Overview of the Ecosystem of environmental-economic accounting (SEEA)

United Nations Statistics Division

International Seminar on Natural Capital Accounting

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Outline

• General introduction to the System of Environmental Economic Accounting (SEEA)
• Introduction to SEEA Central Framework
• Introduction to SEEA Experimental Ecosystem Accounting
• Overview of the SEEA EEA accounts
General Introduction to the System of Environmental Economic Accounting (SEEA)
SEEA as supporting framework
SEEA uses the accounting approach to integrates many data sets

• SEEA accounts can rely up to numerous data sources, covering such areas as
  o energy
  o environment
  o agriculture
  o economy
  o ecosystems

• These data sources are combined to produce an integrated set of accounts and develop policy relevant indicators
From data silos to integrated information

Agency A
Policy A
Info A
Data A

Agency B
Policy B
Info B
Data B

Agency C
Policy C
Info C
Data C

Indicators

Accounts
SNA | SEEA

Basic Data
Economic | Social | Environmental
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.
The SNA and SEEA: Systems of integrated information
One Environment: Two perspectives

**CENTRAL FRAMEWORK**

**Assets**
- Timber
- Water
- Fish

**ECOSYSTEM ACCOUNTING**

**Services**
- Forests (e.g. flood control)
- Rivers (e.g. water purification)
- Coasts (e.g. recreation)
SEEA Conceptual Framework

Economy
- Activities
  - Production
  - Consumption
  - Accumulation

Instruments
- Financial/Monetary
- Taxes/subsidies
- Financing
- Resource rent
- Permits

Economic Units
- Enterprises
- Households
- Government
- Non-profit institutions

Environment
- Natural inputs
- Ecosystem services
- Residuals (e.g., emissions, waste)

Individual Environmental Assets (e.g., land, water, mineral and energy, soil, aquatic)

Ecosystem Assets

Outside territory of reference

Imports/Exports

Transboundary Environmental Flows

Outside territory of reference
| **SEEA-CF**  
(Central Framework) | **• Assets**  
**• Physical flows**  
**• Monetary flows** | **• Minerals & Energy, Land, Timber, Soil, Water, Aquatic, Other Biological**  
**• 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** |
The SEEA Central Framework Accounts

1. **Stock accounts** for environmental assets: natural resources and land
   - physical (e.g. fish stocks and changes in stocks) and/or monetary values (e.g. value of natural capital, depletion)

2. **Flow accounts**: supply and use tables for products, natural inputs and residuals (e.g. waste, wastewater) generated by economic activities.
   - physical (e.g. m³ of water) and/or monetary values (e.g. permits to access water, cost of wastewater treatment, etc.)

3. **Activity / purpose accounts** that explicitly identify environmental transactions already existing in the SNA.
   - e.g. Environmental Protection Expenditure (EPE) accounts, environmental taxes and subsidies

4. **Combined physical and monetary accounts** that bring together physical and monetary information for derivation indicators, including depletion adjusted aggregates
Ecosystem Accounting model

ECOSYSTEM ASSET (1)

Ecosystem characteristics and processes (2)

Final ecosystem services (3)

Other ecosystem assets

Intermediate ecosystem services

Environmental restoration & impact

Benefits - SNA & non-SNA (4)

Users – Economic units (businesses, households, government) (5)

Individual & societal well-being (6)

Human inputs (e.g. labour, produced assets)
SEEA Experimental Ecosystem Accounting

Policy and Decisionmaking

Environmental-Economic Accounting

- Measurement
  - Asset: Classifying ecosystem types, Extent
  - Condition: Measuring ecosystem health

- Valuation
  - Services: Flow of services to beneficiaries
  - Benefits: Value of the benefits people receive
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 depend on whether or not the ecosystems are accessible.
- Therefore...Ecosystem accounting needs to integrate spatial and non-spatial data.
- For example, tropical forest vs. Kruger national park.
- Use of Geographic information systems (GIS)
  > Manage spatial information as layers
  > Tools to integrate spatial information
  > Generate tables based on common properties (e.g., land cover and land cover change)
SEEA EEA – set of accounts
SEEA-EEA accounts, tools and linkages

