System of Environmental Economic Accounting

Measuring Climate Assets through SEEA

UNECE Expert Forum for Producers and Users of Climate Change-Related Statistics
Session 4: Linkages between climate, wealth and well-being
Session chair

Bram Edens, PhD

Senior Statistician, Environmental Economic Accounts Section

United Nations Statistics Division

United Nations

Outline

- Introduction to SEEA
- How SEEA relates to wealth and well-being
- SEEA ecosystem accounting and climate
  - > Carbon accounts
  - > Ecosystem service: Carbon retention
- Does SEEA reflect climate properly?
  - > atmosphere an asset

System of Environmental Economic Accounting

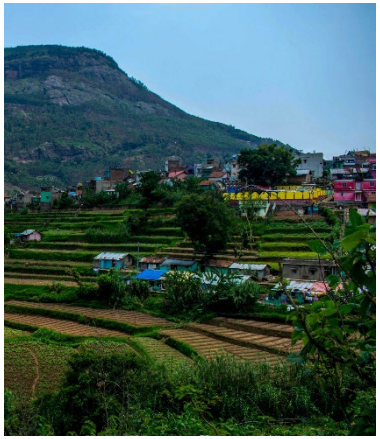
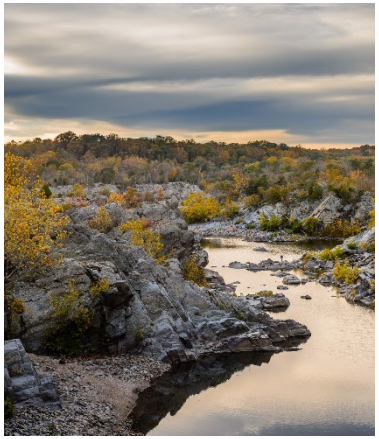
WHAT IS SEEA?

