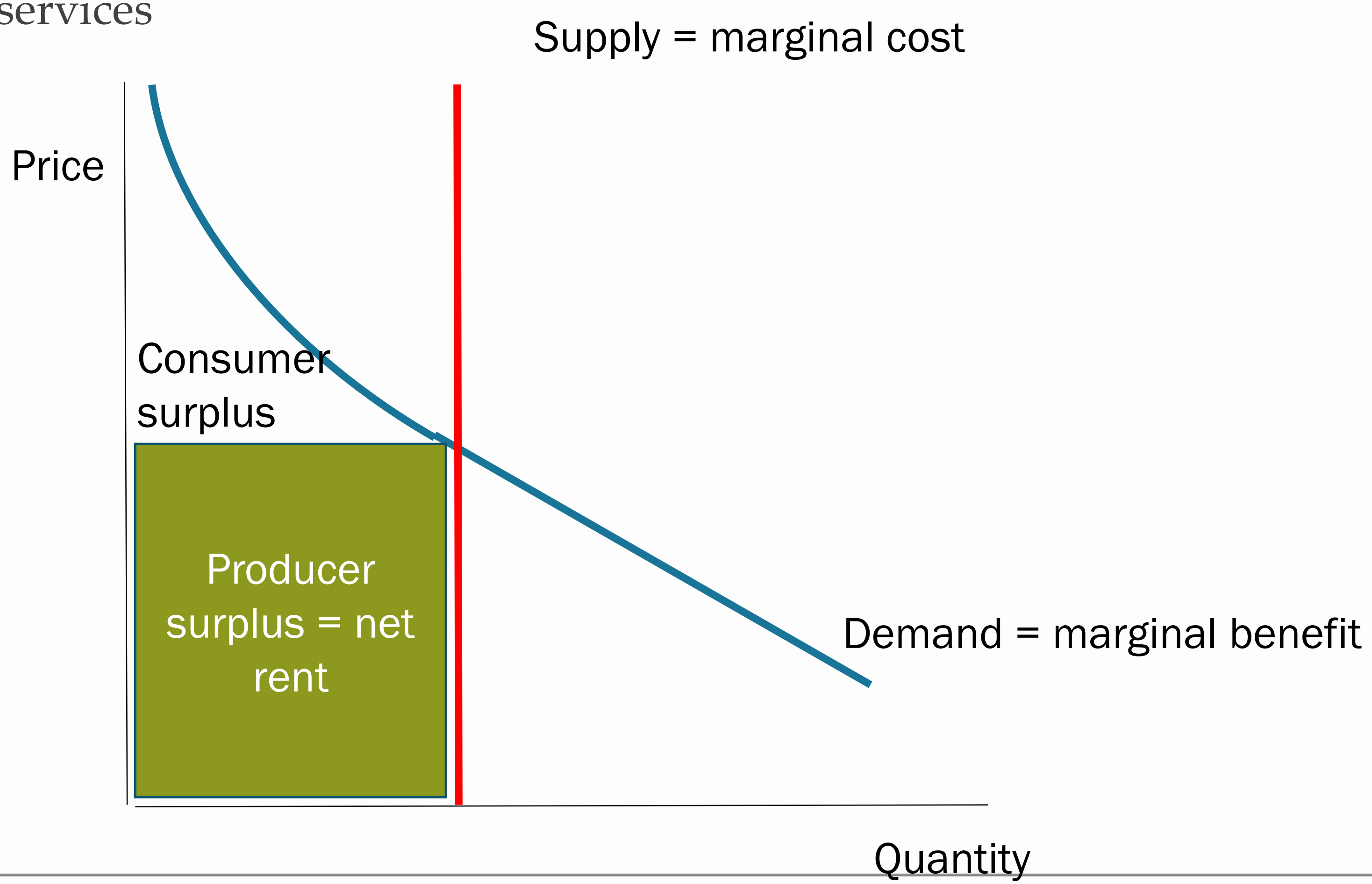
3: Market vs. Exchange values

Essential services



3: Welfare versus market values 1

- Focus of SNA is on assessing economic activity, not assessing welfare

  GDP is often taken as a measure of welfare, but the SNA makes no claim that this is so and indeed there are several conventions in the SNA that argue against the welfare interpretation of the accounts (2008 SNA)

  > Unpaid services

  > Distributional issues

- National Accounts is a transaction-based system:

  > *Externalities* are excluded -> focus is on actual exchange regardless of institutional setting
  > *Consumer surplus* is excluded
  > Both ends of the transaction require the same entry (supply = use)

3: Welfare versus market values 2

- However -> changes in Net Domestic Product approximate changes in welfare, under certain assumptions (Weitzman 1976)
  - Measurement boundaries (e.g. for production and consumption) are chosen based on utility
  - SEEA EEA extend the production boundary -> reflecting non-SNA benefits provided by nature

3: Market vs. Exchange values

- Dealing with non-marketed goods using valuation in SEEA:
  - System of National Accounts principle: Nordhaus (2005): "purpose should be to include activities that are economic in nature and those that substitute for market activities"
  - SEEA-EEA trying to assess exchange value (i.e. price and quantity)
    - The P and Q that would have been revealed in case a market would have existed for the specific ecosystem service)
    - Challenge: what is most likely institutional arrangement?
  - This is different to an ideal market that internalizes externalities
  - Fairly straight-forward in some cases, e.g. subsistence farming

4: Key Methods and Techniques

- Three different principles for generating exchange values:

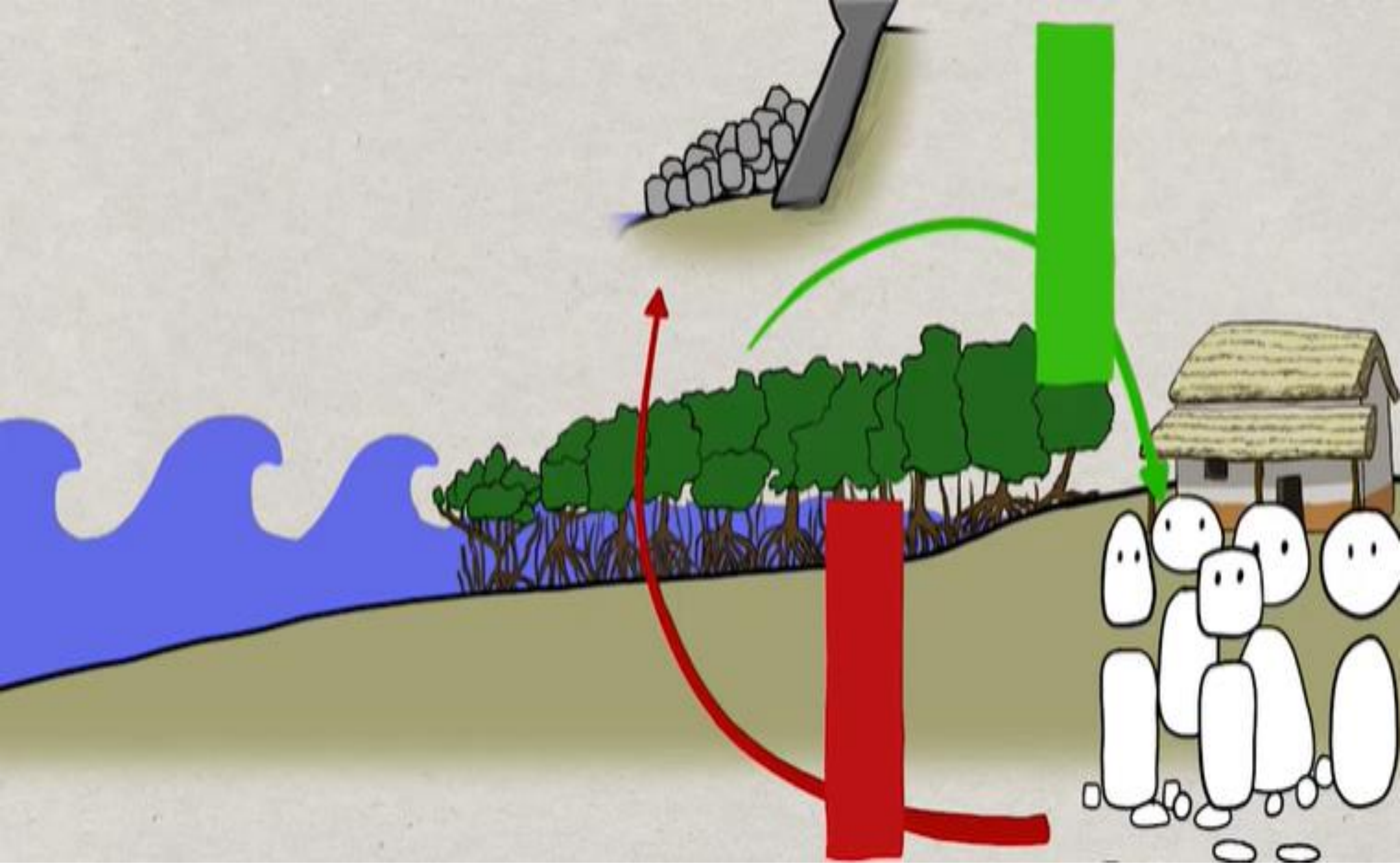
    1. Price of similar good or service: near-market case
    2. Estimate how much of the value of marketed goods or services are due to ecosystem services: only applies if ES contributes to market goods
    3. Estimated cost of not having the ecosystem service: such as avoided damages, cost-saved or replacement costs techniques

4: Key Methods and Techniques

- For many provisioning and some other services, a close connection can be made to the values used in the SNA to estimate production and consumption ('near-market'), for instance:
  - Contribution of ecosystems to crop and timber production
  - Contribution of ecosystems to providing a pleasant living environment with recreational opportunities (the 'amenity service')
- For other services ('far-market') the link between the ecosystem services and the institutional unit benefiting from the service is more indirect as typically in the case of regulating services. For instance:
  - Water purification (spatial dimension)
  - Air filtration (spatial and temporal dimension)
  - Carbon sequestration (temporal dimension)

4: Key Methods and Techniques

- Valuation techniques based on physical linkages (“demand function methods”)
  - > Replacement cost/ avoided damage
  - > Change in output of marketable goods
  - > Cost of illness
- Revealed preferences
  - > Travel cost
  - > Hedonic pricing
  - > Averting / preventative expenditures
- Stated preferences
  - > Elicit willingness-to-pay for or willingness-to-accept a marginal change
  - > Contingent Valuation Method
  - > Choice Experiments



Replacement cost

Image: Conservation Strategy Fund

4: Key Methods and Techniques

- ‘Replacement costs’/’avoided damage costs’
  - Assumes a service can *and would be* replaced
  - Engineering-type focus
    - Method feasible for regulating services such as water regulation, water purification and air filtration
  - Least cost alternative
  - Replacement cost are close to National Accounts concepts used in capital measurement (depreciation)
  - Famous example: Catskills watershed (returns on costs savings)

