Services Supply Account
(Levels 1 and 2)

Project: Advancing the SEEA Experimental Ecosystem Accounting
Overview: Services Supply

1. Learning objectives

2. Review of Level 0 (5m)

3. Level 1 (Compilers)
   • Concepts (15m)
   • Group exercise & Discussion (30m)

4. Level 2 (Data providers)
   • Data options, examples & issues (15m)
   • Group exercise & Discussion (15m)

5. Closing Discussion (10m)
SEEA-EEA Training Levels 1 and 2

- **Learning objectives**
  - **Level 1:** To understand:
    - Why accounting for Ecosystem Services is important
    - The basics of the “ecosystem services cascade” and the difference between its components
    - How Services Supply is treated in the SEEA, including basic concepts and the structure of the accounts that include services
    - How to start to compile a Services Supply account
  - **Level 2:**
    - Understand the data options and sources
    - Be aware of how other countries have approached Ecosystem Services Supply
Review of Level 0: Services Supply Account
Account 6: Services Supply

SEEA-EEA accounts, tools and linkages

Physical
- Thematic: Land, Water, Carbon, Biodiversity
- Extent
- Condition
- Services Supply
- Services Use
- Tools: Classification, Spatial units, scaling & aggregation, Biophysical modelling

Monetary
- Asset
- Services Supply
- Services Use
- Tools: Valuation Techniques

Supporting: SNA, I-O tables, economic production functions

Augmented I-O Table
Integrated Sector Accounts and Balance Sheets
Level 0: 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) \( \rightarrow \) change
  - Indices of aggregated services by ecosystem type \( \rightarrow \) change
**Level 0: Account 6: Services Supply**

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

**Maps**

- **Land cover**
- **Cultural**
- **Regulating**
- **Provisioning**

**Tables**

<table>
<thead>
<tr>
<th>Ecosystem type</th>
<th>Urban and associated</th>
<th>Forest tree cover</th>
<th>Agricultural land</th>
<th>Open wetlands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provisioning</td>
<td>e.g., tonnes of timber</td>
<td>e.g., tonnes of wheat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regulating</td>
<td>e.g., tonnes of CO₂ stored / released</td>
<td>e.g., tonnes of CO₂ stored / released</td>
<td>e.g., tonnes of CO₂ stored / released</td>
<td>e.g., tonnes of P absorbed</td>
</tr>
<tr>
<td>Cultural</td>
<td>e.g., hectares of parkland</td>
<td>e.g., number of visitors / hikers</td>
<td>e.g., hectares of duck habitat</td>
<td></td>
</tr>
</tbody>
</table>

**Lookup tables**

Biophysical modelling

**Valuation**

**Monetary Services Supply**
### Level 0: Account 6: Services Supply

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

<table>
<thead>
<tr>
<th>Ecosystem service</th>
<th>Units</th>
<th>Land cover type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Urban</td>
</tr>
<tr>
<td>Hunting</td>
<td>kg meat</td>
<td></td>
</tr>
<tr>
<td>Drinking water extraction</td>
<td>$10^3$ m³ water</td>
<td>4,071</td>
</tr>
<tr>
<td>Crop production</td>
<td>$10^6$ kg produce</td>
<td></td>
</tr>
<tr>
<td>Fodder production</td>
<td>$10^6$ kg dry matter</td>
<td></td>
</tr>
<tr>
<td>Air quality regulation</td>
<td>$10^3$ kg PM$_{10}$</td>
<td>272</td>
</tr>
<tr>
<td>Carbon sequestration</td>
<td>$10^6$ kg carbon</td>
<td>875</td>
</tr>
<tr>
<td>Cultural</td>
<td>$10^3$ trips</td>
<td>2,690</td>
</tr>
</tbody>
</table>

**Source:** Remme et al., 2014 (Limburg, the Netherlands)
Level 0: Account 6: Services Supply

• What does a Services Supply Account look like?
  • Spatially-detailed physical measures of “final” services according to a common Classification:
    • Provisioning
    • Regulating
    • Cultural
  • Physical measures (crops, flood control, clean drinking water, carbon sequestration, recreation, …)
  • Valuation where appropriate and available
    ⇒ Monetary Services Supply
Level 0: Account 6: Services Supply

What do you need to create a Services Supply Account?