United Nations

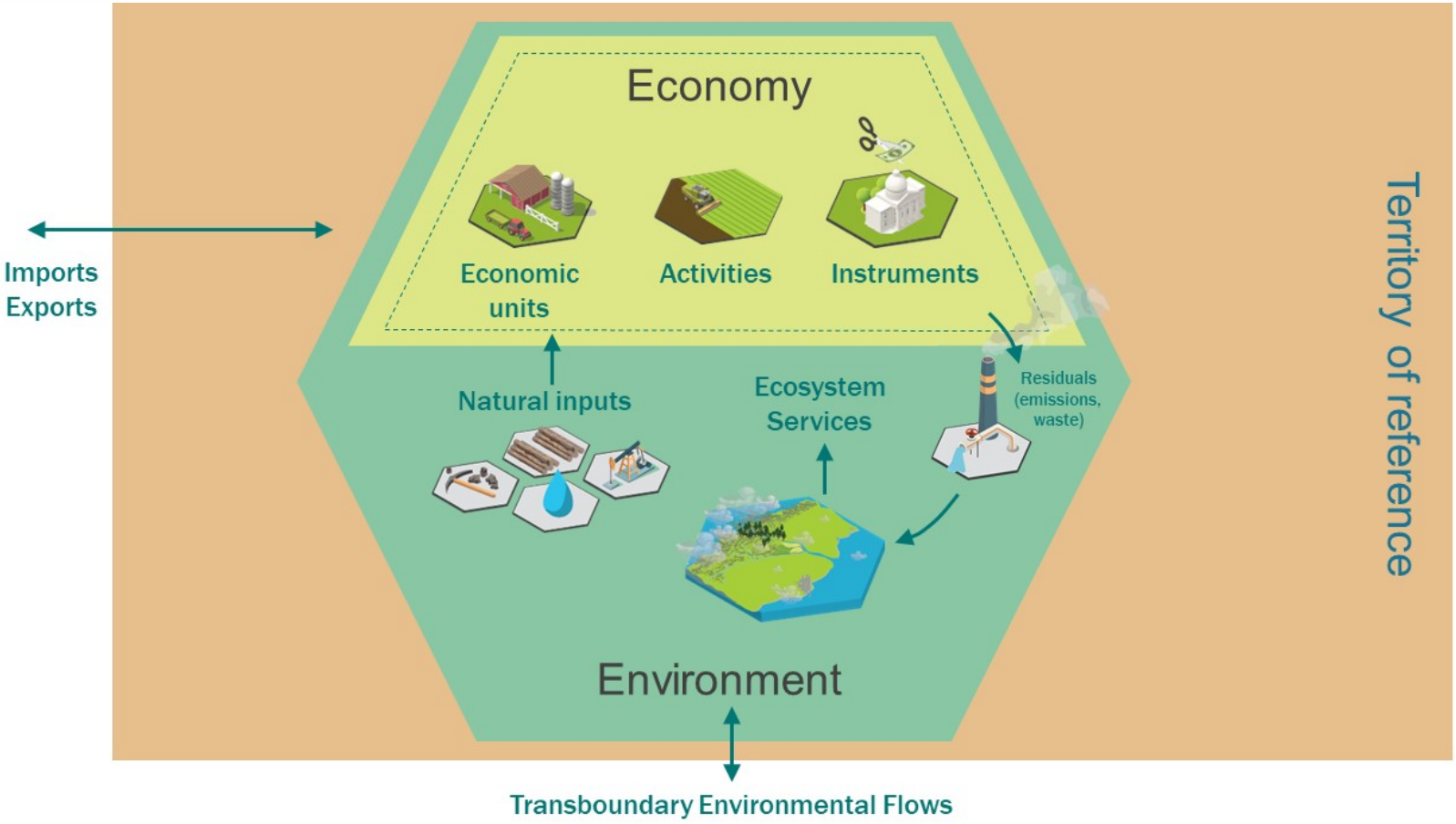
Limitations of traditional accounts

- Our economic well-being crucially depends on nature.
- But headline indicators like GDP, and the unemployment rate do not capture these vital economic contributions.
- As a result, decisionmakers don't have access to key information necessary to effectively pursue and track sustainable development.
- The System of Environmental Economic Accounts (SEEA) fills that gap.



Conceptual framework of SEEA



The System of Environmental-Economic Accounting (SEEA)

The SEEA is the statistical framework to measure the environment and its interactions with economy.

- 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 represent international efforts toward coherent ecosystem accounting.
- **SEEA Applications and Extensions** helps compilers and users of SEEA accounts understand how the accounts can be used in decision making, policy review and formulation, analysis and research.

System of Environmental Economic Accounting

Components of the 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

System of Environmental Economic Accounting

SEEA, WEALTH, AND WELL-BEING

United Nations

SEEA valuation principles

- SEEA is aligned with SNA valuation principles
- SNA accounts do not include consumer surplus, being based on transactions, also referred to as exchange values.
- Externalities (not being transactions) in principle out of scope
- Relation to wellbeing?
  - The exchange value is also the marginal value of the unit, which is the wellbeing that unit provides.
  - Thus a small increase in the availability of a good will generate wellbeing approximately equal to the exchange value.
  - Important whether you look at values at a point in time or changes over time

