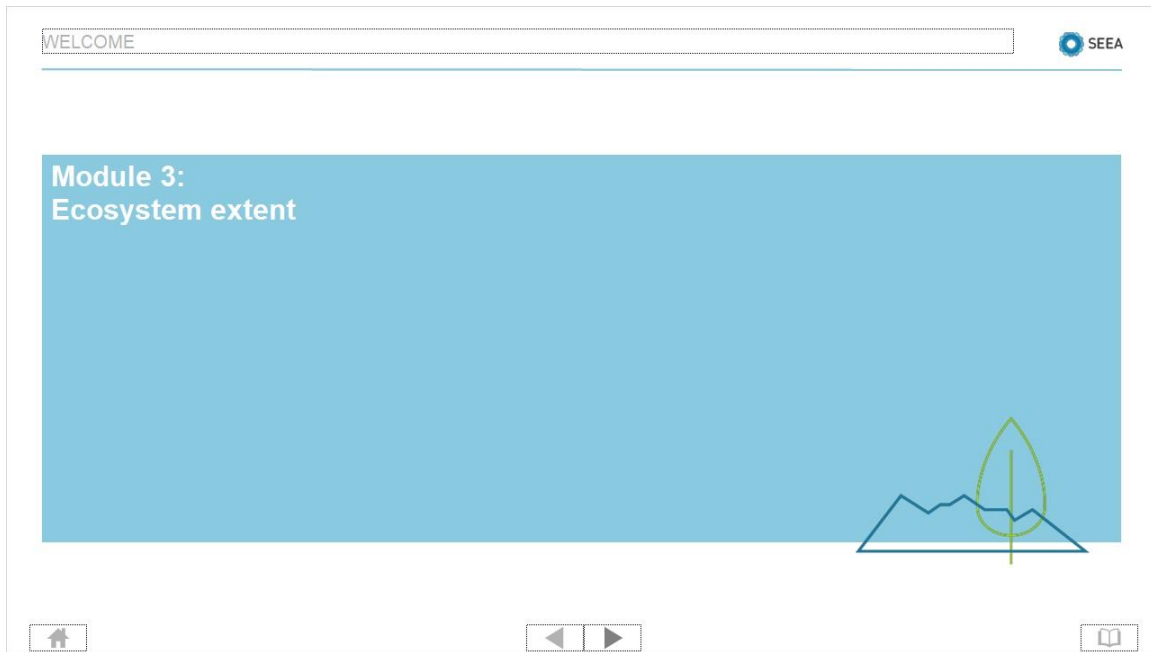


# SEEA\_EnvAcc\_M3\_EN

## 1. Module 1 - Introduction

### 1.1 Welcome



**Notes:**

## 1.2 Welcome...

### Welcome...

.... to the third module on Experimental Ecosystem Accounting!

This module is designed to give you an overview of the ecosystem extent account. The following topics will be covered:

- Basic information
- Mapping of information
- Combining information
- Basic spatial units (BSU)
- Developing a spatial data infrastructure
- Grids and vectors
- Delineating spatial units
- Developing a national spatial data infrastructure (NSDI)
- Key research issues

We appreciate your interest in accounting for the environment!

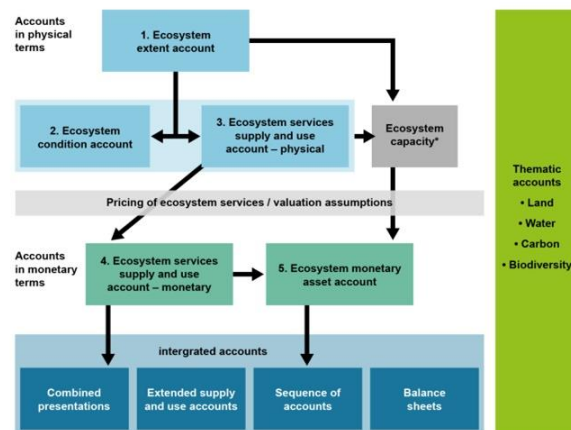


## 1.3 Ecosystem extent accounts

### Ecosystem extent accounts

The ecosystem extent account will usually be the first ecosystem account to be developed. It is organizing information on the **extent of different ecosystem types within a country** in terms of area:

- It measures the area of coverage of a given ecosystem type (ETs), e.g. hectares of area covered by a specific forest and serves as a **link** between the other accounts within the framework by establishing a common spatial infrastructure.
- When compiling the ecosystem extent account the main challenges are to make informed choices on the ETs to be distinguished and the resolution (and minimum mapping unit) of the maps.



## 1.4 Accounting classifications in SEEA

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SEEA

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### Accounting classifications in SEEA





Differentiating and comparing ecosystem accounts for different areas or across countries relies on **common classification of the spatial units** included in the accounts. The SEEA provides classifications for land cover, land use and land ownership.

**Explore the headlines to see more!**

Land Cover

Land Use

Land Ownership



## 1.5 Basic information to include

(Multiple Response, 10 points, 1 attempt permitted)

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### Basic information to include

Where the **type of land cover** is the only characteristic used to delineate different ecosystem assets, then a land cover account and an ecosystem extent account will be the same. Do you know which **additional characteristics are commonly used** to delineate ecosystem assets (EAs)?

**Check all answers you consider to be correct!**

☒ Land use and ownership





☒ More sophisticated classes of ecological habitat information

☒ Information about water catchment areas

☒ Socio-economic information

☒ Information about ecosystem services supplied

OK



Correct	Choice
X	Land use and ownership
X	More sophisticated classes of ecological habitat information
X	Information about water catchment areas
X	Socio-economic information
X	Information about ecosystem services supplied

**Feedback when correct:**

Land cover approximates the major ecosystems on land while use and ownership enrich the picture. This is why these are recommended for national level coverage.

Including more information, such as the extent of more ecologically defined habitat types, is recommendable if resources allow it. Such detail can consequently be aggregated to land cover types for reporting and international comparison.