4: Key Methods and Techniques

- ‘Replacement costs’/’avoided damage costs’
  - > Graciela Chichilnisky and Geoffrey Heal (*Nature*, 1998):
    - “In 1996, New York City invested between $1 billion and $1.5 billion in natural capital, in the expectation of producing cost savings of $6 billion–$8 over 10 years.”
    - “New York City has floated an ‘environmental bond issue’ and will use the proceeds to restore the functioning of the watershed ecosystems responsible for water purification ....”
    - **“demonstrated how New York City realized billions of dollars in economic benefits by sustaining the Catskills watershed as a water filtration system, rather than . . . building a new filtration plant.”**

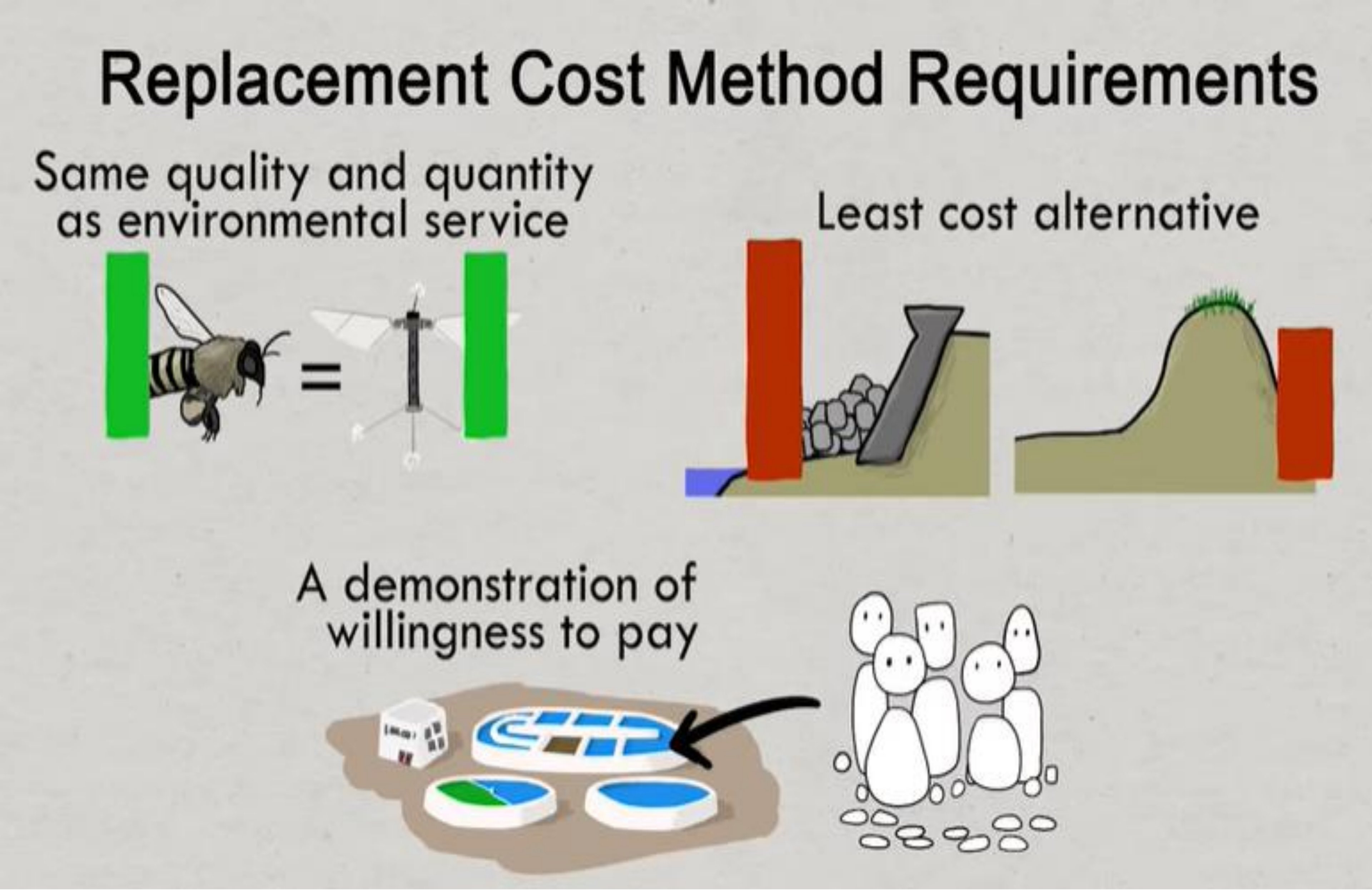


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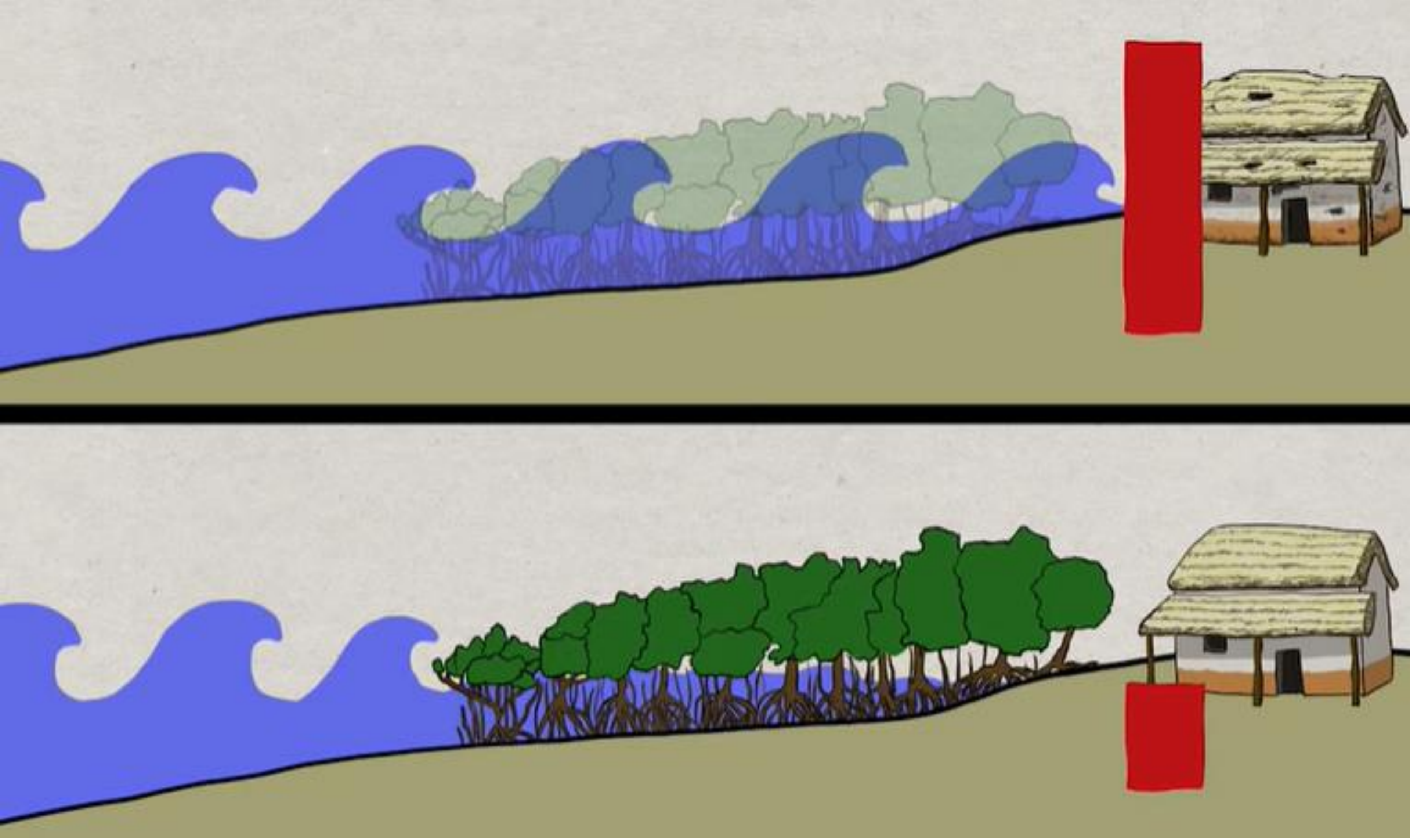
Image: Conservation Strategy Fund



