# SEEA
# Experimental Ecosystem Accounting

Sokol Vako
United Nations Statistics Division

Training for the worldwide implementation of the System of Environmental Economic Accounting 2012 - Central Framework for Latin America and the Caribbean

7-10 July 2015, Santiago, Chile

# SEEA: enabler for the transformative agenda

*SNA*

*SEEA Part 1 - Central Framework*

*SEEA Part 2 - Experimental Ecosystem Accounting*


Enable integration of biophysical data, monitoring changes in ecosystem and linking those changes to economic and human activity

Inform post 2015 development agenda and SDGs

Enable partnership at international, regional, sub-regional and national level.

# SEEA Experimental Ecosystem Accounting

- Complements SEEA Central Framework
- Integrated statistical framework for accounting for ecosystem assets and associated ecosystem services
- Important first step in development of statistical framework for ecosystem accounting

# SEEA-Experimental Ecosystem Accounting - Background

- Complements SEEA Central Framework with focus on ecosystems perspective
- Developed as part of broader process of revising SEEA 2003
- Integrated system of information on distinct stocks and flows
- Not a statistical standard but synthesizes current knowledge related to ecosystem services, ecosystem condition and related concepts
- "Experimental" because significant methodological challenges remain and further testing of concepts needed

# Relationship to SEEA Central Framework

- Extends range of flows (production boundary) for accounting compared to SNA and SEEA in physical and monetary terms
- Many flows from Central Framework also included in Experimental Ecosystem Accounting (e.g. flows of timber), but extension of EEA is to attribute flows to spatial areas
- Some Central Framework natural input flows are excluded from Experimental Ecosystem Accounting (e.g. mineral and energy resources)

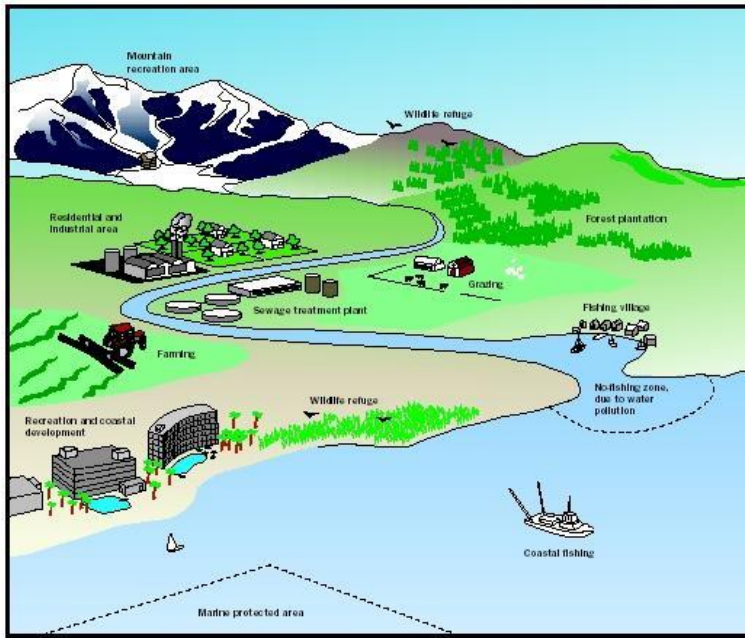
# SEEA Experimental Ecosystem Accounting

- Ecosystem accounting is a tool to understand and monitor **the contributions of ecosystems to economic and human activity**
- Ecosystems include natural as well as man-dominated systems such as croplands or intensive pastures
- Requires a spatial approach (combination of maps and statistics)

The SEEA Experimental Ecosystem Accounting brings in two new dimensions:

1. Spatial characteristics expressed in spatial units
2. Integrated or holistic view of multiple characteristics for each unit

Minimum dataset scheme
Unifying themes




- Land
- Water
- Carbon
- Biodiversity
- Nutrients
- Pollution
- Human activities
- Ecosystem services