**ACCOUNTS IN PHYSICAL TERMS**

1. Ecosystem extent account
2. Ecosystem condition account
3. Ecosystem services supply and use account - physical

**Tools:**
- Classifications
- Spatial units, scaling & aggregation
- Biophysical modelling

**ACCOUNTS IN MONETARY TERMS**

4. Ecosystem services supply and use account - monetary
5. Ecosystem monetary asset account

**Integrated accounts**
- Combined presentations
- Extended supply and use accounts
- Sequence of accounts
- Balance sheets

**Tools:** Valuation techniques

**Thematic accounts**
- Land
- Water
- Carbon
- Biodiversity
1. Ecosystem extent account

• **What?**
  • National coverage of terrestrial, freshwater, coastal and marine areas
  • Mutually exclusive and exhaustive coverage

• **Why?**
  • Land management, conservation policies
  • Spatial foundation for other accounts
    → basis for allocating macro data to spatial units
  • Builds on SEEA CF (land, forest, water)
1. Ecosystem extent account

What does an Extent Account look like?

Maps

Ecosystem type

Spatial units Classifications

<table>
<thead>
<tr>
<th>Proxy ecosystem type (based on land cover)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
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<td>Herbaceous crops</td>
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<td>Woody crops</td>
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<td>Multiple or layered crops</td>
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<td>Grassland</td>
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<td>Shrub-covered areas</td>
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<td>Sparse natural vegetated areas</td>
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<td>Permanent snow and glaciers</td>
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<td>Inland water bodies</td>
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<td>Coastal water and inter-tidal areas</td>
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<td>Sea and marine areas</td>
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</tbody>
</table>

Opening extent

- Additions to extent
  - Managed expansion
  - Natural expansion
  - Upward reappraisals

- Reductions in extent
  - Managed regression
  - Natural regression
  - Downward reappraisals

Net change in extent

Closing extent
1. Ecosystem extent account

Example: Ecosystem map of Europe

## Ecosystem extent account, Netherlands, 2006 - 2013

<table>
<thead>
<tr>
<th>Ecosystem Unit</th>
<th>Area (km²)</th>
<th>2006</th>
<th>2013</th>
<th>Δ</th>
<th>Area (percentage)</th>
<th>2006</th>
<th>2013</th>
<th>Δ</th>
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</thead>
<tbody>
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<tr>
<td><strong>Agriculture</strong></td>
<td></td>
<td>19174</td>
<td>18811</td>
<td>−363</td>
<td>46,16</td>
<td>45,29</td>
<td>−0,87</td>
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<tr>
<td><strong>Forest</strong></td>
<td></td>
<td>3207</td>
<td>3216</td>
<td>8</td>
<td>7,72</td>
<td>7,74</td>
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<tr>
<td><strong>Heath</strong></td>
<td></td>
<td>394</td>
<td>427</td>
<td>33</td>
<td>0,95</td>
<td>1,03</td>
<td>0,08</td>
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<tr>
<td><strong>Sand</strong></td>
<td></td>
<td>356</td>
<td>358</td>
<td>2</td>
<td>0,86</td>
<td>0,86</td>
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<td><strong>Wetlands</strong></td>
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<td>461</td>
<td>580</td>
<td>119</td>
<td>1,11</td>
<td>1,40</td>
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<td><strong>Other nature</strong></td>
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<td>4061</td>
<td>4007</td>
<td>−54</td>
<td>9,78</td>
<td>9,65</td>
<td>−0,13</td>
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<td><strong>Public green areas</strong></td>
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<td>710</td>
<td>708</td>
<td>−1</td>
<td>1,71</td>
<td>1,70</td>
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<td><strong>Built-up and paved</strong></td>
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<td>5236</td>
<td>5410</td>
<td>175</td>
<td>12,60</td>
<td>13,03</td>
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<td><strong>Inland water</strong></td>
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<td>4088</td>
<td>4199</td>
<td>111</td>
<td>9,84</td>
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<td>0,01</td>
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<td><strong>The Netherlands</strong></td>
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<td>0,00</td>
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</table>
2. Ecosystem condition account

• What?
  > **Ecosystem condition** reflects the overall quality of an ecosystem asset, in terms of its characteristics.