Avoided cost

Image: Conservation Strategy Fund

Hedonic pricing Jakarta air quality

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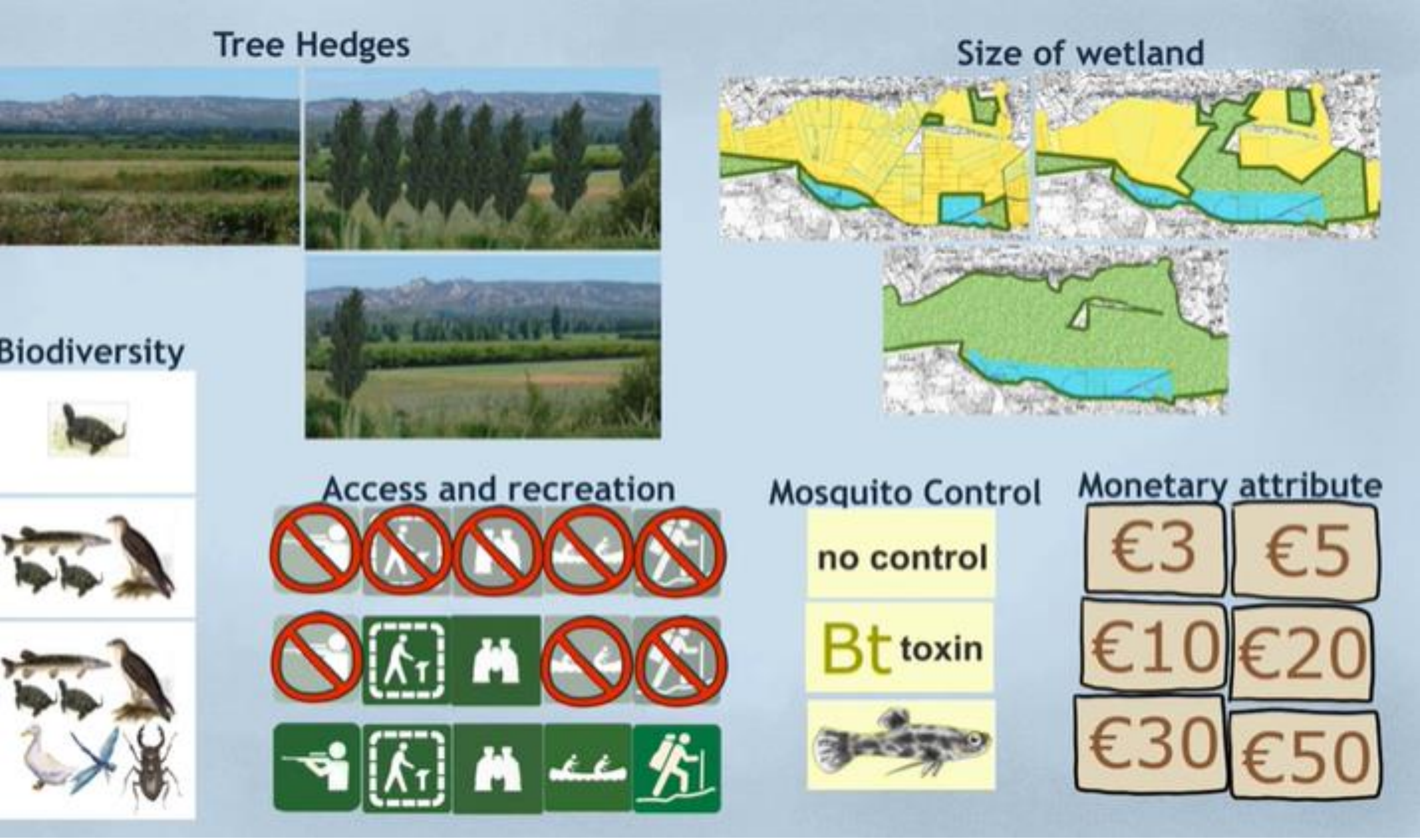
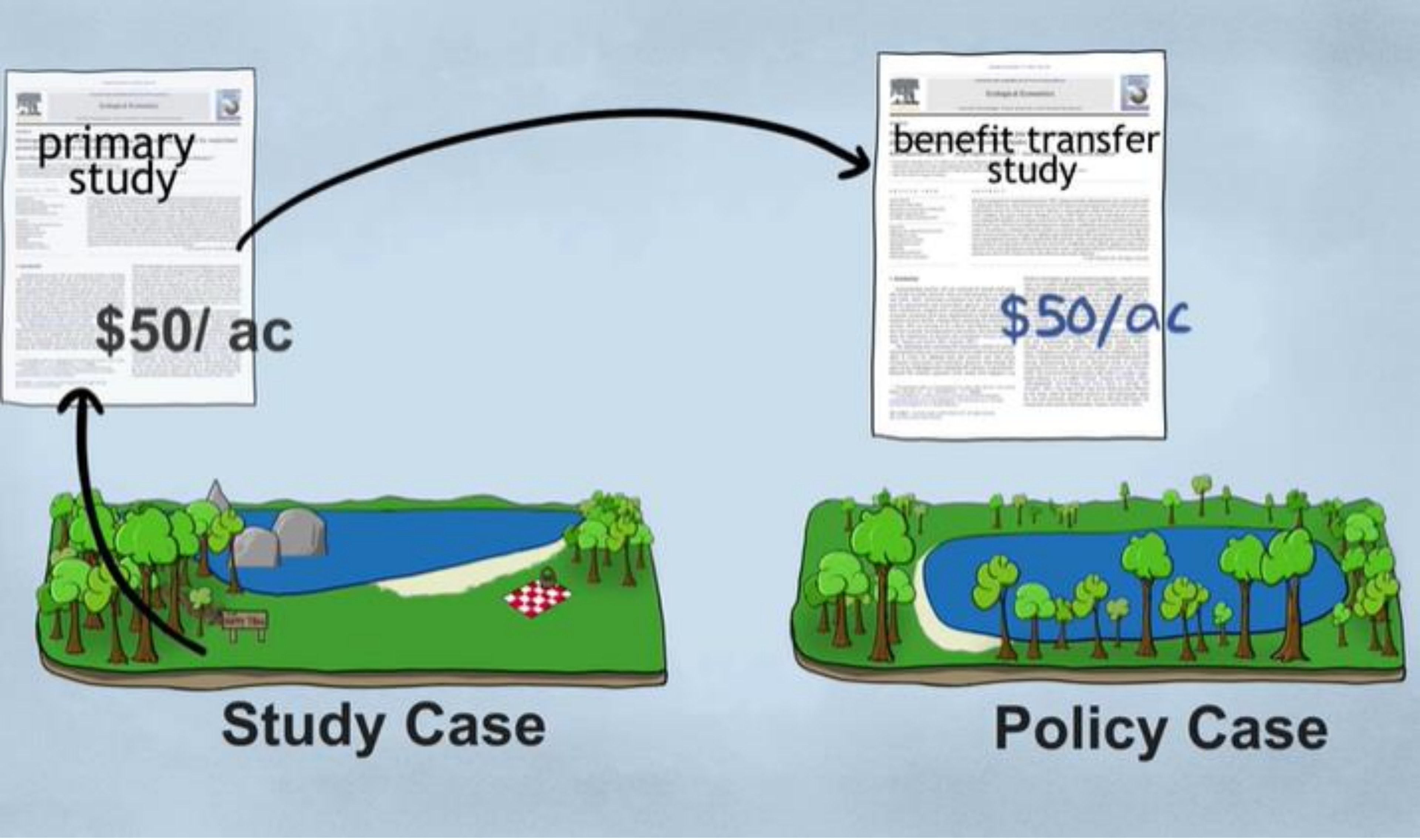
Image: Conservation Strategy Fund



Choice experiments

Image: Conservation Strategy Fund



Benefits Transfer

Image: Conservation Strategy Fund

4: Key Methods and Techniques

- Costanza et al. (2017)
  - > “The estimate for the total global ecosystem services in 2011 is $125 trillion/yr (assuming updated unit values and changes to biome areas) and $145 trillion/yr (assuming only unit values changed), both in 2007 $US.”

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Changes in the global value of ecosystem services

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A B S T R A C T

In 1997, the global value of ecosystem services was estimated to average $33 trillion/yr in 1995 $US ($46 trillion/yr in 2007 $US). In this paper, we provide an updated estimate based on updated unit ecosystem service values and land use change estimates between 1997 and 2011. We also address some of the critiques of the 1997 paper. Using the same methods as in the 1997 paper but with updated data, the estimate for the total global ecosystem services in 2011 is $125 trillion/yr (assuming updated unit values and changes to biome areas) and $145 trillion/yr (assuming only unit values changed), both in 2007 $US. From this we estimated the loss of eco-services from 1997 to 2011 due to land use change at $4.3–20.2 trillion/yr, depending on which unit values are used. Global estimates expressed in monetary accounting units, such as this, are useful to highlight the magnitude of eco-services, but have no specific decision-making context. However, the underlying data and models can be applied at multiple scales to assess changes resulting from various scenarios and policies. We emphasize that valuation of eco-services (in whatever units) is not the same as commodification or privatization. Many eco-services are best considered public goods or common pool resources, so conventional markets are often not the best institutional frameworks to manage them. However, these services must be (and are being) valued, and we need new, common asset institutions to better take these values into account.

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“we estimated the loss of eco-services from 1997 to 2011 due to land use change at $4.3–20.2 trillion/yr, depending on which unit values are used”

4: Key Methods and Techniques

- Issues with Benefits Transfer:
  - Majority of studies in developed world countries – simply adjusting for Purchasing Power Parity likely not sufficient
  - Selection bias: studies are sometimes commissioned where a funder wants to make a case for conservation, and the study area may have productive systems that are atypically high
  - Unit value transfer particularly subject to flaws as relies on the site from which values are transferred to have the same characteristics as the policy site (economic, social, ecological)
- Benefits Transfer: http://lukebrander.com/wp-content/uploads/2013/07/UNEP-2013-Guidance-manual-on-value-transfer-methods-for-ecosystem-services.pdf

Common methods for ecosystem services

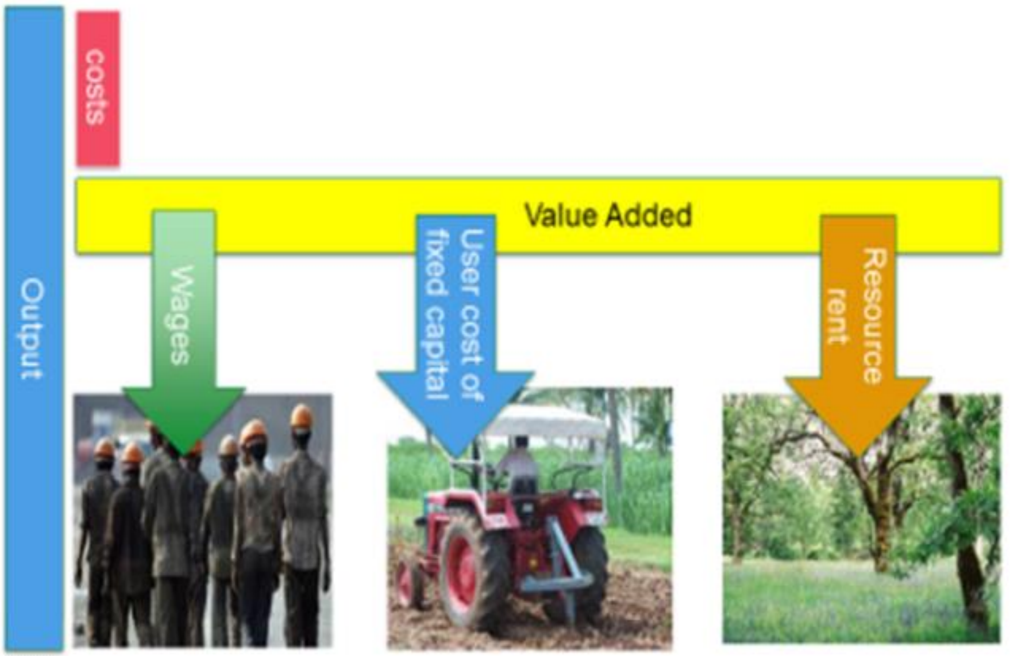
Service or group of services	Valuation methods
Harvested biomass (terrestrial and aquatic)	1. Gross income less certain costs 2. Leases paid for productive land or Share prices paid for harvesting rights 3. Replacement costs (e.g. for subsistence harvesting for cases in which appropriate market data not available)
Water supply	1. Demand function 2. Residual value (e.g. net return to water) 3. Marginal productivity, based on a production function 4. Alternative cost 5. Contingent valuation
Carbon sequestration	1. Emission trading scheme price 2. Social costs of carbon
Soil retention	1. Avoided cost
Air filtration	1. Avoided costs Costs of averting behaviour 2. Hedonic pricing
Water purification	1. Avoided water treatment costs / Avoided health costs 2. Prices in existing PES markets for similar hydrological ecosystem services 3. Simulated exchange value based on Stated preference studies
River flood regulation	1. Avoided costs, the lower of (i) associated with damage or (ii) replacement of the service with infrastructure
Coastal flood regulation	1. Avoided costs, the lower of (i) associated with damage or (ii) replacement of the service with infrastructure
Flow regulation	1. Avoided costs
Recreation services	1. Hedonic pricing 2. Market values for tourism; 3. Simulated exchange methods 4. Marginal value pricing