Image source: http://www.waterencyclopedia.com/La-Mi/Land-Use-Planning.html

The EEA is focused on living (renewable) natural resources

# SEEA-EEA

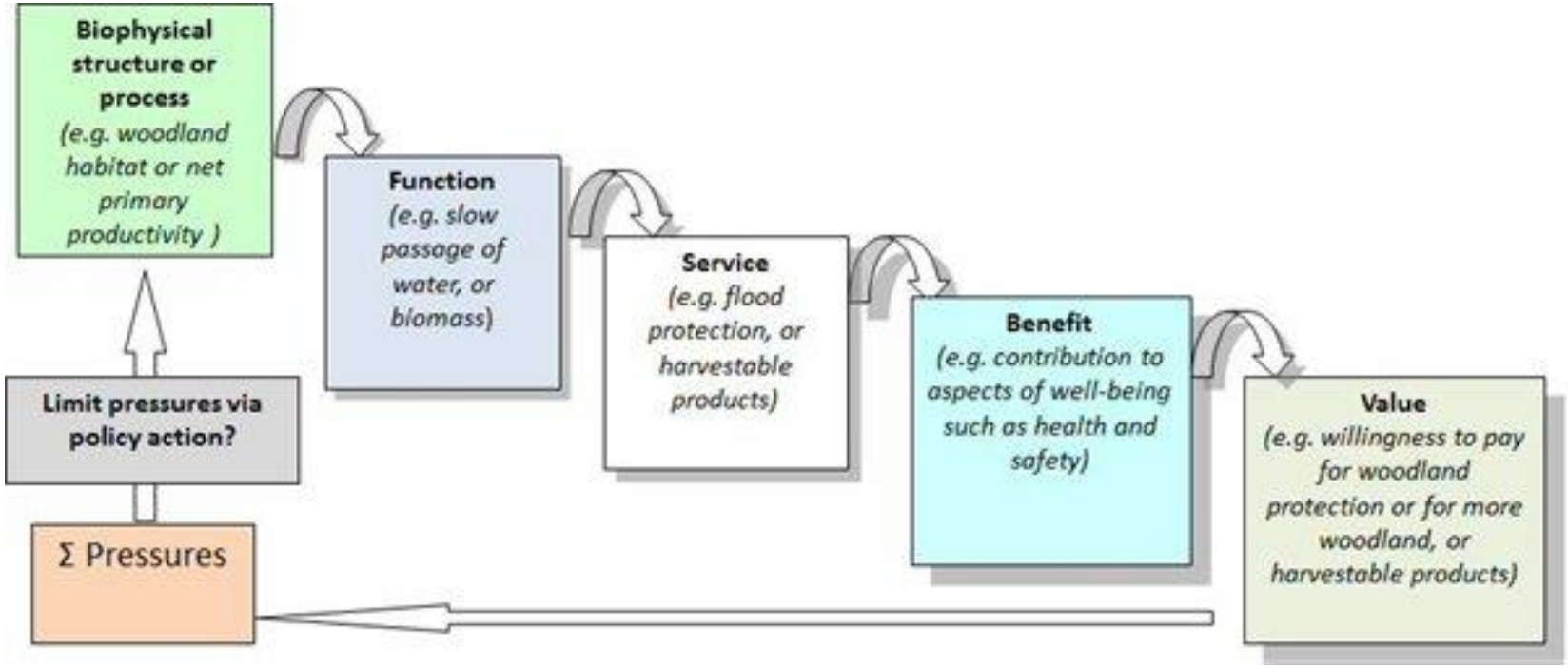
- **Basic concepts and definitions**
  - Ecosystems as “Assets”
  - The Ecosystem Services “Cascade”
    - Ecosystem structure and processes, function, services, benefits and values
  - Accounting (not just “counting”) Principles
    - Assets, stocks and flows
    - Balancing the books
  - Ecosystem Accounting is Spatial
    - Geographic information systems (GIS)

# Ecosystem assets, a definition

- ***Ecosystem assets*** *are spatial areas containing a combination of biotic and abiotic components and other characteristics that function together* (SEEA-EEA Sections 2.31, 4.1)

- A **forest** is an area that:
  - Can be located on a map (spatial)
  - Contains trees, shrubs, grasses, soil biota, birds, mammals, insects… functioning together with
  - The soil, water, geology (rocks), sunlight, wind…

# The Ecosystem Services Cascade




Source: Nottingham School of Geography

- **Ecosystem services** are the contribution of ecosystems to a benefit for people…

# Accounting principles…

- **Apply to environmental data, too…**
  - **Double entry accounting**:
    - Beginning & end of time period → reconcile changes
    - Compare two sources → reconcile and find errors
  - **Time of recording**:
    - Referring to same time period (accounting period)
  - **Unit of measurement**:
    - Same units (physical or monetary)
    - Reconciliation and aggregation
  - **Consistent valuation rules**:
    - Market price: Basic, producer, purchaser
  - **Consistent concepts and classifications**
  - **Stock → Flow (Asset → Service)**