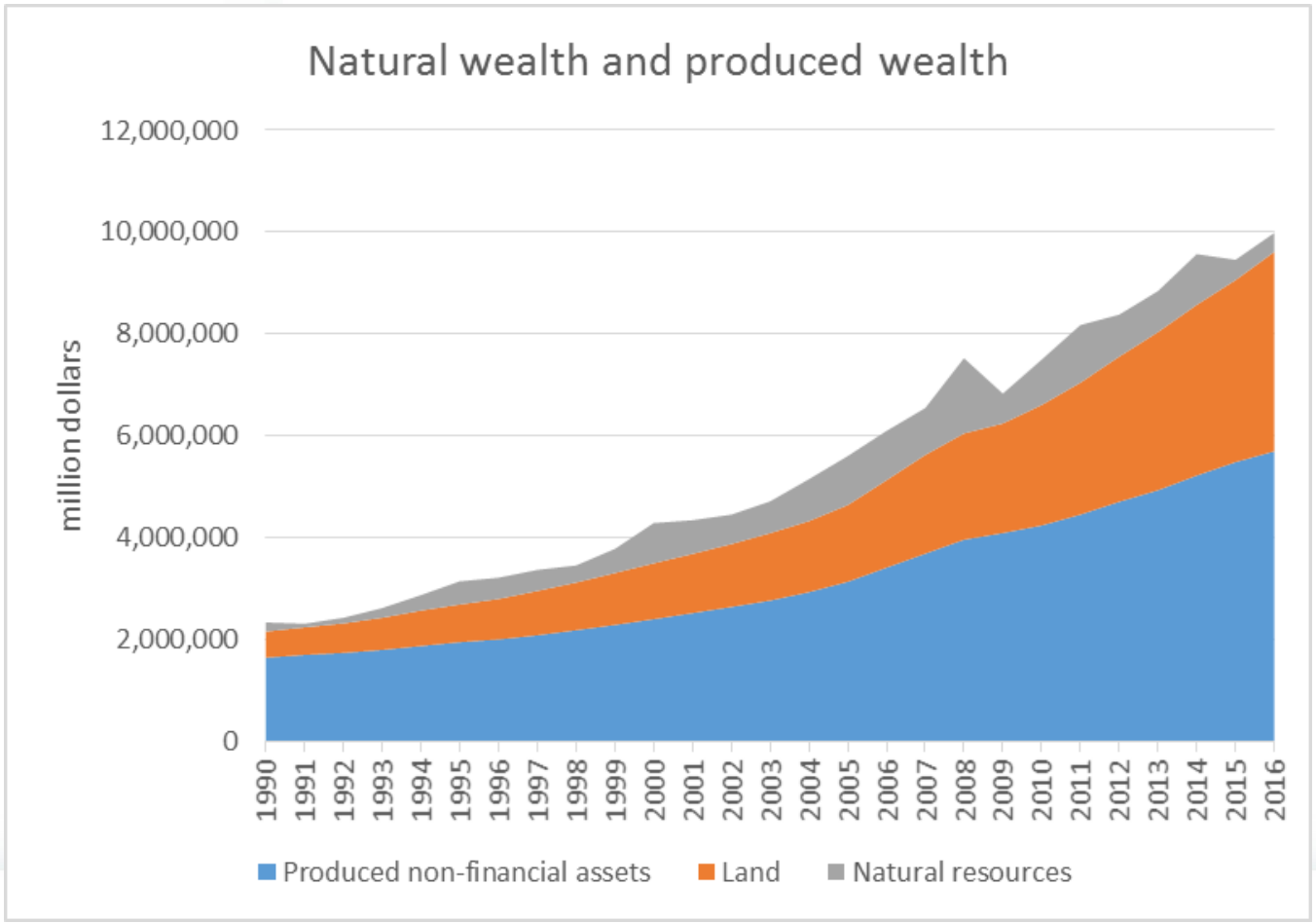
SEEA: valuation of assets

- SEEA CF: extends SNA asset boundary, when valuing (in monetary units) apply SNA production boundary
- SEEA EA: extends SNA production boundary, recognizing ES as outputs of ecosystem assets
  - > Carbon (sequestration/storage) considered as final ecosystem service, included in asset valuation
- Atmosphere (at least for now) recognized as an asset
- In absence of market prices, assets valued as Net Present Value

$$V_\tau(\boldsymbol{EA}) = \sum_{i=1}^{i=S} \sum_{j=\tau}^{j=N} \frac{ES_\tau^{ij}(\boldsymbol{EA}_\tau)}{(1+r_j)^{(j-\tau)}}$$

where ES_τ^{ij} is the value of ecosystem service *i* in year *j* as expected in base year τ generated by a specific ecosystem asset $\boldsymbol{EA}_\tau$, characterized by its extent, condition and management regime; S is the total number of ecosystem services; *r* is the discount rate (in year *j*, and *N* is the lifetime of the asset, which may be infinite for some ecosystem assets if used sustainably. τ is the starting period or base year, which may be referenced to 0.[3]

Natural Resource Assets and National Wealth



Extended SNA balance sheet (Chpt. 11)

- Produced assets
  - Fixed assets
    - Dwellings
    - Other buildings and structures
    - Machinery and equipment
    - Weapons systems
    - Intellectual property products
  - Inventories*
  - Valuables
- Environmental assets
  - Terrestrial ecosystems (excl urban areas)
    - Of which: Timber resources
    - Of which: Cultivated biological resources – non-timb
  - Land (as provision of space)
    - Of which: Land under buildings
  - Freshwater ecosystems
    - Of which: Water resources*
    - Of which: Freshwater aquatic biological resources
  - Marine ecosystems
    - Of which: Marine aquatic biological resources
  - Subterranean ecosystems
  - Deep geological systems
    - of which: Mineral and energy resources*
  - Atmospheric systems
    - of which: Radio spectrum
- Other non-produced assets
  - Contracts, leases and licenses*
  - Goodwill and marketing assets
- Financial assets
- Financial liabilities
- Net worth

Features

- Main structure based on ecosystem types (IUCN GET)
- Individual env. assets subsumed under ecosystem assets
- Land kept separate (as mere provisioning of space)
- Atmospheric systems recognized (will discuss later)

SEEA

Monetary ecosystem asset account (proposed for Chapter 10)

Table 10.1: Ecosystem monetary asset account (currency units)