5: Exercise: Resource rent calculation

Example:

Resource rent (RR) approach:

- Value added of economic activities seen as return to all assets used in production
- RR estimated as residual
- Measures contribution by the ecosystem to production (= ES)



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Resource rent

sales at basic prices, includes all subsidies on products, excludes taxes on products)

	Output
Less	Operating costs
	Intermediate consumption (input costs of goods and services at purchasers' prices, including
	Compensation of employees (input costs for labour)
Equals	**Gross Operating Surplus** – SNA basis*
	Less User costs of produced assets
Equals	**Resource rent** (return to environmental assets used in pr

1) Consumption of fixed capital (depreciation) +
2) Return to produced assets

5: Exercise: Resource rent calculation

Group exercise 1

Estimate the resource rent for crop provisioning services for a hypothetical farm using the following data:

• Sales	500
• Costs of seeds, fertilizers	40
• Wages	200
• Value of machinery	400
• Remaining lifetime of machinery	10 years
• Rate of return for investment	8 %
• Investment	50

5: Exercise: Resource rent calculation

Exercise 1: answer

Resource rent = 188

Step 1: estimate the gross operating surplus (in basic prices)

[=500-40-200 = 260]

Step 2: deduct the return to produced capital

[depreciation: 10% of 400 = 40 + rate of return = 8% 400 = 32

260 - 40- 32 = 188

NB: investment is not needed, as this is what value added is used for,
RR -> looking at sources of revenue

6: Valuation of Ecosystem Assets

- Assets: in absence of market prices
  - Written down replacement cost
  - Net Present Value of future services
  - (alternative methods do exist – Fenichel et al 2015/2016))
- NPV: the value of an asset equals the discounted value of the flow of services from the asset:

$$NPV = \sum_{t=0}^{T} \frac{C_t}{(1+r)_t} = C_0 + \frac{C_1}{(1+r)_1} + \frac{C_2}{(1+r)_2} + \ldots + \frac{C_T}{(1+r)_T}$$

NPV = Net Present Value

C = Net benefits in year t

T = Discount period (e.g. 20 year)

r = Discount rate

6: Valuation of Ecosystem Assets

- The value of the asset equals the discounted flow of services from the asset

Current values	t0	t1	t2	Sum
ES1	40	30	35	
ES2	60	40	20	
Total, undiscounted	100	70	55	225
Total, discounted	100	64	45	209

$$\text{NPV} = 100 + \frac{70}{(1+0.1)} + \frac{55}{(1+0.1)^2} = 209$$

6: Valuation of Ecosystem Assets

NPV is challenging:

- NPV of expected flows -> requires information of all the ES extended into the future
  - Capacity used as a check to assess the sustainability of future ecosystem service flows
  - In part ESS will also depend on demand
  - Alternative is to use capacity-based valuation (as by definition sustainable)
- Choosing an appropriate discount rate
- Lifetime of the asset

6: Degradation

- Degradation:
  > Ecosystem deterioration is the reduction ecosystem condition over an accounting period that is due to human activity [physical concept]

  > Ecosystem degradation is the decrease in the expected ecosystem services flows over an accounting period arising from ecosystem deterioration. [monetary concept]

Table 1: Accounting entries for depletion and degradation (SEEA EEA Table 7.3)

	Accounting entry				
Type of assets	*Opening stock*	*Transactions*	*Other changes in volume*	*Revaluations*	*Closing stock*
Produced assets		Gross fixed capital formation (investment) **Consumption of fixed capital / Depreciation**	Primarily physical appearance and disappearance of assets - Discoveries - Catastrophic losses - Reappraisals of stock	Changes in value between opening and closing stocks due solely to changes in prices of assets	
Natural resources		**Depletion**			
Ecosystem assets		**Degradation**			

6: Degradation

Table 2: Combinations of changes in ecosystem assets

		Rise in expected ES flows	Fall in expected ES flows
Decline in ecosystem condition	Due to human activity (deterioration)	Other change in volume	Degradation
	Due to natural influences	Other change in volume	Catastrophic loss, Disappearance
Rise in ecosystem condition	Due to human activity	Enhancement	Other change in volume
	Due to natural influences	Appearance	Other change in volume
No change in ecosystem condition		Other change in volume	Other change in volume

- Rise in expected ESS with fall in condition possible due to increase in demand -> other changes in volume
- Enhancement is inverse of degradation

6. Degradation

Table 3: Mock-up example of estimating degradation and enhancement

t1

ET	ES	actual	unit	condition		area	price	physical capacity	monetary actual	monetary tot_act	NPV act	act_acre price
Forest	timber	10	tons	age		4	1	8	10	40	$246	$61
	carbon sequestratioı	12	tC	biomass		4	1	12	12	48	$295	$74
	nature based recreat	20	visitors	shannon		4	1	16	20	80	$492	$123
Agricultur	crops	8	tons	soil depth		4	1	6	8	32	$197	$49
Wetland	fishing	5	tons	BOD		4	1	5	5	20	$123	$31
Water	provisioning of wate	4	m3	PB		4	1	4	4	16	$98	$25
											$1,450	

		actual	unit	condition			price	capacity	actual	tot_act	NPV act	act_acre price
Forest	timber	9	tons	age	down	3	1	7	9	27	$166	$55
	carbon sequestratioı	12	tC	biomass	equal	3	1	12	12	36	$221	$74
	nature based recreat	20	visitors	shannon	down	3	1	14	20	60	$369	$123
Agricultur	crops	9	tons	soil depth	equal	6	1	7	9	54	$332	$55
Wetland	fishing	5	tons	BOD	up	3	1	6	5	15	$92	$31
Water	provisioning of wate	3	m3	PB	up	4	1	4	3	12	$74	$18
											$1,253	

6. Degradation

Table 4: Decomposition of changes in value between t1 and t2

Opening stock		**1450**	Condition	ES flows
	delta forest (average)	-22	down	fall
	delta water (average)	-25	up	fall
	delta agriculture (avera	31	equal	rise
	delate wetland (averag	0	up	equal
	conversion forest	-255	loss in forest area	
	conversion water	0	area remains equal	
	conversion wetland	-31	loss in wetland area	
	conversion cropland	104	gain in cropland area	
Closing stock		**1253**		

6. Degradation

Table 5: Decomposition of changes in value between t1 and t2

Opening balance			**1450**
	degradation		-203
	enhancement		31
	obsolescence		0
	(dis)appearance		0
	other changes in volume		-25
Closing balance			**1253**

- Degradation cost can be included in the sequence of accounts to obtain an environmentally adjusted aggrettaes

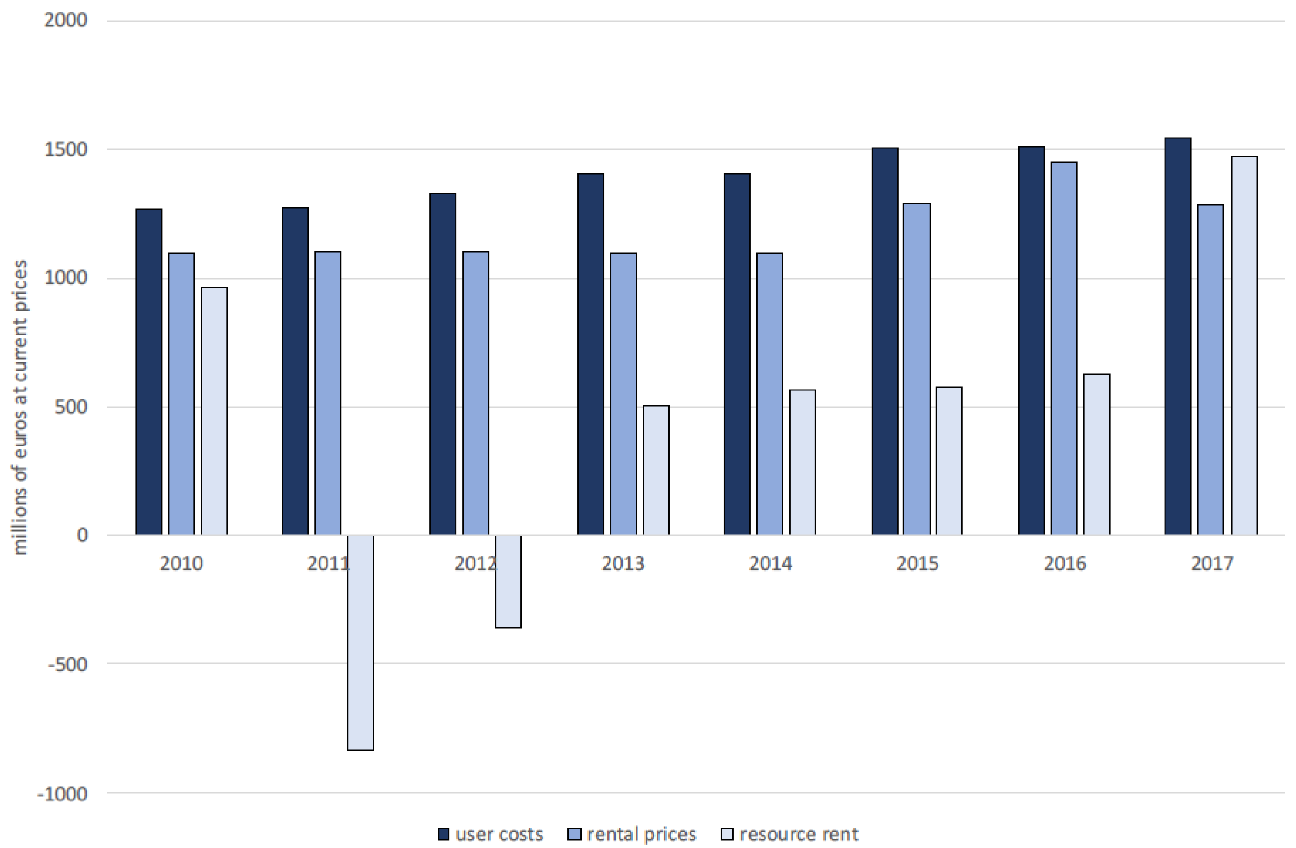
7: Country examples

Netherlands

ESS	Method
Crop production Fodder/grass	Resource rent User costs Rental price
Timber production	Resource rent Stumpage price
Water filtration	Replacement cost
Pollination	Averted production loss
Carbon sequestration	Social cost of carbon Efficient carbon price
Air filtration	Avoided health costs
Nature recreation Nature tourism	Resource rent Tourism expenditures
Amenity services	Hedonic pricing

Comparison of methods

Figure 4.1.2 Value of total ecosystem services provided by agricultural land for crop and fodder production, 2010-2017



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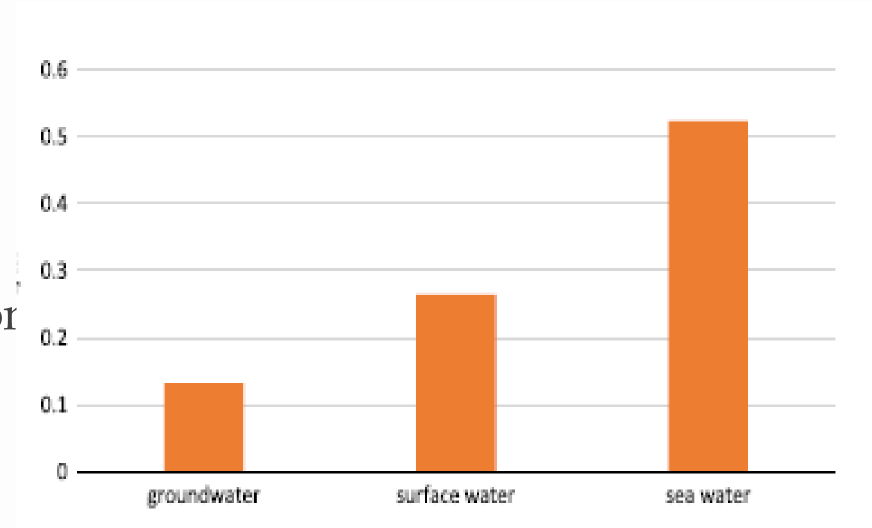
Water filtration



Operational costs of drinking water production for various water sources, 2010.