# Balancing the books of environmental assets

**Time 1**

Assets

Services

Economy and well-being

Regeneration

Waste & degradation

# Balancing the books of environmental assets

**Time 2**

Assets

Services

Economy and well-being

Regeneration

Waste & degradation

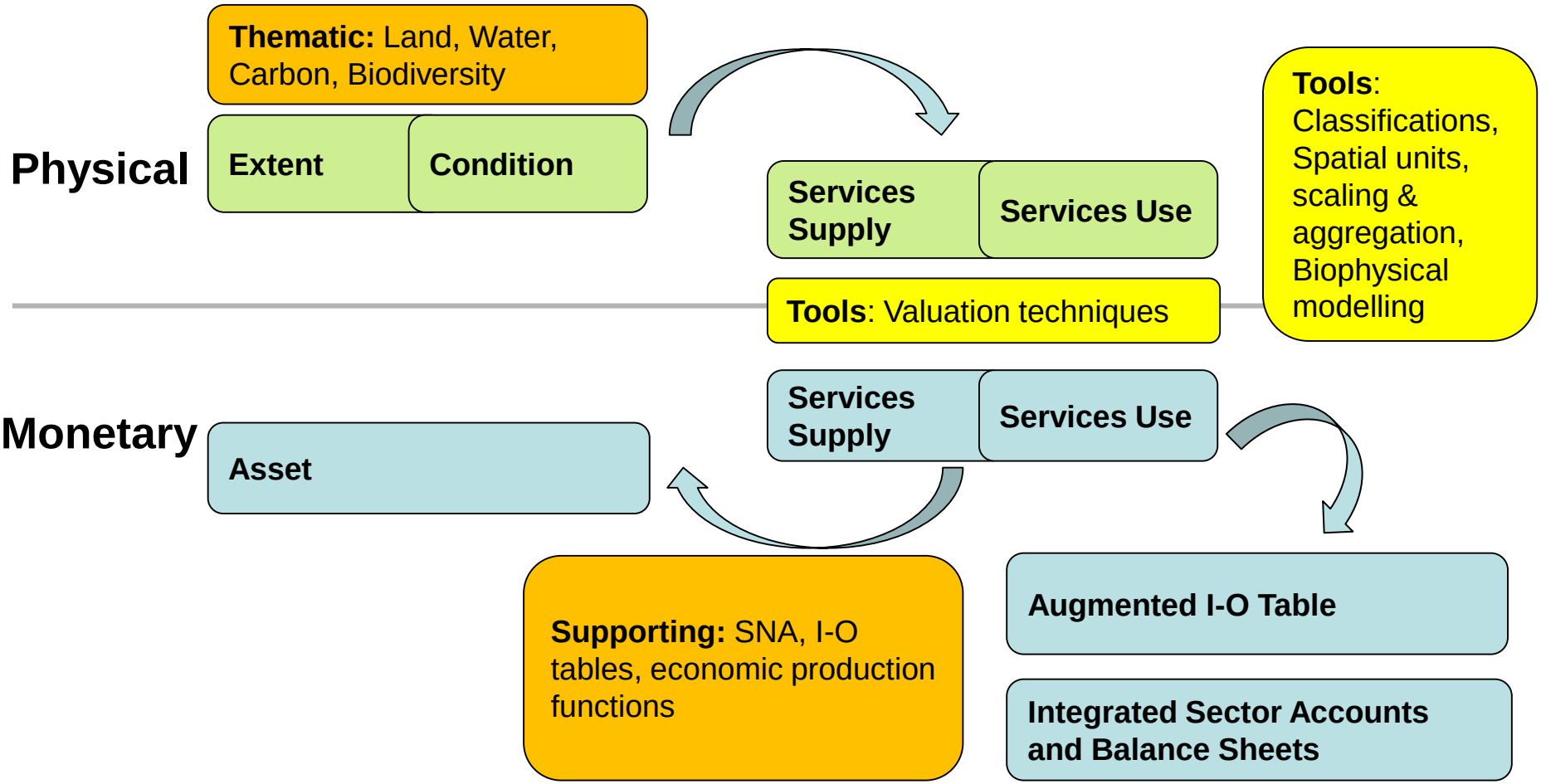
# Ecosystem accounting is spatial

- Ecosystems are different and function differently depending on **where** they are
- Their capacity to supply services depends on their **location**
- The benefits of many services depends on whether or not the ecosystems are **accessible**
- Therefore…Ecosystem accounting needs to integrate **spatial** and **non-spatial** data
- For example, wetlands in northern Canada may have the **capacity** to purify water, but there is no population there to benefit from it.