In particular, when accounts are produced for smaller areas, it may be decided to fill the accounts with more detailed information for individual EAs. This increases the resolution at which data on ecosystem services flows and assets needs to be compiled.

**Feedback when incorrect:**


Land cover approximates the major ecosystems on land while use and ownership enrich the picture. This is why these are recommended for national level coverage.

Including more information, such as the extent of more ecologically defined habitat types, is recommendable if resources allow it. Such detail can consequently be aggregated to land cover types for reporting and international comparison.

In particular, when accounts are produced for smaller areas, it may be decided to fill the accounts with more detailed information for individual EAs. This increases the resolution at which data on ecosystem services flows and assets needs to be compiled.

## Correct (Slide Layer)

MODULE 3: ECOSYSTEM EXTENT

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### Basic information to include

Where the **type of land cover** is the only characteristic used to delineate different ecosystem assets, then a land cover account and an ecosystem extent account will be the same. Do you know **additional characteristics are commonly used** to delineate ecosystem assets (EAs)?

**Check all answers you consider to be correct!**

- ☒ Land use and ownership
- ☒ More sophisticated classes of ecological habitat information
- ☒ Information about water catchment areas
- ☒ Socio-economic information
- ☒ Information about ecosystem services supplied

**Very good!**

Land cover approximates the major ecosystems on land while use and ownership enrich the picture. This is why these **are recommended for national level coverage**.


Including more information, such as the extent of more ecologically defined habitat types, is **recommendable if resources allow it**. Such detail can consequently be aggregated to land cover types for reporting and international comparison.

In particular, when accounts are produced for smaller areas, it may be decided to fill the accounts with more detailed information for individual EAs. This **increases the resolution** at which data on ecosystem services flows and assets needs to be compiled.

Continue

## Incorrect (Slide Layer)

MODULE 3: ECOSYSTEM EXTENT

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### Basic information to include

Where the **type of land cover** is the only characteristic used to delineate different ecosystem assets, then a land cover account and an ecosystem extent account will be the same. Do you know additional characteristics are commonly used to delineate ecosystem assets (EAs)?

**Check all answers you consider to be correct!**

- ☒ Land use and ownership
- ☒ More sophisticated classes of ecological habitat information
- ☒ Information about water catchment areas
- ☒ Socio-economic information
- ☒ Information about ecosystem services supplied

**Not quite right. All answers apply.**

Land cover approximates the major ecosystems on land while use and ownership enrich the picture. This is why these **are recommended for national level coverage**.


Including more information, such as the extent of more ecologically defined habitat types, is **recommendable if resources allow it**. Such detail can consequently be aggregated to land cover types for reporting and international comparison.

In particular, when accounts are produced for smaller areas, it may be decided to fill the accounts with more detailed information for individual EAs. This **increases the resolution** at which data on ecosystem services flows and assets needs to be compiled.

Continue

## 1.6 Delineating spatial units

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### Delineating spatial units

With data sources and tools in place, there is a **range of choices available for delineating the spatial units** needed for ecosystem accounting, depending on scale (i.e. the level of spatial detail) and thematic detail (the number of classes in the classification).

The following considerations are relevant:

**Explore the headlines to see more!!**

- No standardized method
- Focus on ecological principles
- Integration with socio-economic data



## 1.7 Ecosystem extent accounts

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### Ecosystem extent accounts

This table shows a basic condition extent account using high level ecosystem types based on the land cover classification in the SEEA Central Framework. Additional sub-classes may be added depending on the ecosystem types of most relevance within a country.

Explore the highlighted areas to get more information!

	Proxy ecosystem type (based on land cover)															
	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
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																

## 1.8 Mapping of information

MODULE 3: ECOSYSTEM EXTENT

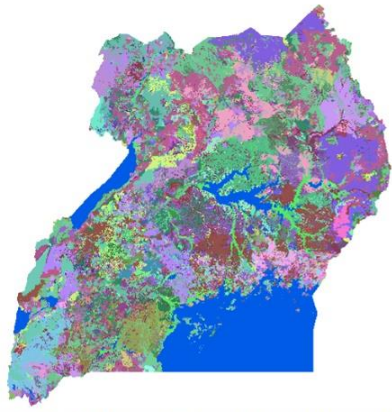
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SEEA

### Mapping of information

In the ecosystem extent there is **no requirement** that the areas of each type of ecosystem be contiguous:

- That is, the total area of, for example, grassland, will occur in various ecosystem assets (EAs) across a country and the data in the accounts represents an aggregation of all of the different EAs.
- Disaggregated information from an ecosystem extent account would be usefully presented in maps using different colours for different ETs.
- Mapping the information can more readily highlight issues of fragmentation of ecosystem types and possible connections between ecosystem types that are not apparent when the information is presented in a traditional table format.



Land cover of Uganda, Multipurpose Landcover Database of Uganda - AFRICOVER, FAO, 2003  
([http://www.fao.org/geonetwork/srv/en/metadata\\_show?id=38103&currTab=simple](http://www.fao.org/geonetwork/srv/en/metadata_show?id=38103&currTab=simple))

Image was produced from visual interpretation of digitally enhanced high-resolution LANDSAT TM images.



## 1.9 Changes of total land area

(Multiple Response, 10 points, 1 attempt permitted)

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SEEA

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### Changes of total land area

Generally, the total area recorded in the extent account **should be the same for the opening and closing stock** and remain unchanged irrespective of the number of different ET that are introduced into the table. But **in some cases, total land area does change**. Can you imagine **what cases that would be**?

**Check all answers you consider to be correct!**

- ☒ Total area may increase owing to reclamation of land through the construction of dykes and other barriers.
- ☒ Changes in area may be the result of political factors such as war or new agreements on areas of disputed territory.
- ☒ Total area may also decrease, for example, owing to land subsidence or higher water levels.

OK



Correct	Choice
X	Total area may increase owing to reclamation of land through the construction of dykes and other barriers.
X	Changes in area may be the result of political factors such as war or new agreements on areas of disputed territory.
X	Total area may also decrease, for example, owing to land subsidence or higher water levels.