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

Conclusion on SEEA and wealth

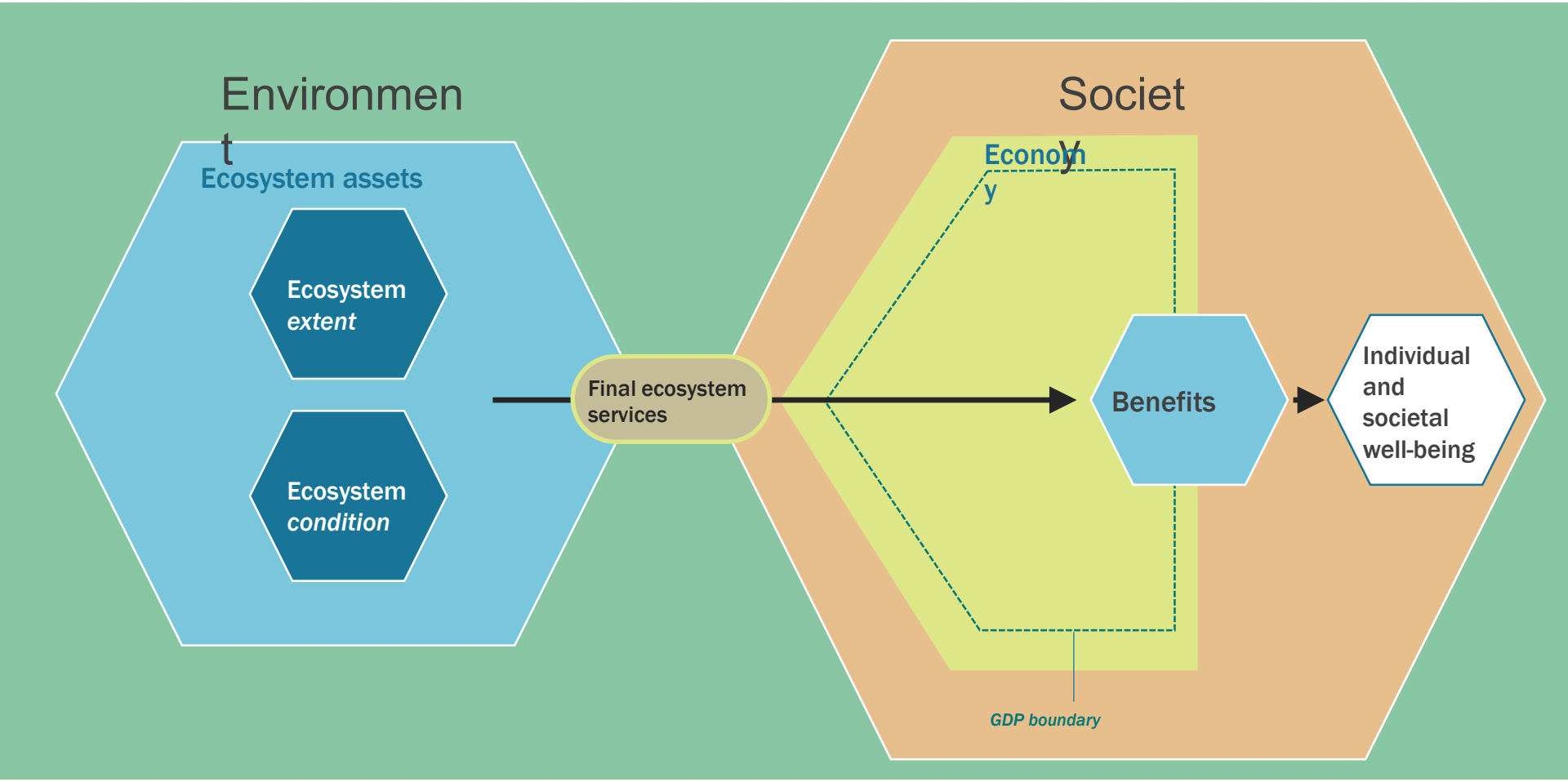
- SEEA allows to compile an extended SNA balance sheet including natural capital (no guidance on human capital)
- Due to exchange value basis, stock value of asset smaller than welfare based estimates (such as inclusive wealth)
- Value also constrained by extended production boundary (e.g. may exclude certain non-use values)
- Valuation is consistent with other asset values (i.e. no double counting)
- Monetary asset accounts are set-up to estimate cost of depletion, degradation, restoration/enhancement), as well as revaluation, that are part of the current accounts