# Ecosystem accounting is spatial

- Geographic information systems (GIS)
  - Manage spatial information as layers
  - Have tools to integrate spatial information:
    - Overlay different data where space is the common denominator
    - Aggregate point information (e.g., water sampling station) to larger areas (polygons)
    - Attribute information from larger areas to smaller ones (downsampling)
    - Geospatial statistics (interpolation, modelling)
  - Generate tables based on common properties (e.g., land cover and land cover change)

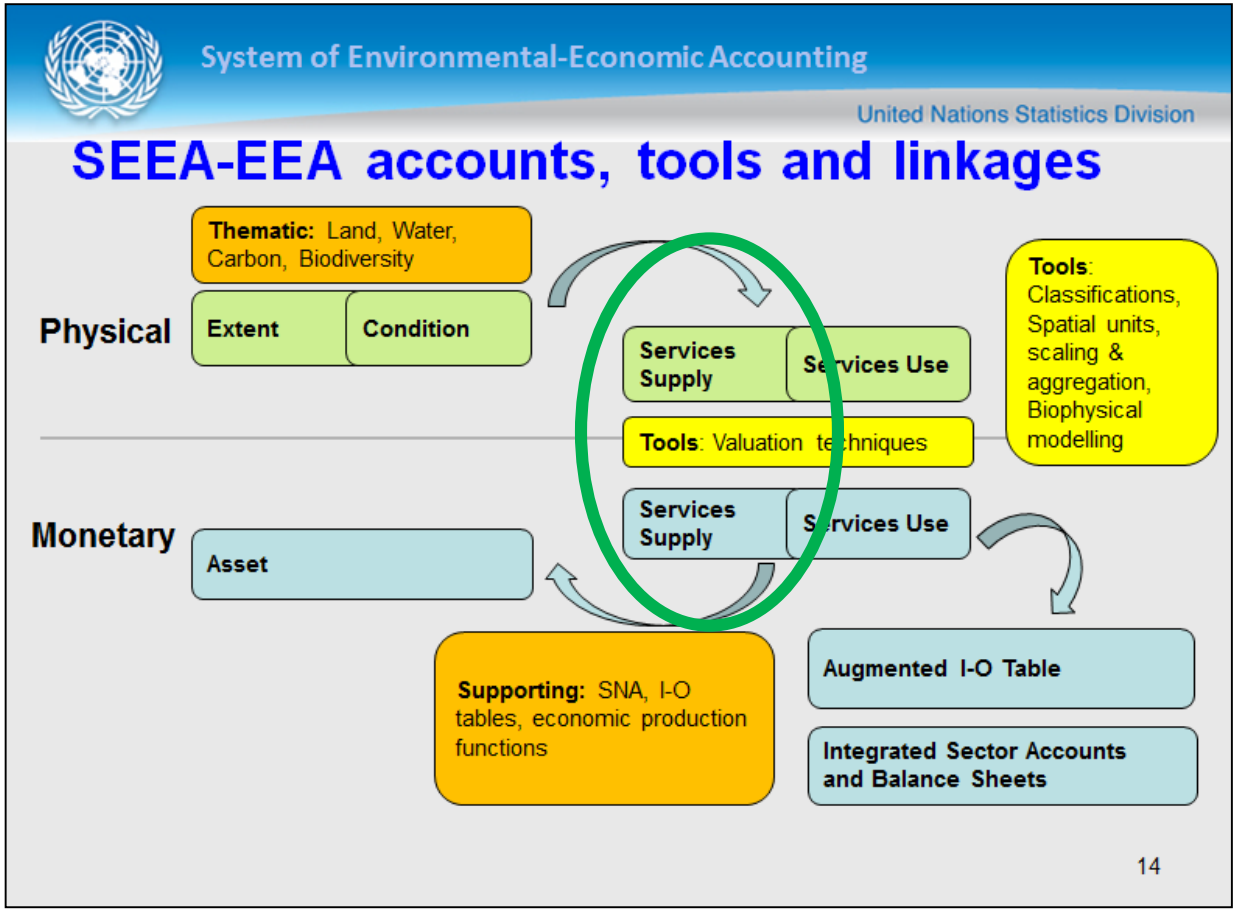
# SEEA-EEA accounts, tools and



# **Account 5**: Biodiversity

- **What does a Biodiversity Account look like?**
  - Spatially-detailed summaries of key species and ecosystems
    - Species groups (genera, families, functional groups)
    - Species characteristics (sensitive, specialist…)
    - Habitat requirements (vegetation, corridors)
    - Habitat conditions (from **Condition Account**)