### Feedback when correct:

All changes due to land reclamation should be recorded against the relevant addition or reduction following the advice in the SEEA Central Framework.



Changes in total area due to natural, economic or political factors are recorded as upward or downward reappraisals.

Such use of updated information may require the revision of previous estimates to ensure a continuity of time series. Thus the area that is within scope of ecosystem accounts should be clearly defined to prevent confusion.

**Feedback when incorrect:**


All changes due to land reclamation should be recorded against the relevant addition or reduction following the advice in the SEEA Central Framework.

Changes in total area due to natural, economic or political factors are recorded as upward or downward reappraisals.

Such use of updated information may require the revision of previous estimates to ensure a continuity of time series. Thus the area that is within scope of ecosystem accounts should be clearly defined to prevent confusion.

## Correct (Slide Layer)

MODULE 3: ECOSYSTEM EXTENT

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### Changes of total land area

Generally, the total area recorded in the extent account **should be the same for the opening and closing stock** and remain unchanged irrespective of the number of different ET that are introduced into the table. But **in some cases, total land area does change**. Can you imagine **what cases that would be**?

**Check all answers you consider to be correct!**

- ☒ Total area may increase owing to reclamation of land through the construction of dykes and other barriers.
- ☒ Changes in area may be the result of political factors such as war or new agreements on areas of disputed territory.
- ☒ Total area may also decrease, for example, owing to land subsidence or higher water levels.

**Very good!**

All changes due to land reclamation should be recorded **against the relevant addition or reduction** following the advice in the SEEA Central Framework.


Changes in total area due to natural, economic or political factors are recorded as **upward or downward reappraisals**.

Such use of updated information may require the revision of previous estimates to ensure a continuity of time series. Thus the area that is within scope of ecosystem accounts should be clearly defined to prevent confusion.

Continue

## Incorrect (Slide Layer)

MODULE 3: ECOSYSTEM EXTENT

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### Changes of total land area

Generally, the total area recorded in the extent account **should be the same for the opening and closing stock** and remain unchanged irrespective of the number of different ET that are introduced into the table. But **in some cases, total land area does change**. Can you imagine **what cases that would be**?

**Check all answers you consider to be correct!**

- ☒ Total area may increase owing to reclamation of land through the construction of dykes and other barriers.
- ☒ Changes in area may be the result of political factors such as war or new agreements on areas of disputed territory.
- ☒ Total area may also decrease, for example, owing to land subsidence or higher water levels.

**Not quite right. All answers apply.**

All changes due to land reclamation should be recorded **against the relevant addition or reduction** following the advice in the SEEA Central Framework.

Changes in total area due to natural, economic or political factors are recorded as **upward or downward reappraisals**.

Such use of updated information may require the revision of previous estimates to ensure a continuity of time series. Thus the area that is within scope of ecosystem accounts should be clearly defined to prevent confusion.

Continue

## 1.10 Cadastre-based datasets


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### Cadastre-based datasets

In countries with well established cadastres – **administratively defined areas that are delineated on the basis of land ownership** – cadastre-based datasets can be linked to information on ecosystem assets (EAs), ecosystem types (ETs), economic activity, land use and other socio-economic information:

- For instance, it is possible to combine information on land ownership (tenure) with ET and water catchment information to understand the ownership of ETs within each water catchment.
- The use of cadastre-based information is meaningful in terms of understanding the link to policy initiatives, particularly in those countries where land is under private ownership.
- However, it is not recommended that land ownership data be directly applied to delineate EA since this information may raise sensitivities in many countries, as well as, it may be common, for a single cadastre to comprise multiple EAs.



Map with land parcels based on cadastral data of Roerdalen, the Netherlands (excerpt of 4.5 x 3.5 kilometers), which was used as a starting point for linking the units to business register information.

Source: Statistics Netherlands, 2013 (<https://www.cbs.nl/nr/rdonly/res/6293456f-8e61-4821-9b4d-17c7d67416b8/0/environmentalaccountssofthenetherlands2013.pdf>)

## 1.11 Basic spatial units (BSU)

(Multiple Response, 10 points, 1 attempt permitted)

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### Basic spatial units (BSU)

While EAs, ETs and ecosystem accounting areas (EAAs) represent the spatial areas for accounting and statistical purposes, for many ecosystem measurement purposes there is a need for a **spatial measurement unit as a basis for constructing the accounts**. For ecosystem accounting, this spatial unit is termed a **basic spatial unit (BSU)**. What do you think a **basic spatial unit (BSU)** is?

**Check all answers you consider to be correct!**

- ☒ A BSU is a small spatial area that is a geometrical construct.
- ☒ The purpose of BSUs is to provide a fine level frame to which a range of different information can be attributed.
- ☐ To make extent accounts comparable, countries are requested to use the same BSU for all accounts compiled.

OK

Correct	Choice
X	A BSU is a small spatial area that is a geometrical construct.
X	The purpose of BSUs is to provide a fine level frame to which a range of different information can be attributed.
	To make extent accounts comparable, countries are requested to use the same BSU for all accounts compiled.

**Feedback when correct:**

The precise definition of BSUs will depend on the context and the nature of the approach taken to managing spatial data for accounting.

A flexible approach is proposed in recognition of the large differences across countries in terms of spatial area, ecological heterogeneity and data availability.

A fundamental choice in setting up the spatial data infrastructure is whether to use a reference grid and use this reference grid to integrate all data layers,  
or to allow different datasets to have different formats (grid or vector) and/or different grid sizes.

**Feedback when incorrect:**

The precise definition of BSUs will depend on the context and the nature of the approach taken to managing spatial data for accounting.


A flexible approach is proposed in recognition of the large differences across countries in terms of spatial area, ecological heterogeneity and data availability.

A fundamental choice in setting up the spatial data infrastructure is whether to use a reference grid and use this reference grid to integrate all data layers,

or to allow different datasets to have different formats (grid or vector) and/or different grid sizes.