RR problematic due to market conditior

Replacement costs techniques:

- Valuation of provisioning service of groundwater: using additional cleaning costs when using surface water
- Assuming that surface water is indeed available under comparable conditions for abstraction and transport and not subject to depletion
- The least cost alternative for using surface water for making drinking water would be to use desalination.
- Etc.

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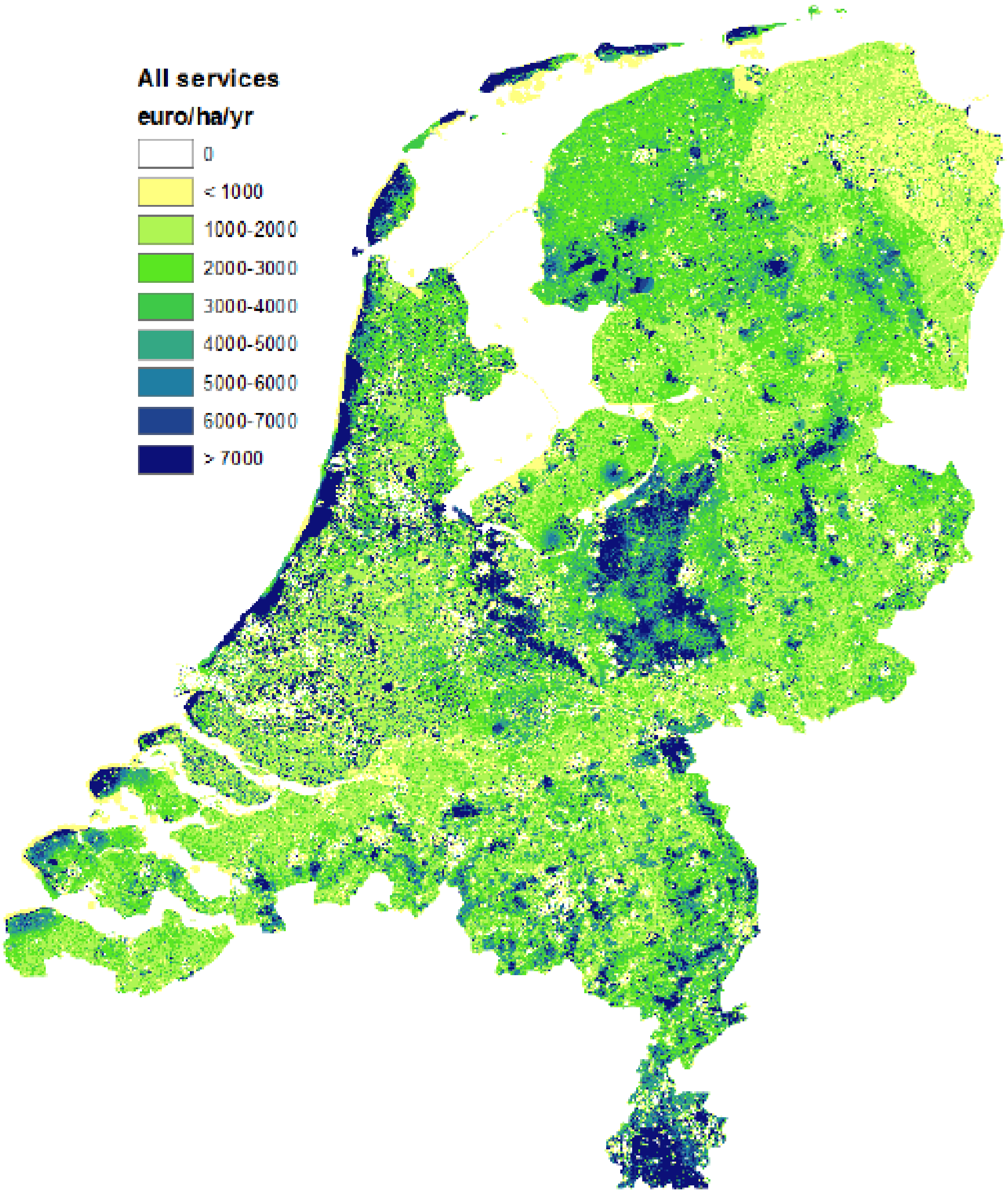

All services
euro/ha/yr
0
< 1000
1000-2000
2000-3000
3000-4000
4000-5000
5000-6000
6000-7000
> 7000

Figure 7.2.3 Percentage share of ecosystem types in the total extent and total estimated value of ecosystem services in 2015 (%; using the broad scope estimates of tourism and recreation)

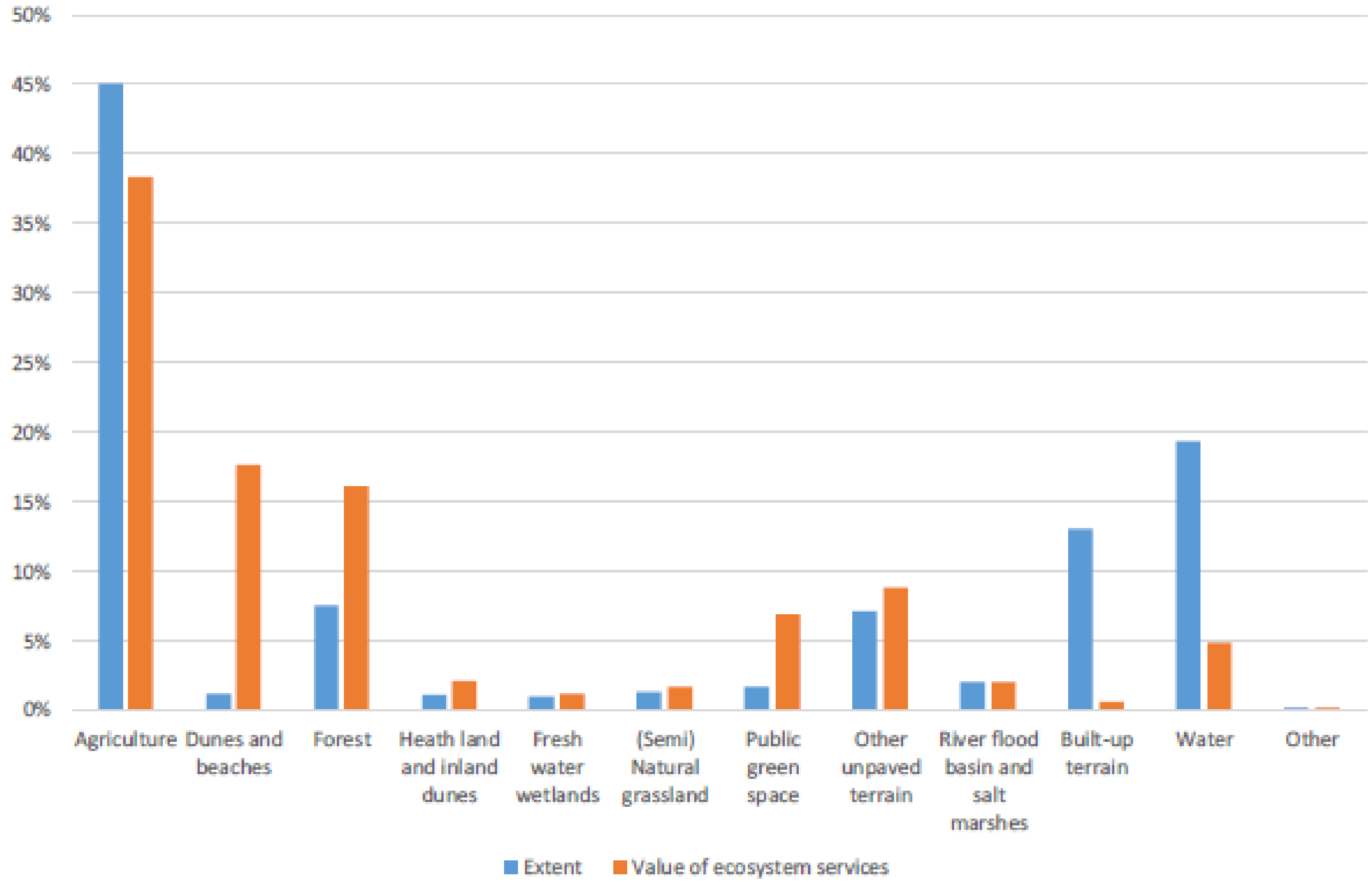
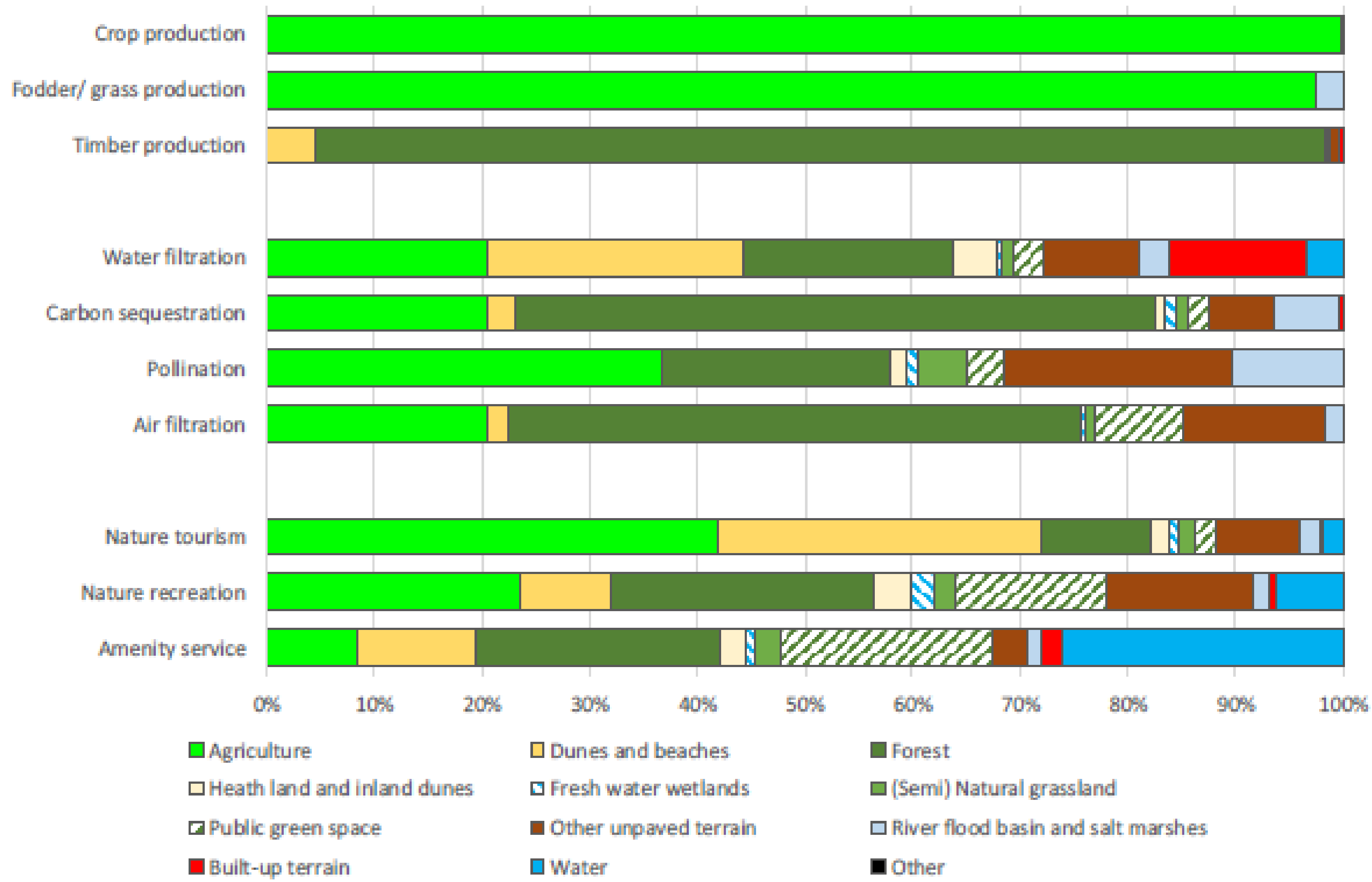