# Account 6: Services Supply



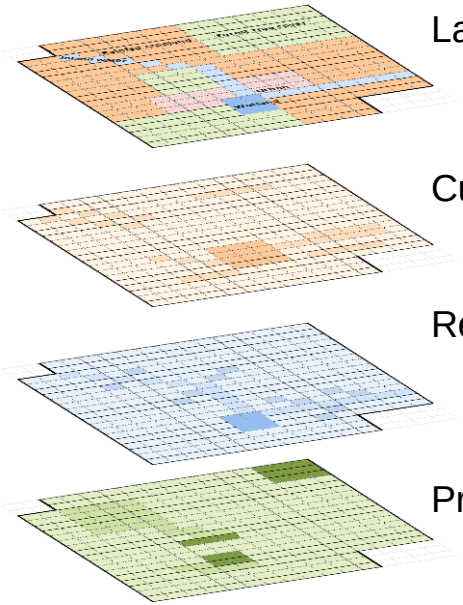
# **Account 6**: Services Supply

- **What?**
  - Physical and monetary flows of “final” ecosystem **services** from ecosystems to beneficiaries
  - Directly used by (or affect) people
- **Why?**
  - Inform policies of contribution of ecosystems to human well-being
  - Assess trade-offs between development and conservation
  - Link to standard economic production measures in SNA
  - Link to other SEEA-EEA accounts (**Condition, Services Use, Monetary Asset** valuation)
  - Indicators:
    - Flows of individual services (physical and monetary) ➔ change
    - Indices of aggregated services by ecosystem type ➔ change

# **Account 6**: Services Supply

- **What does a Services Supply Account look like?**

## Maps



Land cover

Cultural

Regulating

Provisioning

## Tables

| | Ecosystem type | | | |
|---|---|---|---|---|
| Type of service | Urban and associated | Forest tree cover | Agricultural land | Open wetlands |
| Provisioning | | e.g., tonnes of timber | e.g., tonnes of wheat | |
| Regulating | e.g., tonnes of $CO_2$ stored / released | e.g., tonnes of $CO_2$ stored / released | e.g., tonnes of $CO_2$ stored / released | e.g., tonnes of P absorbed |
| Cultural | e.g., hectares of parkland | e.g., number of visitors / hikers | | e.g., hectares of duck habitat |

Lookup tables
Biophysical modelling

Valuation

Monetary Services Supply

# Account 6: Services Supply

- **Example (Services Supply in physical units)**

| Ecosystem service | | Units | Land cover type: Urban | Pasture | Cropland | Forest | Heath | Peat | Surface Water | Other nature | **Provincial total** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Provisioning | Hunting | kg meat | - | 9,100 | 14,732 | 8,100 | 678 | 70 | | 1,513 | **34,193** |
| | Drinking water extraction | $10^3$ $m^3$ water | 4,071 | 7,026 | 11,227 | 3,117 | 214 | - | 478 | 862 | **26,995** |
| | Crop production | $10^6$ kg produce | - | - | 1,868 | - | - | - | - | - | **1,868** |
| | Fodder production | $10^6$ kg dry matter | | 533 | 251 | | | | | | **784** |
| Regulation | Air quality regulation | $10^3$ kg $PM_{10}$ | 272 | 404 | 717 | 700 | 45 | 7 | 40 | 69 | **2,254** |
| | Carbon sequestration | $10^6$ kg carbon | 875 | 8,019 | 273 | 50,664 | 393 | 149 | - | 1,056 | **61,429** |
| Cultural | Recreational cycling | $10^3$ trips | 2,690 | 1,863 | 2,611 | 1,565 | 30 | 3 | 139 | 220 | **9,121** |