## Correct (Slide Layer)

MODULE 3: ECOSYSTEM EXTENT

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### Basic spatial units (BSU)

While EAs, ETs and ecosystem accounting areas (EAAs) represent the spatial areas for accounting and statistical purposes, for many ecosystem measurement purposes there is a need for a **spatial measurement unit as a basis for constructing the accounts**. For ecosystem accounting, this spatial unit is termed a **basic spatial unit (BSU)**. What do you think a **basic spatial unit (BSU)** is?

**Check all answers you consider to be correct!**

- ☒ A BSU is a small spatial area that is a geometrical construct.
- ☒ The purpose of BSUs is to provide a fine level frame to which a range of different information can be attributed.
- ☐ To make extent accounts comparable, countries are requested to use the same BSU for all accounts compiled.

**Very good!**

The precise definition of BSUs will depend on the context and the nature of the approach taken to managing spatial data for accounting.


A flexible approach is proposed in recognition of the large differences across countries in terms of spatial area, ecological heterogeneity and data availability.

A fundamental choice in setting up the spatial data infrastructure is whether to use a reference grid and use this reference grid **to integrate all data layers, or to allow different datasets to have different formats (grid or vector) and/or different grid sizes.**

**Continue**

## Incorrect (Slide Layer)

MODULE 3: ECOSYSTEM EXTENT

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### Basic spatial units (BSU)

While EAs, ETs and ecosystem accounting areas (EAAs) represent the spatial areas for accounting and statistical purposes, for many ecosystem measurement purposes there is a need for a **spatial measurement unit as a basis for constructing the accounts**. For ecosystem accounting, this spatial unit is termed a **basic spatial unit (BSU)**. What do you think a **basic spatial unit (BSU)** is?

**Check all answers you consider to be correct!**

- ☒ A BSU is a small spatial area that is a geometrical construct.
- ☒ The purpose of BSUs is to provide a fine level frame to which a range of different information can be attributed.
- ☐ To make extent accounts comparable, countries are requested to use the same BSU for all accounts compiled.

**Not quite right. Take a look at the solution!**

The precise definition of BSUs will depend on the context and the nature of the approach taken to managing spatial data for accounting.


A flexible approach is proposed in recognition of the large differences across countries in terms of spatial area, ecological heterogeneity and data availability.

A fundamental choice in setting up the spatial data infrastructure is whether to use a reference grid and use this reference grid **to integrate all data layers, or to allow different datasets to have different formats (grid or vector) and/or different grid sizes.**

Continue

## 1.12 Developing a spatial data infrastructure

MODULE 3: ECOSYSTEM EXTENT





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### Developing a spatial data infrastructure

To develop a spatial data infrastructure for accounting, it is first necessary to select and set-up a **soft and hardware environment** integrated into a Geographical Information System (GIS).

**Explore the headlines to see the next steps!**

- GIS software
- Reference coordinate system
- Projection system
- Integration of datasets





## 1.13 Reference grid approach

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### Reference grid approach

A reference grid approach is based on a reference grid using a **single reference coordinate system** and an **agreed grid size**:

- Each cell in the reference grid represents a BSU. A range of information is attributed to each BSU, including for example details of EA, ET, land cover, soil type, elevation and other biophysical or socio-economic information.
- For all data layers, data are attributed to the reference grid cells ensuring that **for every data layer there is a specific value** for each reference grid cell.
- Such an approach has the advantage **that it reduces the amount of data involved** and the complexity of the spatial modelling.

Opening Land Cover

Closing Land Cover

Opening Land Cover

Code	Count
A	1
C	1
G	1
T	1
M	1
S	1
R	1
P	1
E	1
X	1
<b>Total</b>	<b>100</b>

Closing Land Cover

Code	Count
A	1
C	1
G	1
T	1
M	1
S	1
R	1
P	1
E	1
X	1
<b>Total</b>	<b>100</b>

Example of data transfer from map to table for each land cover type. Each colour also has a letter code making it easier to distinguish between the colours.

## 1.14 Types of spatial units

(Drag and Drop, 10 points, 1 attempt permitted)

MODULE 3: ECOSYSTEM EXTENT

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### Deciding on grid size

Where a reference grid is established, a key question is **what size the grid squares** should be for ecosystem accounting purposes. What would you recommend in the two cases below?

Drag the grids to the examples!

EAA with landscape elements such as forest patches and hedgerows

EAA with landscape elements such as savannah areas

Coarser (bigger) grid

Finer (smaller) grid

OK



Drag Item	Drop Target
Finer (smaller) grid	Rechteck 4
Coarser (bigger) grid	Rechteck 5

Drag and drop properties
Return item to start point if dropped outside the correct drop target
Snap dropped items to drop target (Tile)
Allow only one item in each drop target
Delay item drop states until interaction is submitted

#### **Feedback when correct:**

There are three main considerations in the selection of the grid size:

First, the resolution at which data are available.

Second, the spatial variability of the ecosystems within the EAA.

Third, the potential limitations on computational capabilities and data storage.

#### **Feedback when incorrect:**

There are three main considerations in the selection of the grid size:


First, the resolution at which data are available.

Second, the spatial variability of the ecosystems within the EAA.

Third, the potential limitations on computational capabilities and data storage.

## Correct (Slide Layer)

MODULE 3: ECOSYSTEM EXTENT

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### Deciding on grid size

Where a reference grid is established, a key question is **what size the grid squares** should be for ecosystem accounting purposes. What would you recommend in the two cases below?

**Drag the grids to the examples!**

EAA with landscape elements such as forest patches and hedgerows

EAA with landscape elements such as savannah areas

**Very good!**


There are three main considerations in the selection of the grid size:

- First, the resolution at which data are available.
- Second, the spatial variability of the ecosystems within the EAA.
- Third, the potential limitations on computational capabilities and data storage.

Continue

## Incorrect (Slide Layer)

MODULE 3: ECOSYSTEM EXTENT

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### Deciding on grid size

Where a reference grid is established, a key question is **what size the grid squares** should be for ecosystem accounting purposes. What would you recommend in the two cases below?