- Ecosystem Extent, Ecosystem Condition
- Common spatial infrastructure (Spatial Units)
- Common Classification of services

Data:

- Field studies
- Transfer from other locations (benefits transfer, valuation)
- Economic production (agriculture, forestry, fisheries, water)
- Biophysical modelling

Expertise: ecologists, geographers (GIS), economists, policy analysts, statisticians
Level 1: Services Supply Account
Why Services Supply Accounts?

- Ecosystems provide services that are essential to the economy and human activities:
  - Food supply
  - Clean water
  - Flood protection
  - Carbon sequestration
  - Recreation, cultural and religious importance

Ecosystems are being converted and degraded
- Which ones are most important to conserve?
- How can they best be managed to maintain services?
- Link with national planning and accounting to ensure ecosystems are mainstreamed in decisions
Ecosystem services are the contribution of ecosystems to benefits for people...

Source: Nottingham School of Geography
Ecosystem services (are not benefits)

Ecosystem services are the contribution of ecosystems to benefits for people.
Level 1: Account 6: Services Supply

- Ecosystem services are the contribution of ecosystem to benefits for people...
  - They are not the benefits; benefits require capital and labour to use
  - We need to calculate the contribution of ecosystems, for example:

    \[ \text{Crops} = f(\text{nature, equipment, inputs, labour, energy...}) \]

  - To grow crops, nature provides biomass growth, nutrients, water, flood control, pollination...
  - Without these, there would be no crops.
  - In the Services Supply Account, we measure the physical services (e.g., the addition to biomass of the crop).
Types of Ecosystem Services

- **Provisioning Services**
  - = goods that can be harvested from, or extracted from ecosystems
  - Example: providing fish for fisheries, or providing wood for timber harvest

- **Regulating Services**
  - = the regulation of climate, hydrological, ecological and soil processes
  - Example: pollination, carbon sequestration, flood control

- **Cultural Services**
  - = the non-material benefits provided by ecosystems
  - Example: recreation, tourism, providing a setting for cultural or religious practices
Ecosystem services and maps

Forest

- Wood production
- Hydrological function
- Carbon sequestration

Intensive cropland

- Crops
- Carbon sequestration

Extensive pasture

- Livestock production
- Carbon sequestration

Recreation and tourism
Level 1: Account 6: Services Supply

- The SEEA-EEA focuses on “final” services
  - The point before human involvement transforms the services to benefits
    - biomass → harvesting
    - fish → capture
  - Ecosystem processes and functions are not final services
    - e.g., reproduction, predation, food web, nutrient cycle…
  - Biodiversity itself is not a “final” service
    - It is an aspect of Ecosystem Condition and is recorded in the Biodiversity Account.
Level 1: Account 6: Services Supply

- **Services**
  - Based on **Common International Classification of Ecosystem Services (CICES)**
  - Not mutually exclusive
  - A list of “final” services
  - Detailed (4-digit)
  - Does **not** include “supporting” or “intermediate” services (= ecosystem functions)

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

Source: CICES, 2013. [www.cices.eu](http://www.cices.eu)
Level 1: Account 6: Services Supply

- How?
  - Direct measure (e.g., socio-economic survey on recreational use, field survey of available fish…)
  - **Remember** Level 0 – Biophysical modelling?
    - **Lookup tables**: Take values from another location
    - **Statistical approaches**: Estimate based on known explanatory variables
    - **Geostatistical interpolation**: Estimate from nearby known locations
    - **Process-based modelling**: Use models of processes (e.g., land cover change, demand for services…)
  - The group exercise will use only **Lookup Tables**…
Level 1: Account 6: Services Supply

• Compilation Group Exercise (30m)
  • Situation:
    • Know total services supply for some EUs
    • Need to calculate:
      • Missing services supply for missing EUs based on known data and lookup table

• Objective (Groups of 3-5):
  1. Calculate missing services
  2. Calculate totals
  3. Report and discuss results
Level 1: Account 6: Services Supply

Group Exercise: Step 1 – Calculate unknown services

e.g., Crop for EU04 = (18,700 / 500) * 281.3

e.g., Carbon for EU04 = (500 * 20)
Level 1: Account 6: Services Supply

- Is everyone clear on the objectives?
- 30 minutes group work
- Please ask questions!