**Source**: Remme et al., 2014 (Limburg, the Netherlands)

# **Account 6**: Services Supply

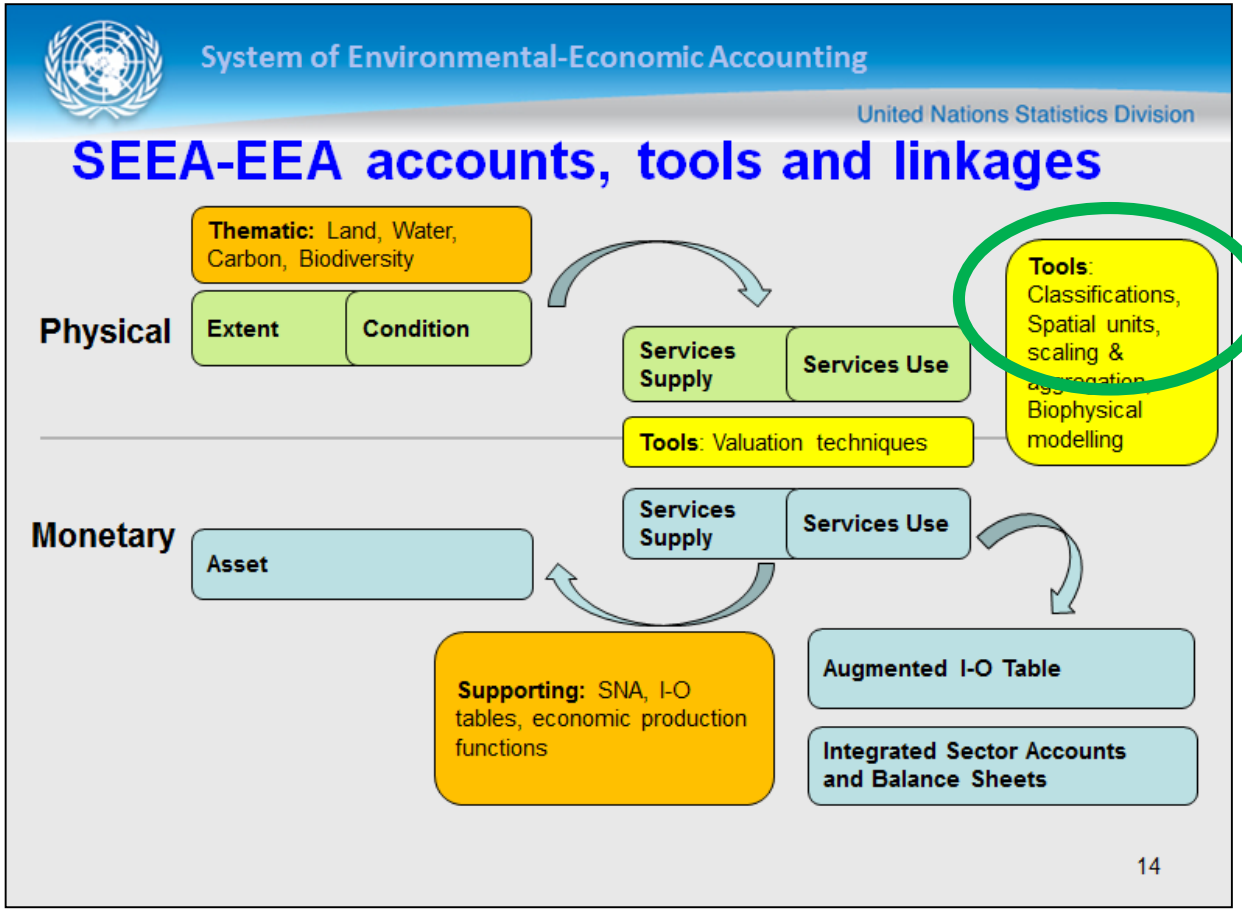
- **What does a Services Supply Account look like?**
  - Spatially-detailed physical measures of “final” services according to common **Classification**:
    - Provisioning
    - Regulating
    - Cultural
  - Physical measures (crops, flood control, clean drinking water, carbon sequestration, recreation, …)
  - **Valuation** where appropriate and available

    → **Monetary Services Supply**

# Other accounts

- Ecosystem Services Use Account
- Ecosystem Capacity
- Augmented I-O Tables
- Integrated Sector Accounts and Balance Sheet
- Supporting information

# Tools 1: Classifications



# Tools 1: Classifications

- **What?**
  - From SEEA-CF:
    - Land Cover, Land Use
    - Economic units, industry sectors
  - New:
    - Final ecosystem services
- **Why?**
  - Accounting needs **C**onsistent and **C**oherent and **C**omprehensive: **C**lassifications
    - **C**onsistent: use same classification for same concept
    - **C**oherent: with other classifications
    - **C**omprehensive: "**C**lassifications **C**ertify **C**omplete **C**overage"

# Tools 1: Classifications

- **Land Cover**
- From SEEA-CF (p.276)
- Uses FAO LCCS3 (Food and Agriculture Organization – Land Cover Classification System v3) definitions
- High-level aggregate:
  - May adapt to local situations
  - Used as basis for "ecosystem type"

01 Artificial surfaces (including urban and associated areas)
02 Herbaceous crops
03 Woody crops
04 Multiple or layered crops
05 Grassland
06 Tree covered areas
07 Mangroves
08 Shrub covered areas
09 Shrubs and/or herbaceous vegetation, aquatic or regularly flooded
10 Sparsely natural vegetated areas
11 Terrestrial barren land
12 Permanent snow and glaciers
13 Inland water bodies
14 Coastal water bodies and inter-tidal areas

# Tools 1: Classifications

- **Land Use**
- From SEEA-CF (p. 266)
- Detailed (4-digit level)

**1.0 Land**
- 1.1 Agriculture
- 1.2 Forestry
- 1.3 Aquaculture
- 1.4 Built up and related areas
- 1.5 Maintenance and restoration of environmental functions
- 1.6 Other uses of land
- 1.7 Land not in use

**2.0 Inland waters**
- 2.1 Aquaculture and holding facilities
- 2.2 Maintenance and restoration of environmental functions
- 2.3 Other uses of inland waters
- 2.4 Inland waters not in use