**Drag the grids to the examples!**

**Finer (smaller) grid**  
EAA with landscape elements such as forest patches and hedgerows

**Coarser (bigger) grid**  
EAA with landscape elements such as savannah areas

**Not quite right. Take a look at the solution!**

There are three main considerations in the selection of the grid size:

- First, the resolution at which data are available.
- Second, the spatial variability of the ecosystems within the EAA.
- Third, the potential limitations on computational capabilities and data storage.

Continue

## 1.15 Grid and vector approaches

MODULE 3: ECOSYSTEM EXTENT

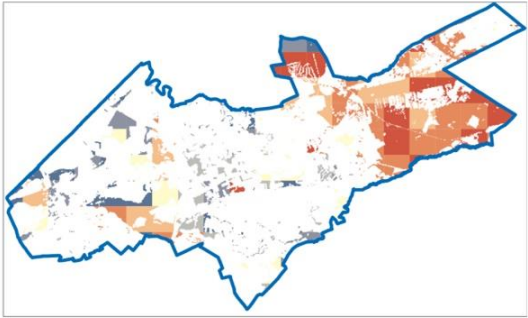
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SEEA

### Grid and vector approaches

When **no reference grid is used**, the EAs and the ETs may be defined in the ecosystem extent account either using a raster or a vector based approach:

- However, depending on the number of data layers that are combined the **resulting intersecting areas may be small** and additional computational resources may be needed.
- Further, without a reference grid, **each data layer may have its own specific resolution**. In this case, the BSU represents the smallest spatial unit underlying the ecosystem extent account, which may either be in a raster or in a vector format.



Deposition kgC/ha yr-1

less than 1250
1250-1350
1350-1500
1500-1600
1600-1750
1750-1875
1875 or more

Excerpt of map of carbon sequestration per hectare (kgC/ha yr-1) of Roerdalen, the Netherlands, created by overlaying the GIS land use map with data about ecosystem services.

Source: Statistics Netherlands, 2013  
(<https://www.cbs.nl/NR/rdonlyres/6293456F-8E61-4821-964D-17C7D67416B8/0/environmentalaccounts2013.pdf>)

## 1.16 Vector based approach

(Multiple Response, 10 points, 1 attempt permitted)

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SEEA

### Vector based approach

The alternative to using a reference grid, perhaps more appropriate for smaller EAAs, is to include **spatial datasets with different resolutions, for examples vector-based thematic data**. An advantage of this approach is that there is **no loss of information due to the aggregation** of datasets to a specific grid. What would you consider when choosing this approach?

**Check all answers you consider to be correct!**

- ☒ The use of a vector format is recommended for the analysis of linear and point elements in the landscape such as roadsides, hedgerows, streams or individual trees in an urban context, which may not be covered accurately using a raster map.
- ☒ In a raster-based account, an EA may be composed of one or a set of BSUs (of the same ET).
- ☒ In a vector-based account, the BSU corresponds to individual polygons (which are likely to represent areas of different sizes). Typically, one BSU represents one EA.

OK

Correct	Choice
X	The use of a vector format is recommended for the analysis of linear and point elements in the landscape such as roadsides, hedgerows, streams or individual trees in an urban context, which may not be covered accurately using a raster map.
X	In a raster-based account, an EA may be composed of one or a set of BSUs (of the same ET).
X	In a vector-based account, the BSU corresponds to individual polygons (which are likely to represent areas of different sizes). Typically, one BSU represents one EA.

**Feedback when correct:**

Provided a consistent reference coordinate system is used for all data layers, different datasets can be used and integrated in the accounting structure, such as:

Coarse vector-based thematic data

Detailed vector-based topographic datasets

Ecosystem condition indicators sampled with remote sensing imagery of 30m resolution

Other ecosystem condition indicators sampled at 10m resolution

**Feedback when incorrect:**

Provided a consistent reference coordinate system is used for all data layers, different datasets can be used and integrated in the accounting structure, such as:

Coarse vector-based thematic data

Detailed vector-based topographic datasets

Ecosystem condition indicators sampled with remote sensing imagery of 30m resolution

## Correct (Slide Layer)

MODULE 3: ECOSYSTEM EXTENT

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SEEA

### Vector based approach

The alternative to using a reference grid, perhaps more appropriate for smaller EAAs, is to include **spatial datasets with different resolutions, for examples vector-based thematic data**. An advantage of this approach to the aggregation of datasets to a specific grid. What would you consider when choosing

**Check all answers you consider to be correct!**

☒ The use of a vector format is recommended for the analysis of linear and point elements in the landscape such as roadsides, hedgerows, streams or individual trees in an urban context, which may not be covered accurately using a raster map.

☒ In a raster-based account, an EA may be composed of one or a set of BSUs (of the same ET).

☒ In a vector-based account, the BSU corresponds to individual polygons (which are likely to represent areas of different sizes). Typically, one BSU represents one EA.

**Very good!**

Provided a **consistent reference coordinate system** is used for all data layers, different datasets can be used and integrated in the accounting structure, such as:

- Coarse vector-based thematic data
- Detailed vector-based topographic datasets
- Ecosystem condition indicators sampled with remote sensing imagery of 30m resolution
- Other ecosystem condition indicators sampled at 10m resolution

Continue

## Incorrect (Slide Layer)

MODULE 3: ECOSYSTEM EXTENT

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SEEA

### Vector based approach

The alternative to using a reference grid, perhaps more appropriate for smaller EAAs, is to include **spatial datasets with different resolutions, for examples vector-based thematic data**. An advantage of this approach to the aggregation of datasets to a specific grid. What would you consider when choosing

**Check all answers you consider to be correct!**

☒ The use of a vector format is recommended for the analysis of linear and point elements in the landscape such as roadsides, hedgerows, streams or individual trees in an urban context, which may not be covered accurately using a raster map.

☒ In a raster-based account, an EA may be composed of one or a set of BSUs (of the same ET).