System of Environmental Economic Accounting

SEEA ECOSYSTEMS AND CLIMATE CHANGE

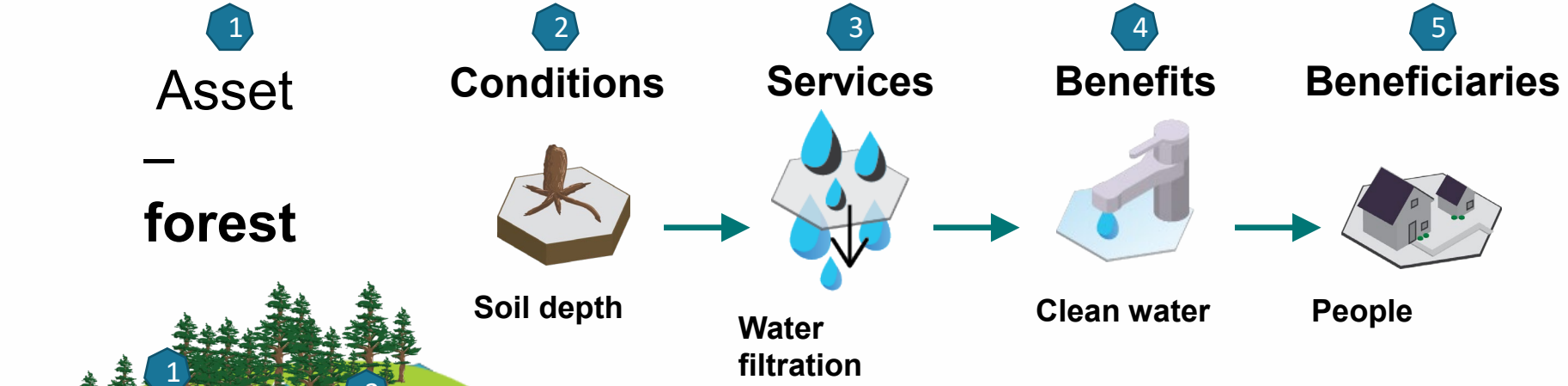
United Nations

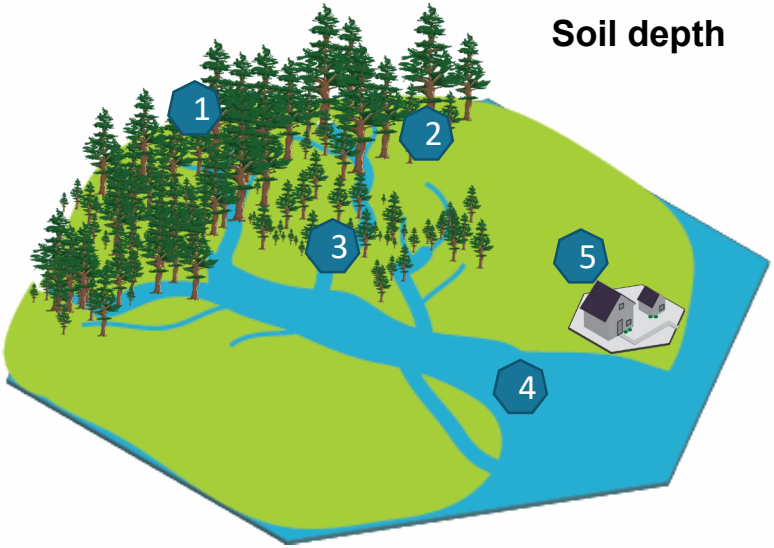
SEEA EEA Framework (Simplified)



SEEA

SEEA EEA Framework – Illustration





- Services defined in such a way as to avoid double counting (e.g. as contributions to benefits)
- Therefore also no double counting of asset values

Example: Carbon account (NL)