• Why?
  > Policies to limit degradation of natural heritage, rehabilitation of degraded ecosystems
  > Links to capacity to produce services (Services Supply)
  > Indicators:
    - Indices of condition ➔ change over time ➔ where changes
    - Good/bad condition (exceeding “safe” levels) ➔ where
2. Ecosystem condition account

Maps

Carbon

Water

Soil

Biodiversity

Vegetation

Tables

<table>
<thead>
<tr>
<th>Class</th>
<th>Variables</th>
<th>Ecosystem types</th>
<th>Ecosystem type 1</th>
<th>Ecosystem type 2</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Year 1</td>
<td>Year 2</td>
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<tr>
<td>Class 1</td>
<td>Variable 1</td>
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<td>Variable 2</td>
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<td></td>
<td>Variable 3</td>
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<tr>
<td>Class 2</td>
<td>Variable 4</td>
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<td></td>
<td>Variable 5</td>
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<tr>
<td></td>
<td>Variable 6</td>
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</table>

Scaling & aggregation
Example: soil organic matter in forests

Soil organic matter content

- Broad-leafed forest
- Coniferous forest
- Mixed forest
- Vegetated dunes

Soil organic matter (%)

- ≤ 3
- 3 - 4
- 4 - 5
- 5 - 6
- > 6
Example: Condition account for Dutch forests, 2013

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Unit</th>
<th>Deciduous forest</th>
<th>Coniferous forest</th>
<th>Mixed forest</th>
<th>Mixed forest (Dunes)</th>
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<tbody>
<tr>
<td><strong>EXTENT</strong></td>
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<tr>
<td>Extent</td>
<td>ha</td>
<td>109,142</td>
<td>81,923</td>
<td>118,571</td>
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<td><strong>STATE INDICATORS</strong></td>
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<tr>
<td>Tree cover</td>
<td>%</td>
<td>54</td>
<td>64</td>
<td>64</td>
<td>32</td>
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<tr>
<td>Shrub cover</td>
<td>%</td>
<td>10</td>
<td>6</td>
<td>7</td>
<td>9</td>
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<tr>
<td>Low vegetation cover</td>
<td>%</td>
<td>28</td>
<td>24</td>
<td>23</td>
<td>43</td>
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<td>Carbon stock in biomass</td>
<td>Mton C</td>
<td>6.8</td>
<td>5.1</td>
<td>7.4</td>
<td>1.0</td>
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<td>Protected areas (Natura2000, EHS)</td>
<td>% of area</td>
<td>16</td>
<td>44</td>
<td>38</td>
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<td>Living Planet Index</td>
<td>Index 2000=100</td>
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<td>102</td>
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<td>Characteristic species</td>
<td>Index intact=100</td>
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<td>33.1</td>
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<td>46.0</td>
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<tr>
<td>Ecosystem quality</td>
<td>% of area with ≥50% of qualifying species</td>
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<td>33.9</td>
<td></td>
<td>63.5</td>
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<td>Habitat structure and function</td>
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<td></td>
<td>Unfavourable/inadequate</td>
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<td>Soil organic matter</td>
<td>% of area with &lt;3% SOM</td>
<td>17</td>
<td>34</td>
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<td>92</td>
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<tr>
<td>Air pollution – PM10</td>
<td>μg PM_{10} /m³</td>
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<td>20.2</td>
<td>20.1</td>
<td>17.2</td>
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<td>Air pollution – PM2.5</td>
<td>μg PM_{2.5} /m³</td>
<td>12.8</td>
<td>13.0</td>
<td>12.9</td>
<td>10.8</td>
</tr>
<tr>
<td>Air pollution – NO2</td>
<td>μg NO₂ /m³</td>
<td>16.0</td>
<td>15.7</td>
<td>15.5</td>
<td>12.3</td>
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<tr>
<td>Air Pollution – SO2</td>
<td>μg SO₂ /m³</td>
<td>0.9</td>
<td>0.8</td>
<td>0.8</td>
<td>1.2</td>
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<td><strong>PRESSURE INDICATORS</strong></td>
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<td>Urbanisation</td>
<td>% paved surface</td>
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<td>0.02</td>
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<td>Acidification</td>
<td>mol H⁺/ha/ yr</td>
<td>2368</td>
<td>2724</td>
<td>2663</td>
<td>1887</td>
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<tr>
<td>Eutrophication</td>
<td>mol N/ha/ yr</td>
<td>1713</td>
<td>2025</td>
<td>1982</td>
<td>1220</td>
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<tr>
<td>Drainage organic soils</td>
<td>cm</td>
<td>67</td>
<td>97</td>
<td>85</td>
<td>29</td>
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</tbody>
</table>
3. Ecosystem Services Supply & Use

• **What?**
  - Physical 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
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
3. Ecosystem Services Supply & Use

What does an Ecosystem Service Supply Account look like?