☒ In a vector-based account, the BSU corresponds to individual polygons (which are likely to represent areas of different sizes). Typically, one BSU represents one EA.

**Not quite right. All answers apply.**

Provided a **consistent reference coordinate system** is used for all data layers, different datasets can be used and integrated in the accounting structure, such as:

- Coarse vector-based thematic data
- Detailed vector-based topographic datasets
- Ecosystem condition indicators sampled with remote sensing imagery of 30m resolution
- Other ecosystem condition indicators sampled at 10m resolution

Continue

## 1.17 Missing data

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SEEA

### Missing data

In some instances, data layers may only be **partially populated**, i.e. the spatial cover of the data does not extend to the full EAA, or it involves geo-referenced point data rather than maps:

- In these cases, the unpopulated areas of each spatial layer need to be classified as either **no data** or **unclassified**, or the missing data need to be **modelled or inter- and extrapolated**, to ensure consistent coverage and reporting.
- Various spatial interpolation tools such as inverse distance weighting, 'kriging' or maximum entropy modelling may also be used for this. The appropriate approach for populating data layers should consider the **type of data and experience of experts** in the specific measurement area.

#### Possible spatial information

- Land cover and land use from either existing maps and referenced point data or based on additional remote sensing imagery
- The topography of the country (coastline, digital elevation model (DEM), slopes, river basins and drainage areas)
- Vegetation type and habitat type
- Species composition
- Hydrology (river and stream networks, lakes, groundwater flows and aquifers)
- Soil resources and geological data
- Meteorological data
- Bathymetry, i.e. measurement of depth of water (for coastal areas)
- Administrative boundaries
- Population, built-up areas and settlements
- Transport and communication (roads, railways, power lines, pipelines)

## 1.18 Grid size and resolution

(Multiple Response, 10 points, 1 attempt permitted)

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### Grid size and resolution

Relevant elements to consider in building upon an existing, or establishing a new spatial data infrastructure include, but are not limited to, the **coordinate and spatial projection system**, and whether a **reference grid** will be used. A reference grid may be most relevant in case of large areas, large datasets, and restrictions in computing capacity.

Note that resolution is not equal to grid size - can you tell the difference?

**Check all answers you consider to be correct!**

- ☒ Resolution relates to the smallest objects visible in an image or map.
- ☒ Grid size is the on-the-ground area covered by a pixel.
- ☒ Objects need to be larger than half the grid size to be visible in an image (i.e. dominant cover).

OK

Correct	Choice
X	Resolution relates to the smallest objects visible in an image or map.
X	Grid size is the on-the-ground area covered by a pixel.
X	Objects need to be larger than half the grid size to be visible in an image (i.e. dominant cover).

**Feedback when correct:**

Another consideration in setting up the spatial data infrastructure is the minimum mapping unit (MMU), i.e. the minimum size a contiguous area needs to have to be distinguished in the map.

Usually, an MMU substantially exceeding the grid size is chosen to facilitate interpretation of the map.

**Feedback when incorrect:**


Another consideration in setting up the spatial data infrastructure is the minimum mapping unit (MMU), i.e. the minimum size a contiguous area needs to have to be distinguished in the map.

Usually, an MMU substantially exceeding the grid size is chosen to facilitate interpretation of the map.



## Correct (Slide Layer)

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### Grid size and resolution

Relevant elements to consider in building upon an existing, or establishing a new spatial data infrastructure include, but are not limited to, **the coordinate and spatial projection system, and whether a reference system** may be most relevant in case of large areas, large datasets, and restrictions in computing.

Note that resolution is not equal to grid size - can you tell the difference?

**Check all answers you consider to be correct!**

- ☒ Resolution relates to the smallest objects visible in an image or map.
- ☒ Grid size is the on-the-ground area covered by a pixel.
- ☒ Objects need to be larger than half the grid size to be visible in an image (i.e. dominant cover).

**Very good!**


Another consideration in setting up the spatial data infrastructure is the minimum mapping unit (MMU), i.e. the **minimum size a contiguous area needs to have to be distinguished in the map.**

Usually, an MMU substantially exceeding the grid size is chosen to facilitate interpretation of the map.

Continue

## Incorrect (Slide Layer)

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### Grid size and resolution

Relevant elements to consider in building upon an existing, or establishing a new spatial data infrastructure include, but are not limited to, **the coordinate and spatial projection system, and whether a reference system** may be most relevant in case of large areas, large datasets, and restrictions in computing.

Note that resolution is not equal to grid size - can you tell the difference?

**Check all answers you consider to be correct!**

- ☒ Resolution relates to the smallest objects visible in an image or map.
- ☒ Grid size is the on-the-ground area covered by a pixel.
- ☒ Objects need to be larger than half the grid size to be visible in an image (i.e. dominant cover).

**Not quite right. All answers apply.**

Another consideration in setting up the spatial data infrastructure is the minimum mapping unit (MMU), i.e. the **minimum size a contiguous area needs to have to be distinguished in the map.**

Usually, an MMU substantially exceeding the grid size is chosen to facilitate interpretation of the map.

Continue

## 1.19 Developing a NSDI

### Developing a NSDI

Establishing the spatial areas required for ecosystem accounting is **best undertaken within a broader context of work**. While not being essential to commence work, a national spatial data infrastructure (NSDI) would **support integration of environmental and socio-economic data**:

- The starting point in utilizing an NSDI is an inventory of **what spatial data infrastructure already exists in a country**, in particular within government agencies such as spatial planning or environmental agencies.
- This assessment should include documenting the most commonly used **GIS software packages and the available datasets**. Where feasible, the development of a spatial data infrastructure for accounting should build upon existing infrastructure.
- The development of spatial data infrastructure also requires selecting **hardware with sufficient processing, storage and back-up capacity, and GIS software**.