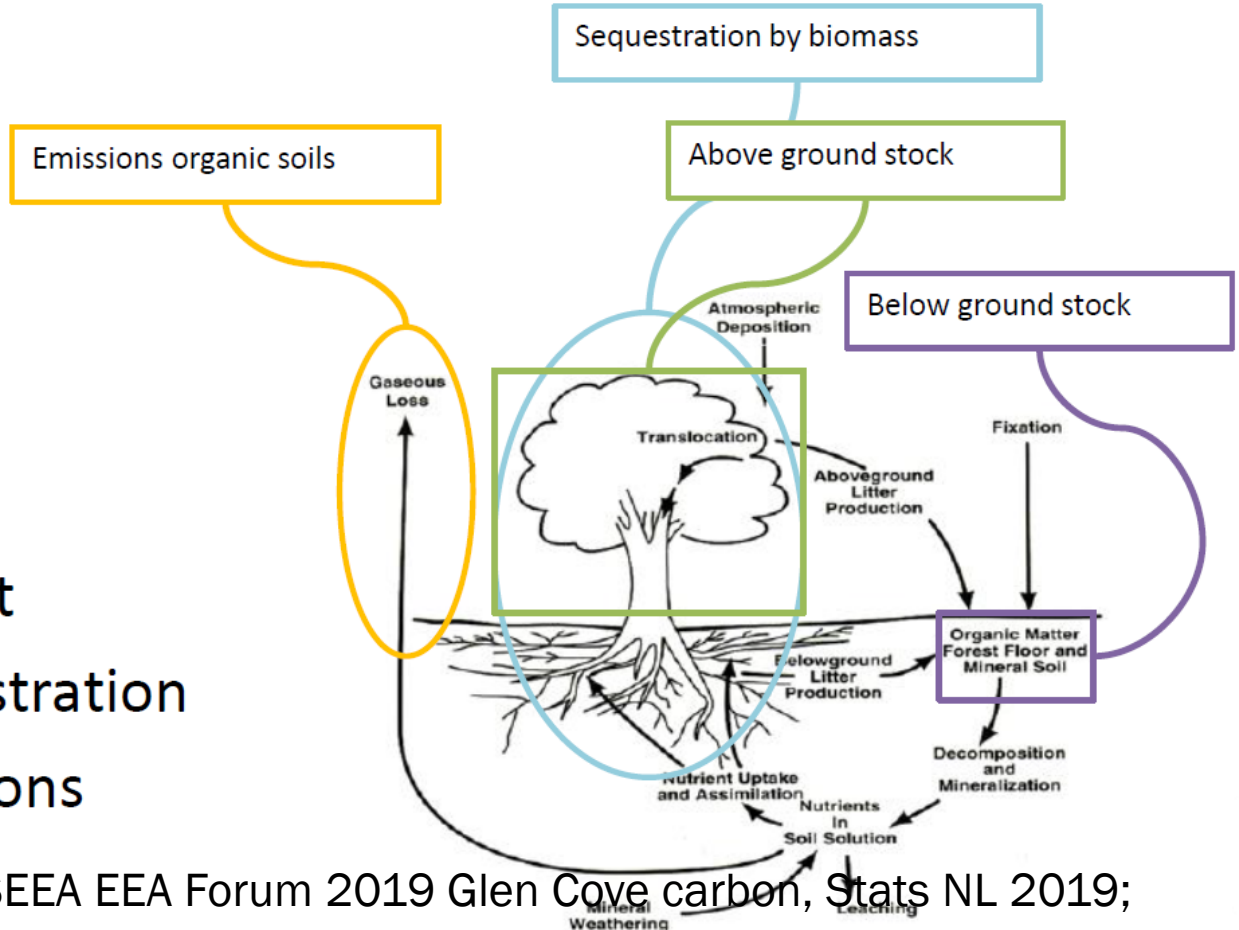
Biocarbon

Carbon stocks:

- above ground
- below ground

Carbon flows:

- timber harvest
- carbon sequestration
- carbon emissions



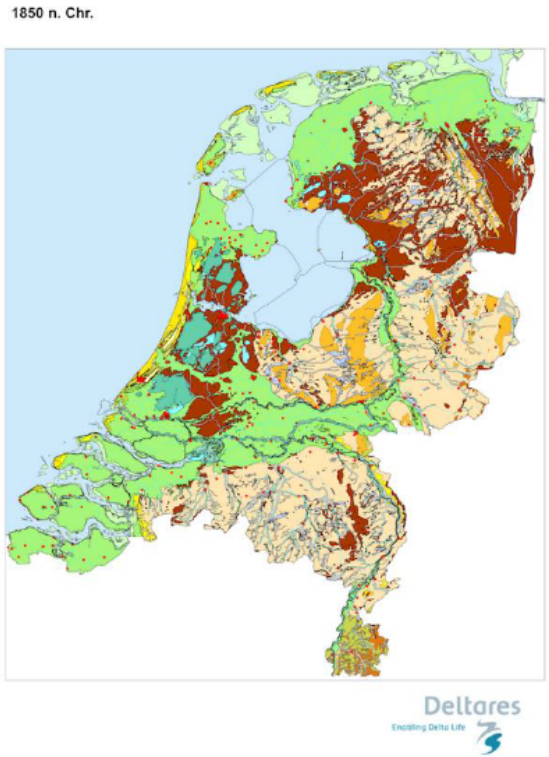
Source: SEEA EEA Forum 2019 Glen Cove carbon, Stats NL 2019; https://www.cbs.nl/en-gb/background/2017/45/the-seea-eea-carbon-account-for-the-netherlands