Results:
- Each group report:
  - Totals for each service
  - Which EU generates the most of each service?
  - Were there any surprises?
Level 2: Services Supply Account
Level 2: Account 6: Services Supply

- Learning objectives (Level 2)
  - Understand the data options and sources
  - Be aware of how other countries have approached Services Supply Accounting
Level 2: Account 6: Services Supply

- A full Services Supply Account is more complex than the exercise:
  - More services (48 “final” services in CICES)
  - More types of data (tonnes, risks, visitors, air quality, cultural significance…)
  - Less measured data → need models to estimate
  - High variability among ecosystem types and region (e.g., salt marsh carbon = 650 to 1750 tCO$_2$/ha/year)

- Do not need to include all services:
  - High priority services → measure or estimate
  - Get started with available data
Ecosystem services in an account

- Ecosystem service account developed for Limburg Province, the Netherlands
- 2200 km², 1.1 million inhabitants
- Analysis of 7 ecosystem services

Source: Remme et al., 2014 (Limburg, the Netherlands)
## Level 2: Account 6: Services Supply

- **Example (services in physical units)**

<table>
<thead>
<tr>
<th>Ecosystem service</th>
<th>Units</th>
<th>Urban</th>
<th>Pasture</th>
<th>Cropland</th>
<th>Forest</th>
<th>Heath</th>
<th>Peat</th>
<th>Surface Water</th>
<th>Other nature</th>
<th>Provincial total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunting</td>
<td>kg meat</td>
<td>-</td>
<td>9,100</td>
<td>14,732</td>
<td>8,100</td>
<td>678</td>
<td>70</td>
<td>1,513</td>
<td>26,995</td>
<td>34,193</td>
</tr>
<tr>
<td>Provisioning</td>
<td>$10^3$ m³ water</td>
<td>4,071</td>
<td>7,026</td>
<td>11,227</td>
<td>3,117</td>
<td>214</td>
<td>-</td>
<td>478</td>
<td>862</td>
<td>26,995</td>
</tr>
<tr>
<td>Crop production</td>
<td>$10^6$ kg produce</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,868</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1,868</td>
</tr>
<tr>
<td>Fodder production</td>
<td>$10^6$ kg dry matter</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>784</td>
</tr>
<tr>
<td>Regulation</td>
<td>$10^3$ kg PM₁₀</td>
<td>272</td>
<td>404</td>
<td>717</td>
<td>700</td>
<td>45</td>
<td>7</td>
<td>40</td>
<td>69</td>
<td>2,254</td>
</tr>
<tr>
<td>Carbon sequestration</td>
<td>$10^6$ kg carbon</td>
<td>875</td>
<td>8,019</td>
<td>273</td>
<td>50,664</td>
<td>393</td>
<td>149</td>
<td>-</td>
<td>1,056</td>
<td>61,429</td>
</tr>
<tr>
<td>Cultural</td>
<td>Recreational cycling</td>
<td>$10^3$ trips</td>
<td>2,690</td>
<td>1,863</td>
<td>2,611</td>
<td>1,565</td>
<td>30</td>
<td>3</td>
<td>139</td>
<td>9,121</td>
</tr>
</tbody>
</table>