- Official boundaries (country, administrative, statistical, river basins, biogeographic areas, shorelines, etc.) as polygon vector data
- Elevation and topography data, based on a digital elevation model (DEM) to distinguish elevation and slope of BSU
- Land cover data
- Land management/use
- Vegetation type
- Soil and geology data
- Hydrological data related to rivers, lakes, streams, coastal and marine areas
- Data on urban infrastructure, including cities, villages, industrial zones, and transport (rail, road), needed for assessing ecosystem condition and understanding ecosystem use (e.g. relevant for mapping fragmentation and other impacts)
- Socio-economic data including population data, employment, economic activity, etc.

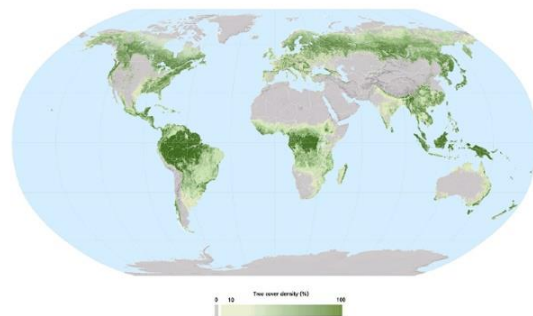
List of data layers recommended for integration in a spatial data infrastructure

## 1.20 Data sharing and capacity

### Data sharing and capacity

Data sharing and capacity are the **key bottlenecks**, even more than the availability of data:

- It is recommended that, given the amount of **time it may take to establish data sharing arrangements**, this is one of the first priorities in the development of an NSDI.
- It is recommended to consider the data formats including the reference coordinate systems used by the various agencies and to **assess if similar formats and coordinate systems can be aligned within an NSDI**.
- Typically, an initial pilot ecosystem accounting project may be run on an up-to-date, powerful, stand-alone computer. However, if ecosystem accounting is applied for large countries or at a continental scale, **additional computing power, either deploying a server or computing and data storage in the cloud may be required**.



The 2015 Global Forest Resources Assessment (FRA2015) is a raster product with a pixel size of 250 meters by 250 meters and includes forest cover, water data, elevation, country boundaries and global ecological zones. Accessible via FAO GeoNetwork.

## 1.21 Building on work that has already been done

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### Building on work that has already been done

An NSDI is ultimately a national register or listing of ecosystem assets. So when starting with the development of such a register, it will be helpful to look at **spatial areas that have already been delineated by government agencies** for administrative purposes

Hover over the fields to see more!

Starting point

Know your ecosystems

Step-by-step approach

Data sharing

## 1.22 Developing a NSDI – step by step

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### Developing a NSDI – step-by-step

The first step in developing a spatial data infrastructure for ecosystem accounting is to establish **objectives, priorities and a time path for the compilation of the accounts**, including the development of the NSDI.

Click on the following steps to see more!

Step 1: Establish objectives, priorities, funding and time path for developing the accounts

## 1.23 Compiling an ecosystem extent account

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### Compiling an ecosystem extent account

NSDI is not essential, but very useful in the compilation of an extent account. After an NSDI has been populated with data, the **first ecosystem extent account is compiled** as a priority output. This requires the following considerations:

**Explore the headlines to see the next steps!**

Use of existing land cover data

Level of detail

Data for testing

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## 1.24 Freely available data

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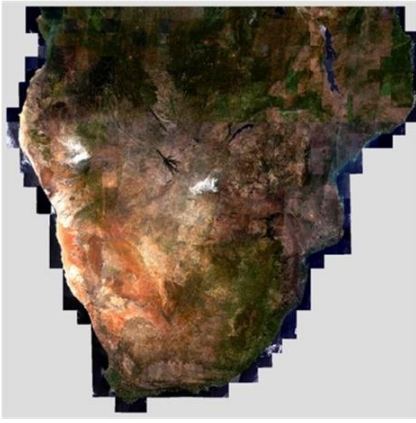
---

### Freely available data

The delineation of spatial areas may involve the use of remote sensing data including satellite earth observation data. Where there is an agreed national land cover map this should be utilized.

Otherwise, there is an increasing availability of such data freely available:

- Data from **MODIS** with medium spatial resolution since 2000, high temporal frequency and including derived products such as land cover, vegetation dynamics and NPP.
- **Landsat** (several bands (wavelengths) available at 30m grid since 1984 but with lower temporal frequency)
- **Sentinel** including the Sentinel I radar sensor and the Sentinel II optical sensor, with grid sizes of 10m for some bands of the optical sensor.



The European Space Agency (ESA) provides access via GlobCover to newest data obtained from Sentinel-2 satellites, that map global land cover at 10m resolution. Processing and interpretation of images is required if the available products are not sufficient, as well as dealing with issues such as cloud cover (for optical sensors).

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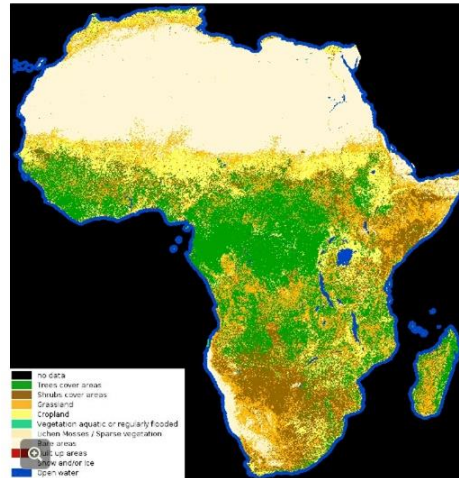


## 1.25 Key research issues

### Key research issues

Approaches to delineate spatial areas for ecosystem accounting are still under development. Key research issues include:

- Detailed standard classifications are still under development and in testing. In the first instance, countries should **seek to use relevant country specific classifications** as these will reflect the local situation.
- The framework of spatial units has been developed for terrestrial areas. The importance of **accounting for marine areas** is well recognized and further research is required to fully consider the spatial framework in this context. Some work has already been achieved by the Australian Bureau of Statistics (ABS) with the Experimental Environment-Economic Accounts for the Great Barrier Reef in 2017.
- Incorporating some specific ecological aspects such as information on **soil resources and properties**, linear features such as hedgerows and roads and **subterranean ecosystems** like caves and groundwater systems needs further research.