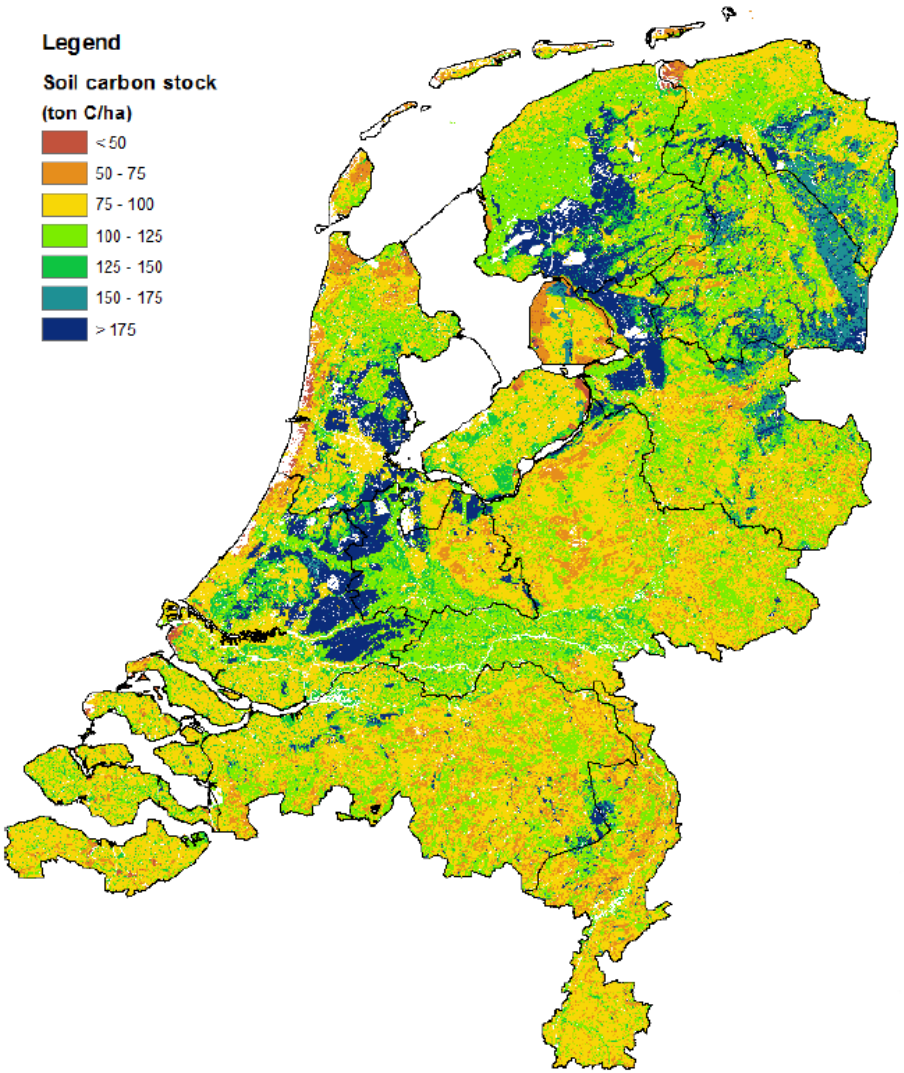
Carbon sequestration

Ecosystem unit	Carbon sequestration ton C /ha /yr	Carbon stock ton C/ha
Non-perennial plants	0	0
Perennial plants	0.38	17
Greenhouses	0	0
Meadow	0.18	2
Buffer strips	0.17	2
Coastal dunes (vegetated)	1.89	84
Coastal dunes (active)	0	0
Beaches	0	0
Deciduous forest	1.89	81
Coniferous forest	1.89	86
Mixed forest	1.89	84
Heath land	0.19	8
Inland dunes	0	
Fresh water wetlands	0.22	1
Natural grassland	0.19	2
Public green space	0.27	6
Other unpaved terrain	0.18	2
River flood basin	0.2	
Tidal salt marshes	4	12

SEEA

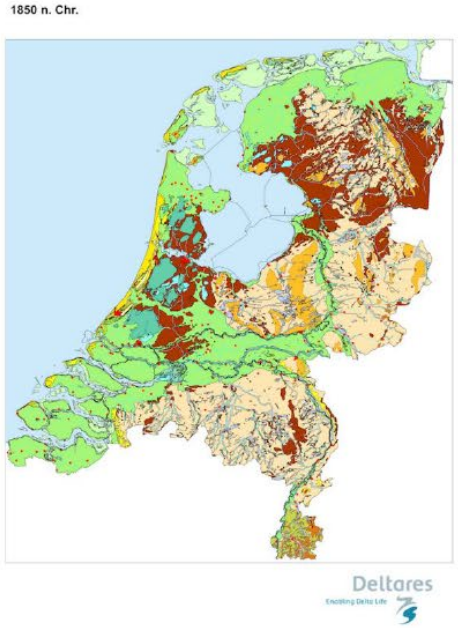
Carbon stock in soil (upper 30cm)