Maps

- Ecosystem extent
- Provisioning
- Regulating
- Cultural

Tables

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

Look up tables
Biophysical modelling

Valuation

Monetary Services Supply
Example: Central Kalimantan

Carbon storage

- High: 7882.64 ton/ha
- Low: 32.34 ton/ha

Model used

Look Up Tables (every land cover class is attributed a specific carbon storage value)

Timber production

- High: 1.67 m³/ha/year
- Low: 0.42 m³/ha/year

Kriging
(values are interpolated from samples)

Source: Sumarga and Hein, 2014
4. Valuation

• **What is the purpose?**
  > To integrate environmental issues in economic decision making and development planning

• **What are we trying to value?**
  > 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
Revision of the SEEA Experimental Ecosystem Accounting

- Launched in March 2018 with the aim to finish by the end of 2020
  > For endorsement by UN Statistical Commission in March 2021
- Engagement with various stakeholders – wide engagement of various communities, including ecologists, environmental economists, earth observation, etc.
- Seek for broad involvement of partners and experts in the process – in the first year over 80 experts contributed to drafting of the discussion papers
- Ambition is to elevate it to an agreed methodological document – international statistical standard
- Process aligned with the post-2020 global biodiversity framework, review of SDG and climate change process
Revision Working Groups

WG1: Spatial units
WG2: Ecosystem condition
WG3: Classification of ecosystem services
WG4: Individual ecosystem services (completed)
WG5: Valuation and accounting treatments

Cross-cutting issues:
1. Framing of values
2. Aggregation and scaling
3. Degradation and capacity
4. Biodiversity
5. Application of ecosystem accounting principles to specific areas
6. Connections between ecosystem accounts

Guidelines on biophysical modelling and valuation

Expert Review Groups

Draft chapters
Revision process: keystones & timeline

- **January 2018**: Broad consultation of the revision issues
- **March 2018**: Progressive drafting and review of individual discussion papers
- **June 2018**: Expert review of the discussion papers and their finalization
- **July 2018**: Drafting of the chapters and research on individual topics and cross-cutting issues
- **Dec 2018**: Global Consultation on (grouped) individual chapters
- **Dec 2019**: Global Consultation on the whole document

- **January 2018**: Establishment of four Working Groups according to the research issues
- **March 2018**: Establishment of four Working Groups according to the research issues
- **June 2018**: Establishment of four Working Groups according to the research issues
- **June 2018**: Establish discussion paper topics and draft work plans at the 2018 Forum of Experts
- **July 2018**: Establish discussion paper topics and draft work plans at the 2018 Forum of Experts
- **Dec 2018**: Establish discussion paper topics and draft work plans at the 2018 Forum of Experts
- **Dec 2019**: Establish discussion paper topics and draft work plans at the 2018 Forum of Experts
- **Apr 2019**: Discussion papers discussed at the 2019 Forum of Experts
- **June 2019**: Discussion papers discussed at the 2019 Forum of Experts
- **June 2019**: Discussion papers discussed at the 2019 Forum of Experts
- **Dec 2019**: Discussion papers discussed at the 2019 Forum of Experts
- **Jun 2020**: Discussion papers discussed at the 2019 Forum of Experts
- **Dec 2020**: Discussion papers discussed at the 2019 Forum of Experts

- **SEEA EEA Technical Committee**: to oversee the drafting of the chapters
- **UNCEEA and 2020 Forum of Experts**: to oversee the drafting of the chapters

**SEEA EEA**: is finalized for discussion at UNSC.
SEEA Implementation
Implementation of the SEEA

• Implementation strategy (2013) objectives:
  > Adopt the SEEA as the measurement framework for sustainable development
  > Mainstream SEEA implementation in countries
    - Target 100 countries by 2020 for implementation of SEEA Central Framework
    - Target 50 countries by 2020 for implementation of SEEA Experimental Ecosystem Accounting

• Setting up country programmes
Capacity building & training

• Blended approach to training:
  1. Online course
  2. In-person training
  3. Follow-up phase

• UNSD eLearning platform (https://elearning-cms.unstats.un.org/):
  > SEEA Central Framework (Arabic, English, Russian, French)
  > Water Accounts (English)
  > Energy accounts (English, Russian)
  > Ecosystem Accounts (English, Spanish, French soon)
THANK YOU
seea@un.org // https://seea.un.org/