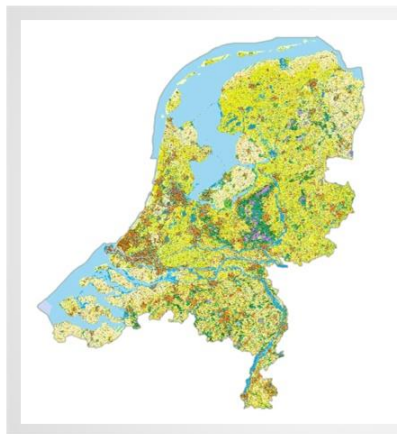
CCI LAND COVER – S2 prototype Land Cover  
20m map of Africa 2016 provided by ESA.

## 1.26 Example: Netherlands

### Example: the Netherlands

In 2015, Statistics Netherlands, in a project carried out in collaboration with Wageningen University (WUR), developed an **ecosystem extent account for the Netherlands**. The account comprised of a detailed map of ecosystem assets in the Netherlands, plus a table specifying the amount of hectares in each ecosystem type.

**Click through the slides to see more!**



The map classifies ecosystem assets on the basis of land cover and ecosystem use. Mapping was done, as far as possible, consistent with the SEEA EEA ecosystem types.

Ecosystem use was defined on the basis of the management of the ecosystems as well as on the basis of the services provided by ecosystems.

## Untitled Layer 1 (Slide Layer)

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### Example: the Netherlands

In 2015, Statistics Netherlands, in a project carried out in collaboration with Wageningen University (WUR), developed an ecosystem extent account for the Netherlands. The account comprised of a detailed map of ecosystem assets in the Netherlands, plus a table specifying the amount of hectares in each ecosystem type.

Click through the slides to see more!



In low-lying, flood-prone Netherlands, key ecosystem services are water retention and storm protection. Flood plains along rivers are used as water retention areas which are critical for controlling flood risks.

Therefore, dunes and flood plains are distinguished as ecosystem types (darker blue). The land cover in these flood plains is mostly grassland.

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## Untitled Layer 2 (Slide Layer)

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### Example: the Netherlands

In 2015, Statistics Netherlands, in a project carried out in collaboration with Wageningen University (WUR), developed an ecosystem extent account for the Netherlands. The account comprised of a detailed map of ecosystem assets in the Netherlands, plus a table specifying the amount of hectares in each ecosystem type.

Click through the slides to see more!



Natural and semi-natural areas are classified in the same detail as intensely managed and paved areas (e.g. different types of perennial crops, non-perennial crops, greenhouses, roads). This high level of detail allows for precise assessments of e.g. land use intensity and temporal changes in land use.

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## 1.27 Summary

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### Summary

- The ecosystem extent account will usually be the first ecosystem account to be developed. It is organizing information on the extent of different ecosystem types within a country in terms of area.
- Differentiating and comparing ecosystem accounts for different areas or across countries relies on common classification of the spatial units included in the accounts.
- The columns of an account reflect the chosen classification for ecosystem types. The structure of the rows reflects the opening extent, closing extent, additions and reductions.
- Information on land cover, use and ownership are a common starting point for delineating spatial areas. Incorporation of data reflecting ecological habitats classes, socioeconomic data and ecosystem services supplied enrich the picture. A focus on ecological principles is recommended since EAs are considered the units that function to supply ecosystem services.
- The basic spatial unit (BSU) is a geometrical construct providing a fine level frame to which a range of different information can be attributed.
- Because all data layers are connected to a common reference system, it is possible to overlay different spatial information (data layers) in different ways for accounting purposes.
- To develop a spatial data infrastructure for accounting, it is necessary to set-up a soft and hardware environment integrated into a Geographical Information System (GIS). A national spatial data infrastructure (NSDI) supports integration of environmental and socio-economic data.
- A reference grid approach uses a single reference coordinate system and an agreed grid size. The use of a vector format is recommended for the analysis of linear and point elements in the landscape which may not be covered accurately using a raster map.

## 1.28 More info....

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### More info....

- **World Wildlife Fund (WWF) eco-regions**  
<https://www.worldwildlife.org/biomes>
- **ESRI/USGS global ecosystems map**  
<https://mngsc.cr.usgs.gov/ecosystems/>
- **Ecosystem units map, Netherlands, 2017**  
<https://www.cbs.nl/en-gb/background/2017/12/ecosystem-unit-map>
- **Project Ecosystem Accounting of Wageningen University, Netherlands**  
<http://www.wur.nl/en/Expertise-Services/Chair-groups/Environmental-Sciences/Environmental-Systems-Analysis-Group/Research/Ecosystem-Services-and-Biodiversity/Ecosystem-Accounting.htm>
- **Images and products provided by NASA (MODIS and Landsat)**  
<https://earthexplorer.usgs.gov/>
- **Images and products provided by ESA (GlobCover 2009 and Sentinel)**  
[http://due.esrin.esa.int/page\\_globcover.php](http://due.esrin.esa.int/page_globcover.php)

Some examples from countries:

- **UK Natural Capital Land Cover in the UK**  
<https://www.ons.gov.uk/economy/environmentalaccounts/articles/uk-naturalcapitalandcoverintheuk/2015-03-17>
- **Australia: Land Account: Victoria, Experimental Estimates, 2012**  
<http://www.abs.gov.au/ausstats/abs@.nsf/Products/4609.0.55.002-2012-Main+Features+Towards+Ecosystem+Accounting>
- **Netherlands: Chapter 7 of the Environmental Accounts of the Netherlands 2013**  
<https://www.cbs.nl/NR/rdonlyres/6293456F-8E61-4621-964D-17C7D67416B8/0/environmentalaccountsofthenetherlands2013.pdf>



## 1.29 Module units

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### Wrapping up...

This is the last screen in Module 3 of the in-depth training on experimental ecosystem accounting.

We hope that this introduction has given you the tools you need to get started with the next module.

See you there, thanks for learning!



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