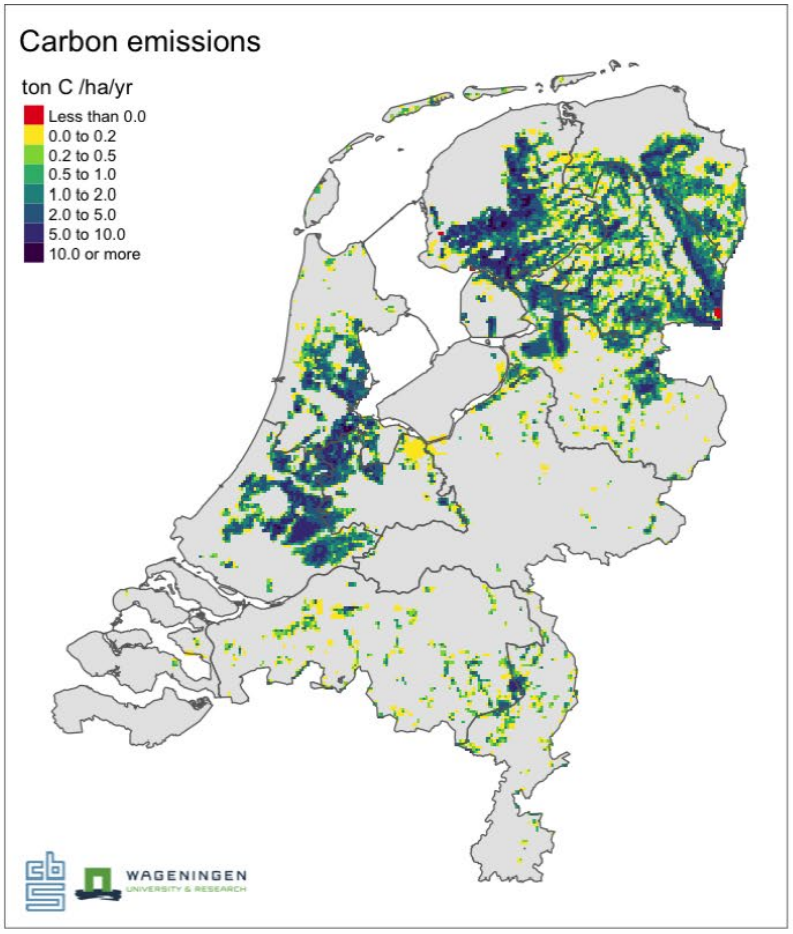




SEEA

Carbon emissions from drained peatland





SEEA

Biocarbon account

	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	94.1	48.2	5.3	0	5	6.1	30.6	52	23.6	376.9	← C stock above ground and in soil
Additions to stock												
Natural expansion	0.2	0	0.6	0	0	0	0	0.1	0	-0.9	0	← C sequestration
Managed expansion												
Upwards reappraisals												
Reductions in stock												
Natural contraction	0.9	0.4	0.1	0	0	0	0.1	0.1	0.2	-1.8	0	← Emissions from peat
Managed contraction			0.5								0.5	← Timber harvest
Downwards reappraisals												
Net carbon balance	-0.7	-0.3	0	0	0	0	0	-0.1	-0.2	0.9	-0.5	
Closing stock	111.3	93.7	48.2	5.3	0	5	6.1	30.5	51.8	24.5	376.4	

SEEA

How to reflect climate in ecosystem accounts?

- Agreement of the importance of compiling carbon accounts (in physical terms) that describe stocks and changes in stocks of carbon.
- Since 2019 Forum (and before) – ongoing discussion about how to reflect carbon related service(s) in the ecosystem supply-use table (on physical and monetary units).
  - > Is it a service or a process? Final or intermediate?
  - > Sequestration only? Storage only? Both?
  - > Other options?
- SEEA EEA TC (in May) discussed various options (with pros and cons) and broadly agreed with carbon retention approach, noting some further clarifications were needed.

Carbon retention proposal

- Retention can be defined as:
  - (i) estimate carbon stocks,
  - (ii) multiply this by a suitable carbon price, and
  - (iii) turn this into an annual service flow by multiplying this value by a suitable rate of return (to create an annuity).
- This framing recognizes that the retained carbon stocks represent a value (avoided damages).
  - In physical terms, the amount stored is a "proxy" for the service flow provided;
  - In monetary units, the service flow is the annual annuity, with higher annuity flows reflecting higher levels of ecosystem services provision.

What is wrong with seq. / storage?

- Sequestration (only):
  - Asymmetry: only deals with removals from the atmosphere, silent on situation on (net) emissions from peatlands (e.g. due to soil subsidence).
  - Perverse policy incentives (e.g. replace a tropical old growth forest by fast-growing bamboo);
    - Loss of stored carbon would not show in degradation costs (only extent to which this would change future sequestration services;)
  - Unclear what metric for sequestration would be most appropriate: NPP, NEP (net of soil respiration), NECB (net of timber harvest).
- Sequestration + emissions
  - Need to recognizing disservices in the account (with negative output)
- Sequestration + storage
  - Unclear how to value a distinct storage service that avoids double counting

Why carbon retention?

- Avoids negative production (in case of net emissions)
- Retention provides the 'right' signals to policy makers;
  - if an ecosystem loses carbon, we have lower retention services;
  - ecosystems with high carbon stocks (e.g. tropical rainforests) would get high retention values (even though oftentimes they have low sequestration (as they are in equilibrium / old growth); sending the signal that they are worth conserving;
  - in case of logging, the accounts display the range of trade-offs of services;
- The focus on storage aligns well with REDD+ schemes;
- Data availability: estimates of carbon stored (needed for retention) seems to be easier for most countries than getting estimates for sequestration
- change in the level of service can be decomposed into changes due to sequestration and removal/loss of carbon.

Ongoing testing

- India
  - Scope around carbon retention in forests (data from Forest Survey of India
  - Valuation: value of 2-3 % of GDP, larger than GVA of forestry sector
- Mexico
  - Variation: sum of retention + sequestration
- Australia
  - Test the approach also with longitudinal data from NSW

Outstanding issue

- Carbon retention proposal satisfactory for ecosystem accounting purposes, but what to do with fossil fuel based emissions / increasing GHG concentrations?
- SEEA CF records GHG emission in physical units, but does not price them
- The framing to conceive the atmosphere as providing sink services was ruled out (for ecosystem accounts), as it would lead to counterintuitive conclusions, but provides many other services / functions
- Currently discussion on seeing atmosphere as asset in SNA revision process
- Implications for the recording of emission permits (emission permits no longer recorded as taxes but e.g. as resource lease or permit to pollute)
- SEEA EA Chapter 13 will discuss possibility to record excess emissions as unpaid ecological cost (essentially as form of a liability).

THANK YOU

seea@un.org