Figure 7.2.5. Contribution of ecosystem types to the total value of individual ecosystem services in 2015 (%; using the broad scope estimates of tourism and recreation)



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Ecosystem services supply and use table

ECOSYSTEM SERVICES SUPPLY TABLE

		Type of economic unit							Type of Ecosystem Unit															
	UNITS	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	TOTAL SUPPLY
									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

		Type of economic unit							Type of Ecosystem Unit															
	UNITS	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	TOTAL USE
									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															

Netherlands

- Total value very low – 1.9 % of GDP.

Table 4.9.1. Monetary supply table for ecosystem services, 2015 (using the broad scope estimates of tourism and recreation)

	millions of euros	Agriculture	Dunes and beaches	Forest	Heath land and inland dunes	Fresh water wetlands	(Semi) Natural grassland	Public green space	Other unpaved terrain	River flood basin and salt marshes	Built-up terrain	Water	Other	TOTAL
Provisio-ning services	Crop production	415	0	0	0	0	0	0	1	0	0	0	0	415
	Fodder production	849	0	0	0	0	0	0	2	21	0	0	0	872
	Timber production	0	2	41	0	0	0	0	0	0	0	0	0	44
Regulating services	Water filtration	36	42	35	7	1	2	5	15	5	23	6	0	177
	Carbon sequestration	35	5	102	1	2	2	3	11	10	1	0	0	171
	Pollination	132	0	75	6	5	16	12	77	37	0	0	0	359
	Air filtration	18	2	46	0	0	1	7	11	1	0	0	0	86
Cultural services	Nature tourism	2489	1791	602	100	52	97	113	463	115	6	116	0	5946
	Nature recreation	910	327	949	135	78	75	547	532	58	26	237	1	3873
	Amenity service	87	114	236	24	9	24	204	35	13	19	272	0	1037
TOTAL	Total	4970	2283	2085	274	146	217	891	1147	260	74	631	1	12981

Source: Statistics Netherland and Wageningen University 2019

Netherlands

Table 4.9.2. Monetary use table for ecosystem services, 2015 (using the broad scope estimates of tourism and recreation)

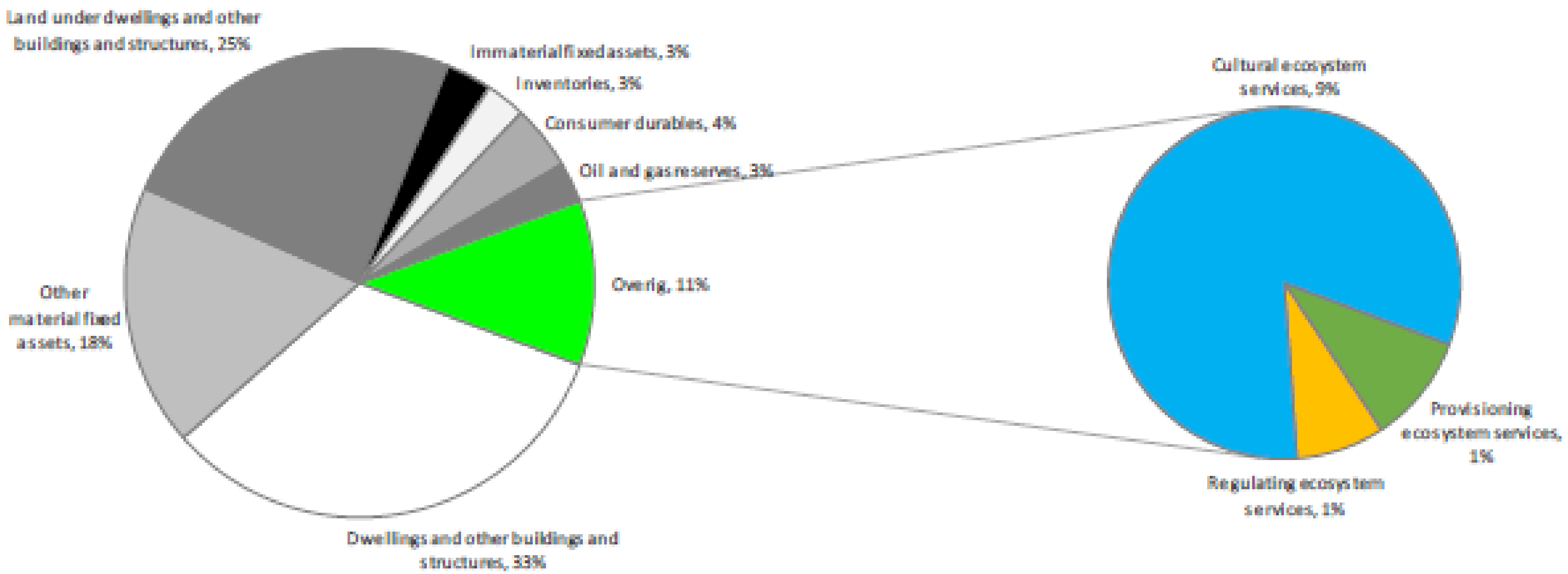
	millions of euros	A - Agriculture, forestry and fishing	B,C - Mining and manufacturing	D - Electricity	E - Water supply	F-H - Contruction, wholesale and transportation	I,R - Accommodation and food service, culture, sports and recreation	Export	Households	Government	Investments	Inventories	TOTAL
Provisio-ning services	Crop production	415											415
	Fodder production	872											872
	Timber production	44											44
Regulating services	Water filtration				177								177
	Carbon sequestration									171			171
	Pollination	359											359
	Air filtration								86				86
Cultural services	Nature recreation								3873				3873
	Nature tourism							3341	2605				5946
	Amenity service								1037				1037
TOTAL	**Total**	1690	0	0	177	0	0	3341	7601	171	0	0	12981

Source: Statistics Netherland and Wageningen University 2019

SEEA

Netherlands

- Asset values



Valuation of ES – South Africa

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

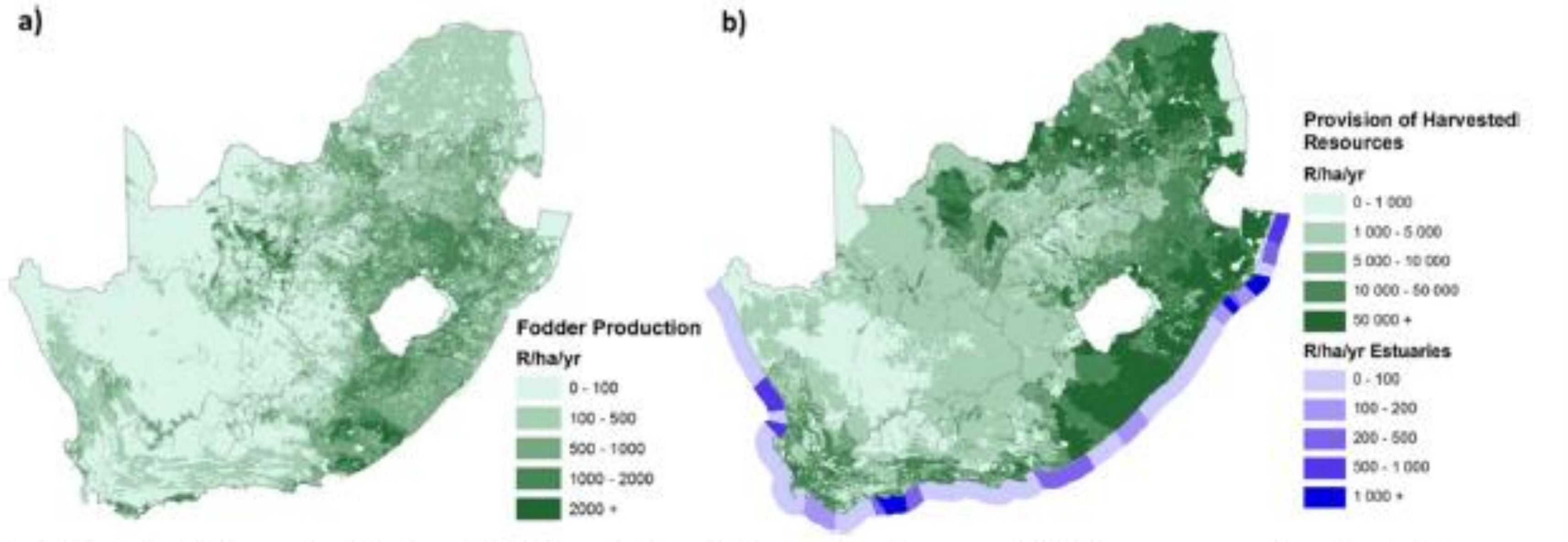


Fig. 3. Value of provisioning services in the form of (a) fodder production and (b) harvested natural resources, including instream water and estuarine/coastal resources.