**3.0 Coastal waters**
- 3.1 Aquaculture and holding facilities
- 3.2 Maintenance and restoration of environmental functions
- 3.3 Other uses of coastal waters
- 3.4 Coastal waters not in use

**4.0 Exclusive Economic Zone (EEZ)**
- 4.1 Aquaculture and holding facilities
- 4.2 Maintenance and restoration of environmental functions
- 4.3 Other uses of coastal waters
- 4.4 Coastal waters not in use

# Tools 1: Classifications

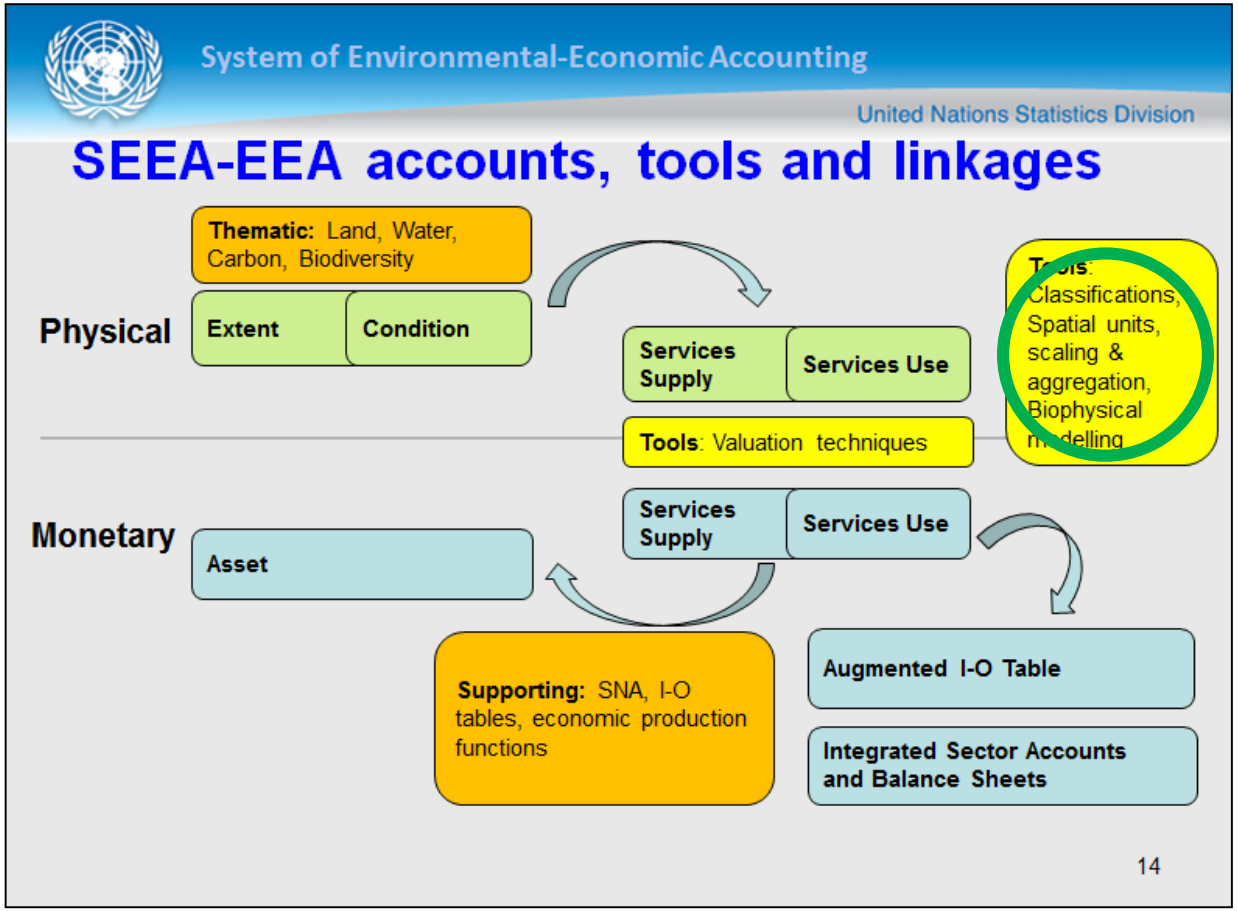
- **Services**
- Based on **Common International Classification of Ecosystem Services** (CICES)
- Not mutually exclusive
- A list of "final" services
- More detail (4-digit)
- Does not include "supporting services" (= ecosystem functions)