**Note:** Units of measure are very different

**Source:** Remme et al., 2014 (Limburg, the Netherlands)
Level 2: Account 6: Services Supply

- Data options and sources
  - Field studies
    - Literature on similar sites or specific research
  - Transfer from other locations (Benefits Transfer, Valuation)
    - Ecosystem valuation research databases (e.g., www.evri.ca)
  - Economic production (agriculture, forestry, fisheries, water)
    - Socio-economic statistics already available with spatial detail
  - Biophysical modelling
    - Know conditions, can estimate some services using production functions (e.g., hydrology → flood control)
Level 2: Account 6: Services Supply

Canada Example

Water purification potential change by drainage area for boreal wetlands
Index based on:
- % forest cover
- % agricultural land
- % riparian forest
- % wetlands
- % anthropogenic disturbance
- % burn area
- Edge & linear density (fragmentation)
- Human footprint
- Slope
- Nitrogen & Sulphur exceedance (from atmospheric deposition)

Source: Statistics Canada, 2013
Level 2: Account 6: Services Supply

Canada example

Net biomass extraction for human use

Includes:
- Agricultural crops
- Livestock and poultry
- Milk
- Maple products and honey
- Forestry
- Fisheries (inland and marine)

Source: Statistics Canada, 2013
Level 2: Account 6: Services Supply

Canada example

Weight of commercial fish landings by marine statistical area

Includes:
- Groundfish
- Pelagic fish
- Shellfish

Also done for west coast

Statistical area defined by Ministry of Fisheries and Oceans

Source: Statistics Canada, 2013
## Level 2: Account 6: Services Supply

- Some services flow data are available

<table>
<thead>
<tr>
<th>Service</th>
<th>Flow measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Provisioning services</strong></td>
<td></td>
</tr>
<tr>
<td>Timber services</td>
<td>timber increment</td>
</tr>
<tr>
<td>Crops</td>
<td>crop production</td>
</tr>
<tr>
<td>Livestock</td>
<td>livestock production</td>
</tr>
<tr>
<td>Water provision</td>
<td>annual freshwater supply</td>
</tr>
<tr>
<td><strong>Regulating services</strong></td>
<td></td>
</tr>
<tr>
<td>Water quantity regulation</td>
<td>total amount of water stored</td>
</tr>
<tr>
<td></td>
<td>total amounts of pollutants removed annually</td>
</tr>
<tr>
<td>Climate regulation</td>
<td>annual carbon fixation</td>
</tr>
<tr>
<td>Storm protection</td>
<td>total number of storms mitigated</td>
</tr>
<tr>
<td>Air quality regulation</td>
<td>total amount of pollutants removed via dry deposition on leaves</td>
</tr>
<tr>
<td>Erosion control</td>
<td>total amount of soil retained</td>
</tr>
<tr>
<td>Pollination</td>
<td>increased yield of crops due to pollination</td>
</tr>
<tr>
<td>Soil quality regulation</td>
<td>increased yield of crops attributable to soil quality</td>
</tr>
<tr>
<td><strong>Cultural services</strong></td>
<td></td>
</tr>
<tr>
<td>Recreation</td>
<td>number of visitors</td>
</tr>
</tbody>
</table>

Source: (Maes, Parachini et al. 2011)
Level 2: Account 6: Services Supply

- **Data sources:** Socio-economic statistics
  - Agricultural statistics: crop, livestock production
  - Energy statistics: biomass for fuel
  - Fisheries statistics: catch, stock
  - Forestry statistics: timber stock, harvest
  - Park surveys: visitors, use
  - Water statistics: withdrawals, consumption
  - Natural disasters: incidence of floods, erosion, storms
  - Soil inventories: erosion potential
  - Health statistics: regulation of biotic environment

- Best if they are national and good quality
Level 2: Account 6: Services Supply

- **Data sources:** Environmental statistics
  - Iconic species ranges & habitats
  - Land cover → carbon sequestration, air filtration
  - Hydrology & weather data: Flow rates, variability → flood risk
  - Topography, land cover, soil & weather data → erosion and landslide risk
  - Carbon storage and sequestration (see Carbon Accounts)
  - Remote sensing → primary production
- Best if they are national and good quality
Level 2: Account 6: Services Supply