Source: Turpie et al., 2017

SA - continued

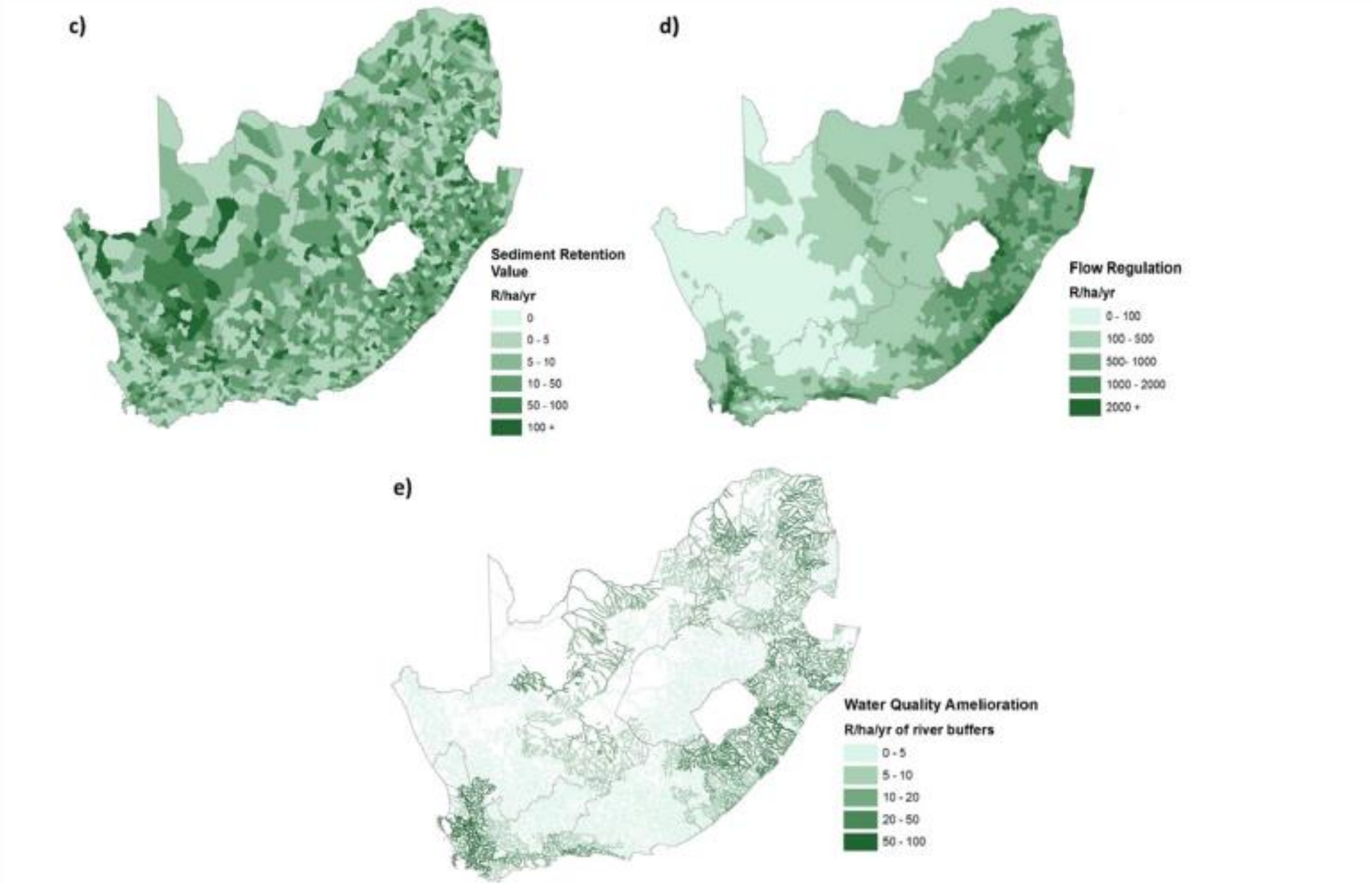


Fig. 5. Values of regulating services for (a) carbon storage, (b) agricultural and fisheries support, (c) sediment retention, (d) flow regulation and (e) water quality amelioration.

Source: Turpie et al., 2017

SA - continued

Table 4
Overall estimates for each ecosystem service valued in this study, including where gaps have been identified and still need to be filled. Values in R millions.

Category	Services	Value (R million million)
Provisioning services	Livestock fodder	39 750
	Harvested renewable resources	7 716
	Genetic resources, biological compounds	?
Cultural services	Amenity values (aesthetic, recreation)	112 261
	Cultural and religious value	?
	Existence and bequest (non-use) values	6 450
	Scientific and educational value	?
Regulating services	Carbon storage	40 686
	Regulation of local climate	?
	Pollination	6 908
	Control of pests and pathogens	> 2 170
	Maintaining soil fertility	?
	Critical habitats/refugia	804
	Control of erosion and sedimentation	2 112
	Flow regulation	55 795
	Coastal storm protection	?
	Water quality amelioration	9
	Air quality amelioration	?
Total		> 274 661

Source: Turpie et al., 2017

SA - continued

Service	Valuation method
Cultural - existence value	Stated-preference study
Amenity/tourist value	Tourist experniture plus spatial variation in the density of geo-tagged photographs uploaded to www.panoramio.com to estimate the spatial spread of tourism.
Property value natural open space	Hedonic pricing study
Livestock fodder production	Replacement cost (in terms of bought feed)
Harvested living resources	Minimum of their sustainable yields and the estimated demand
Carbon sequestration	Social cost of carbon
Pollination	Additional cost of hand pollination
Pest control	Benefits transfer
Erosion control	Amount of storage that would have to be constructed to prevent a similar amount of sediment from reaching downstream aquatic environments
Flow regulation	Replacement storage capacity
Water quality	Avoided cost of water treatment

EU

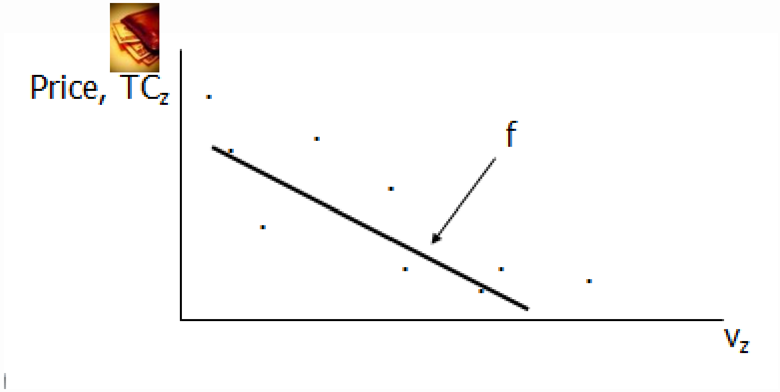
Ecosystem services	Main data source	Monetary valuation	Years assessed
Crop provision	Disentangling from official statistics on yield the ecosystem contribution	Market prices	2000, 2006, 2012
Timber provision	Disentangling from official statistics on timber the ecosystem contribution	Market prices	2000, 2006, 2012
Global climate regulation	CO_2 uptake from LULUCF inventories	Prices related to carbon emissions	2000, 2006, 2012
Flood control	Modelling ecosystem service components: potential, demand and flow	Avoided damage cost	2006, 2012

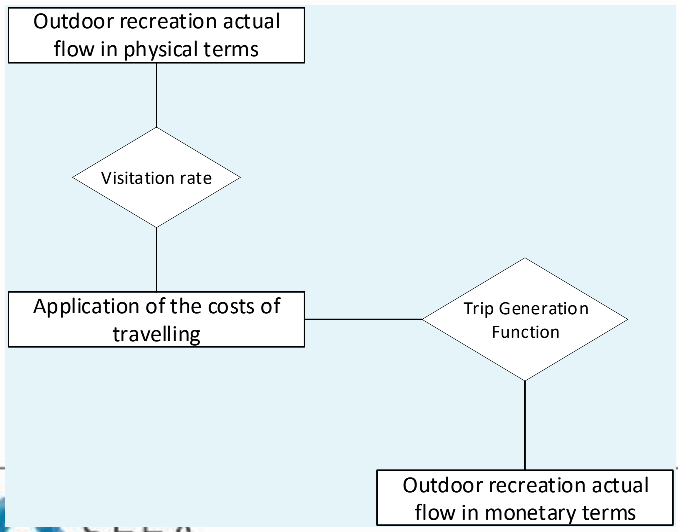
Source: Turpie et al., 2017

Outdoor recreation: travel cost values

For each municipality

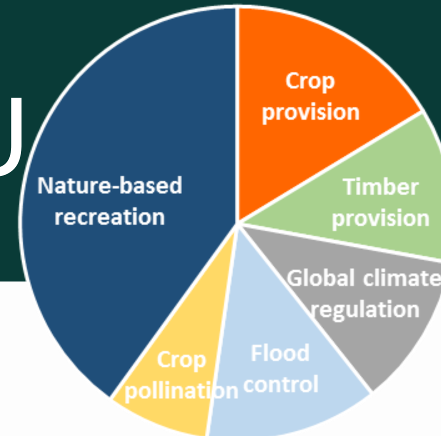
$V_z = f(TC)$





Existence of natural recreational areas is valued as € per year

Supply table for the EU



Year 2012, million EUR	Ecosystem type									Total
Ecosystem service	Urban	Cropland	Grassland	Heathland and shrub	Woodland and forest	Sparsely vegetated land	Wetlands	Rivers and lakes	Coastal and intertidal areas	
Crop provision		20,560								20,560
Timber provision					14,540					14,540
Global climate regulation	20	150	850	20	13,330	20	0	NA	NA	14,390
Flood control	90	1,020	3,130	360	11,390	0	330	NA	NA	16,320
Crop pollination		9,720								720
Nature-based recreation	80	4,070	7,480	3,100						400
Total	190	35,520	11,460	3,480						,930
Value in EUR/km^2	880	22,090	22,610	19,250						740