| Section | Division | Group |
|---|---|---|
| 01. Provisioning | 01.01 Nutrition | 01.01.01 Biomass |
| | | 01.01.02 Water |
| | 01.02 Materials | 01.02.01 Biomass |
| | | 01.02.02 Water |
| | 01.03 Energy | 01.03.01 Biomass-based energy sources |
| | | 01.03.02 Mechanical energy |
| 02. Regulation & Maintenance | 02.01 Mediation of waste, toxics and other nuisances | 02.01.01 Mediation by biota |
| | | 02.01.02 Mediation by ecosystems |
| | 02.02 Mediation of flows | 02.02.01 Mass flows |
| | | 02.02.02 Liquid flows |
| | | 02.02.03 Gaseous / air flows |
| | 02.03 Maintenance of physical, chemical, biological conditions | 02.03.01 Lifecycle maintenance, habitat and gene pool protection |
| | | 02.03.02 Pest and disease control |
| | | 02.03.03 Soil formation and composition |
| | | 02.03.04 Water conditions |
| | | 02.03.05 Atmospheric composition and climate regulation |
| 03. Cultural | 03.01 Physical and intellectual interactions with biota, ecosystems, and land-/seascapes [environmental settings] | 03.01.01 Physical and experiential interactions |
| | | 03.01.02 Intellectual and representative interactions |
| | 03.02 Spiritual, symbolic and other interactions with biota, ecosystems, and land-/seascapes [environmental settings] | 03.02.01 Spiritual and/or emblematic |
| | | 03.02.02 Other cultural outputs |

# Tools 1: Classifications

- From SEEA-CF: **Economic Units**
  - Enterprises (business → industry)
  - Households (people and non-corporate business)
  - Government
  - Rest of the world
- SEEA-EEA adds a spatial dimension:
  - Local
  - Regional
  - National
  - Global

# Tools 2: Spatial units



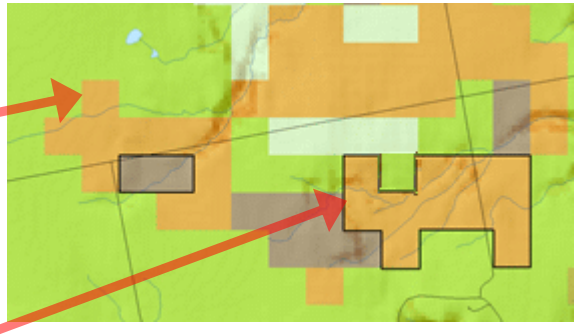
# Tools 2: Spatial units

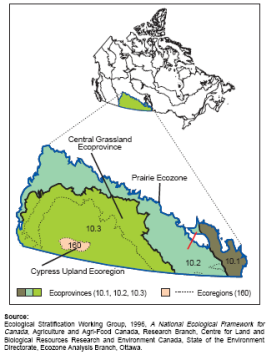
- **What?**
  - A common definition of Spatial Units for all accounts
  - Based on surface characteristics (terrestrial, freshwater, coastal and marine)
- **Why?**
  - Accounting needs **statistical units** about which information is compiled, derived, reported and compared
    - e.g., business statistics are built on locations, establishments, companies and enterprises
  - Information is collected on many **spatial levels**
    - Needs to be consolidated within a GIS or spatial model
  - First step in **tabulating & aggregating** more detailed data
    - Not everybody is a GIS expert
  - Links accounts together:
    - (**Extent, Condition, Services Supply…**)

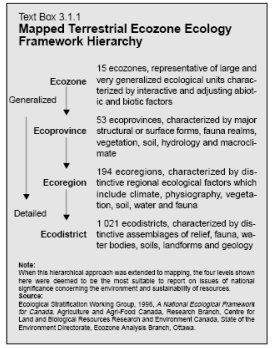
# Tools 2: Spatial units

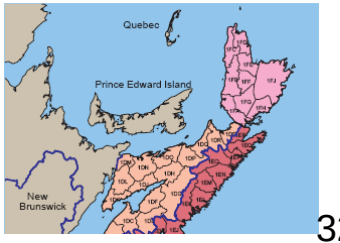
**Recommended three levels: hierarchical and mutually exclusive:**

1. Basic Spatial Unit **(BSU)**
   - Pixel or grid cell
2. Ecosystem Unit **(EU)**
   - Homogenous according to criteria (cover, slope, drainage area, elevation…)
   - Consolidate for tables by EU type
3. Ecosystem Reporting Area **(ERA)**
   - For reporting (sub-drainage area, administrative area…)






→ **Establishes Ecosystem Extent Account**

Source: Statistics Canada, 2013

# Other tools

- Scaling
- Aggregation
- Biophysical Modeling
- Valuation

# Thank You!

seea@un.org