- **Data sources:** Ecosystem valuation databases
  - Based on codifying scientific studies
  - Include data for many countries, ecosystem type, physical services measures
    - Environmental Valuation Reference Inventory ([www.evri.ca](http://www.evri.ca))
    - TEEB Ecosystem Service Valuation Database ([ESVD](http://www.esvd.org))
    - Gulf of Mexico Ecosystem Services Valuation Database ([www.gecoserv.org](http://www.gecoserv.org))
  - Need to understand location, definitions and methods used
Level 2: Account 6: Services Supply

- **Data sources:** Specific studies & models
  - These may not be included in valuation databases
  - **Specific studies:**
    - National or regional ecosystem assessments (Millennium Ecosystem Assessment, UK National Ecosystem Assessment)
    - Small-area studies (e.g., one park, one region)
    - TEEB studies and country studies (multiple ecosystems and services)
  - **Decision-support models:**
    - There are landscape-scale and site-scale models that can help estimate service flows (AIRES, InVEST, LUCI…)
    - See Biophysical Modelling
Level 2: Account 6: Services Supply

- **Data sources:** Special surveys and case studies
  - High-priority data gaps may also be addressed by collecting **new** data
    - Ecological field studies to determine “production functions”
    - Socio-economic surveys to determine use of services (e.g., water, food, recreation)
    - Case-studies for specific locations or social groups (e.g., dependence on nature of low-income residents)
  - If possible, add questions to existing surveys, for example,
    - Households use of water, source of food, incidence of hazards (flooding, erosion, drought, disease), source of biomass for fuel
Level 2: Account 6: Services Supply

- Group exercise (15m) (Groups of 3-5)

1. In your country, what are three important **ecosystem services** that should be included in a Services Supply Account?
2. Which ecosystem types supply them?
3. What **national data** are available in your country on the supply of these services?
4. Report your results
Level 2: Account 6: Services Supply

- Concepts Group exercise (15m)

- Group reports
  - The ecosystem services you selected
  - The main land cover types for each
  - Are national data available in your country on the supply of these services?

- Discussion
  - What other ecosystem services would be important to measure?
  - On what topic might a special survey be used to fill priority data gaps?
Level 2: Account 6: Services Supply

- Discussion and questions
- Take home points
  - Services Supply in biophysical terms is one of the **most important** aspects of ecosystem accounting
  - Data on Services Supply are available from many sources
  - There are some simple methods and models available to integrate these data and fill gaps
  - Start by focussing on available data and priority services
References

- CICES, 2013. [www.cices.eu](http://www.cices.eu)
- Nottingham School of Geography, nd, Nature’s services in decision making. [http://nottingham.ac.uk/geography/research/impact/natures-services.aspx](http://nottingham.ac.uk/geography/research/impact/natures-services.aspx)
Level 2: Account 6: Services Supply

- Further Information
  - SEEA Experimental Ecosystem Accounting (2012)
  - SEEA-EEA Technical Guidance (forthcoming)
    - Detailed supporting documents
    - “Linkages between ecosystem service accounts and ecosystems asset accounts” and
    - “Biophysical Modelling and Analysis of Ecosystem Services in an Ecosystem Accounting Context” by Lars Hein
Evaluation of the training module

Please complete the online evaluation form for this module: [http://www.tinyurl.com/pbopmy2](http://www.tinyurl.com/pbopmy2)

For this module

- What did you learn that you could apply in your work?
- Was the presentation clear and informative?
- Was it too simple? Too complex?
- Was there anything you did not understand?
- What additions or deletions would you suggest (recognizing that the unit is intended for a general audience)?
- Do you have any suggestions as to how the SEEA-EEA may be improved (concepts, principles) in this area?
Acknowledgements

- This project is a collaboration of The United Nations Statistics Division, United Nations Environment Programme and the Secretariat of the Convention on Biological Diversity and is supported by the Government of Norway.

- Contact: seea@un.org