NA: not assessed

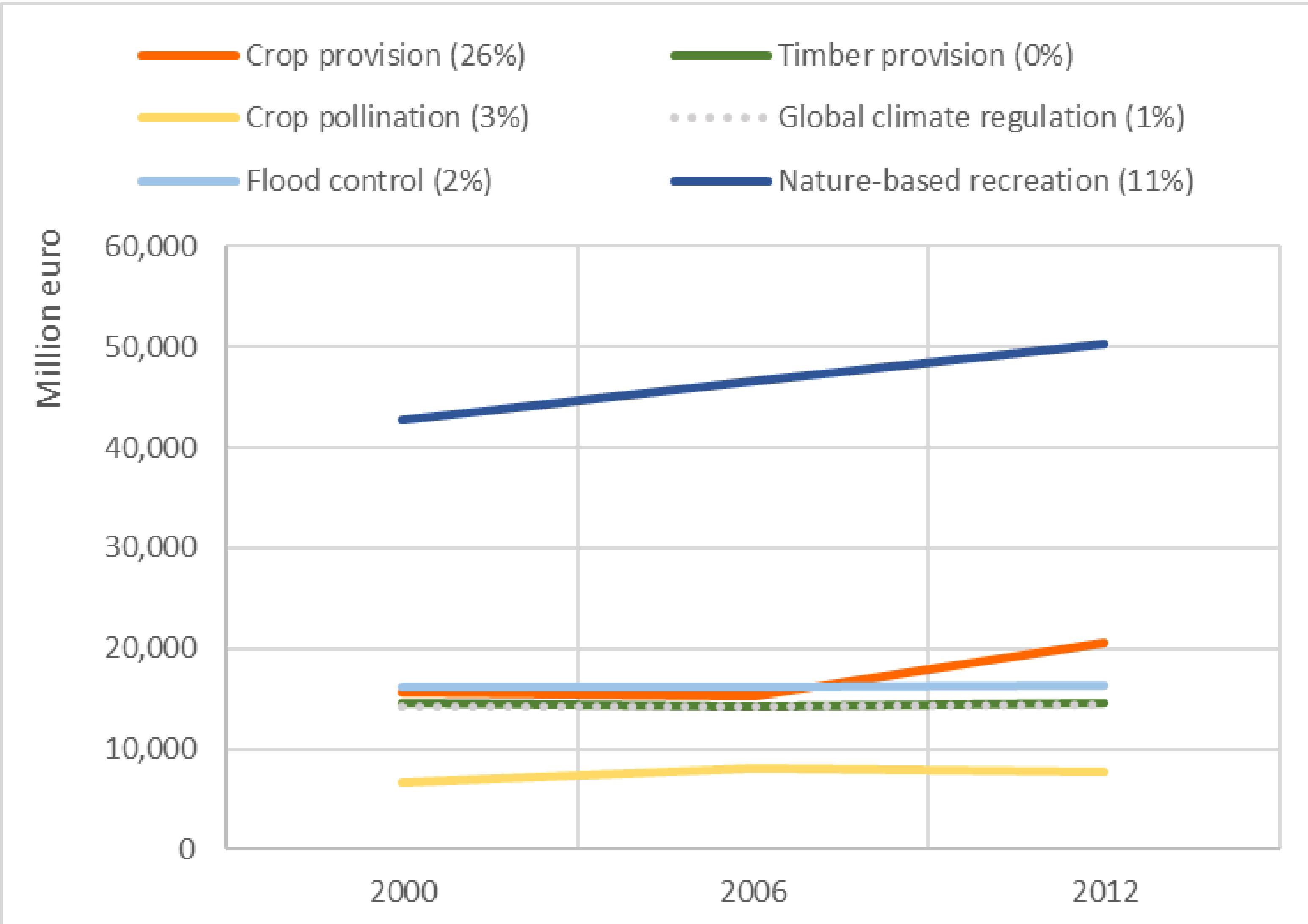
Values rounded to the nearest tens

56,370 euro/km^2 of green urban area

Q4:What is the ultimate goal of NCA?

SEEA

Trends for ecosystem services



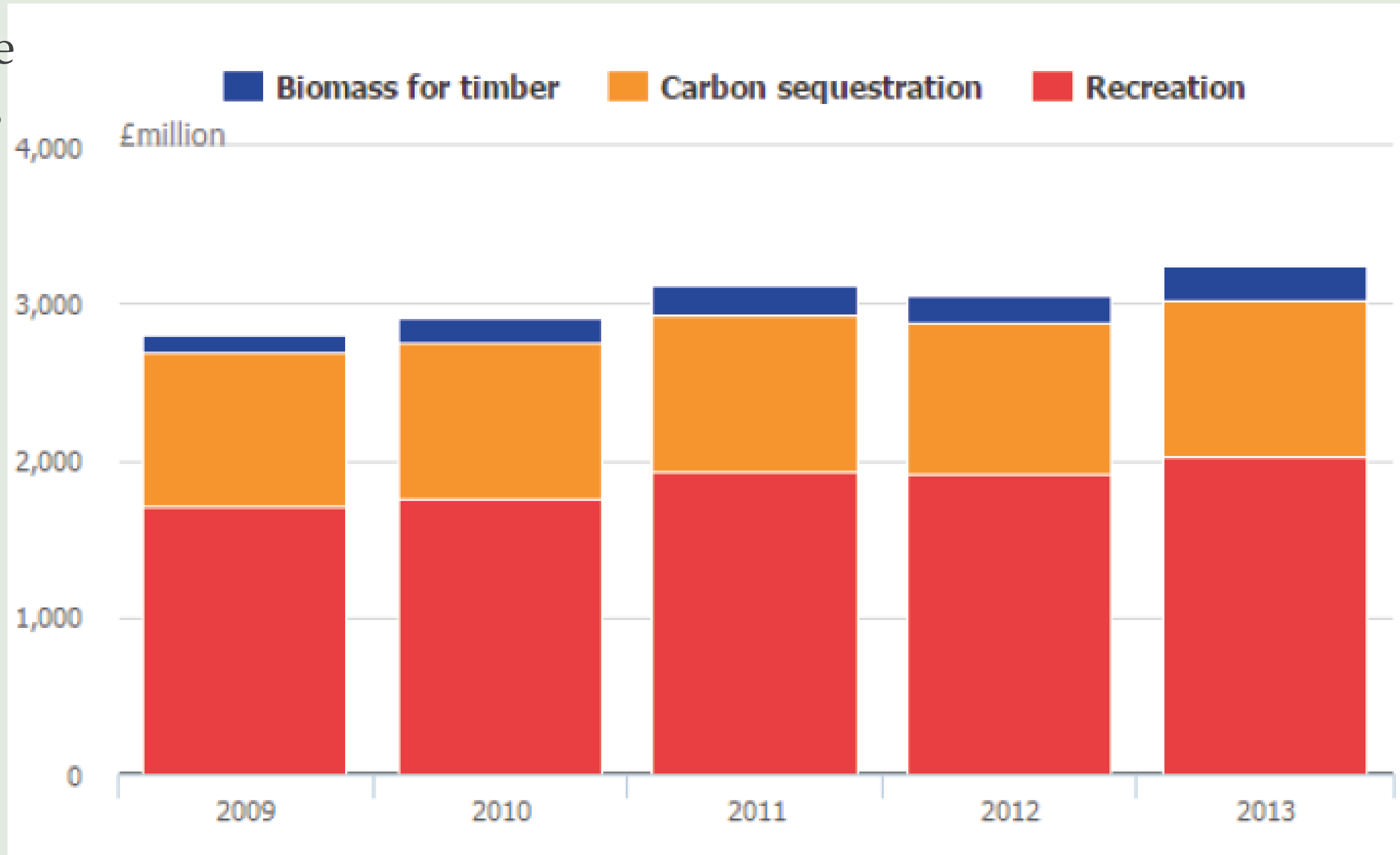
UK

- ET approach
- Also balance sheet values

Box 23.3 The value of a tree: ecosystem services in UK woodland

The UK Office for National Statistics (ONS Woodlands, 2015) studied the values of UK woodland ecosystems. The study considered three ecosystem services (timber production, carbon sequestration and recreation), calculating monetary flows for them. The results are presented in the graph below.

Similar work carried out in Germany, Spain and by EU-funded research projects indicate similar orders of magnitude.



Chapter 23. Developing Pilot Ecosystem Accounts in the European Union: Potential Policy Applications
Laure Ledoux and *Jakub Wejchert* Biodiversity Unit, DG Env.

8 Integrated presentations

- Integrating services into Supply and Use tables
- Assume we have a hypothetical simple economy
- GDP = 200

	Economy	Household	Total
Supply			
Ecosystem service A			
Ecosystem service B			
Product X	200		200
Use			
Ecosystem service A			
Ecosystem service B			
Product X		200	200
Value added (supply less use)	200		**200**
		200	

8 Integrated presentations

- Integrating services into Supply and Use tables
- Suppose the economy depends on a ecosystem service B

	Ecosystem	Economy	Household	Total
Supply				
Ecosystem service A				
Ecosystem service B	50			50
Product X		200		200
Use				
Ecosystem service A				
Ecosystem service B		50		50
Product X			200	200
Value added (supply less use)	50	150		**200**
			200	

- This increases output, but GDP remains the same
- We have made the contribution by nature visible !

8 Integrated presentations

- Now suppose there is an additional ecosystem service A finally consumed by households (say an amenity service)

	Ecosystem	Economy	Households	TOTAL
Supply				
Ecosystem service a	100			100
Ecosystem service b	50			50
Product X		200		200
Use				
Ecosystem service a		50	50	100
Ecosystem service b			50	50
Product X			200	200
Value added (supply less use)	150	150		**300**
			300	

- Now we see that both output and GDP of the economy changes

8 Integrated presentations

- The impact of including ecosystem services in the national accounts will depend on the type of services and their usage: output will increase but GDP may not
- Likewise, various possibilities exist for recording degradation in the accounts. By definition GDP will remain the same (but NDP may change) [one of the reasons to dislike green GDP]
- A sequence of accounts has been proposed now under global expert consultation

Allocation/use of income accounts							
(Degradation-adjusted) net operating surplus	140		140	130		25	155
Compensation of employees		50	50		50		50
Ecosystem transfers					30	-30	0
(Degradation-adjusted) disposable income	140	50	190	130	80	-5	205
Less final consumption—products		200	200		200		200
Less final consumption—ecosystem services (non-SNA)					30		30
(Degradation-adjusted) net saving	**140**	**-150**	**-10**	**130**	**-150**	**-5**	**-25**
Capital account							
(Degradation-adjusted) net saving	140	-150	-10	130	-150	-5	-25
Plus consumption of fixed capital	10		10	10			10
Plus ecosystem degradation (non-SNA)				10		5	15
Net Lending/Net Borrowing	**150**	**-150**	**0**	**150**	**-150**	**0**	**0**
Financial accounts							
Changes in cash	150	-150	0	150	-150	0	0
Net Lending/Net Borrowing	**150**	**-150**	**0**	**150**	**-150**	**0**	**0**
Changes in balance sheets							
Changes in fixed capital	-10		-10	-10			-10
Changes in ecosystems (non-SNA)				-10		-5	-15