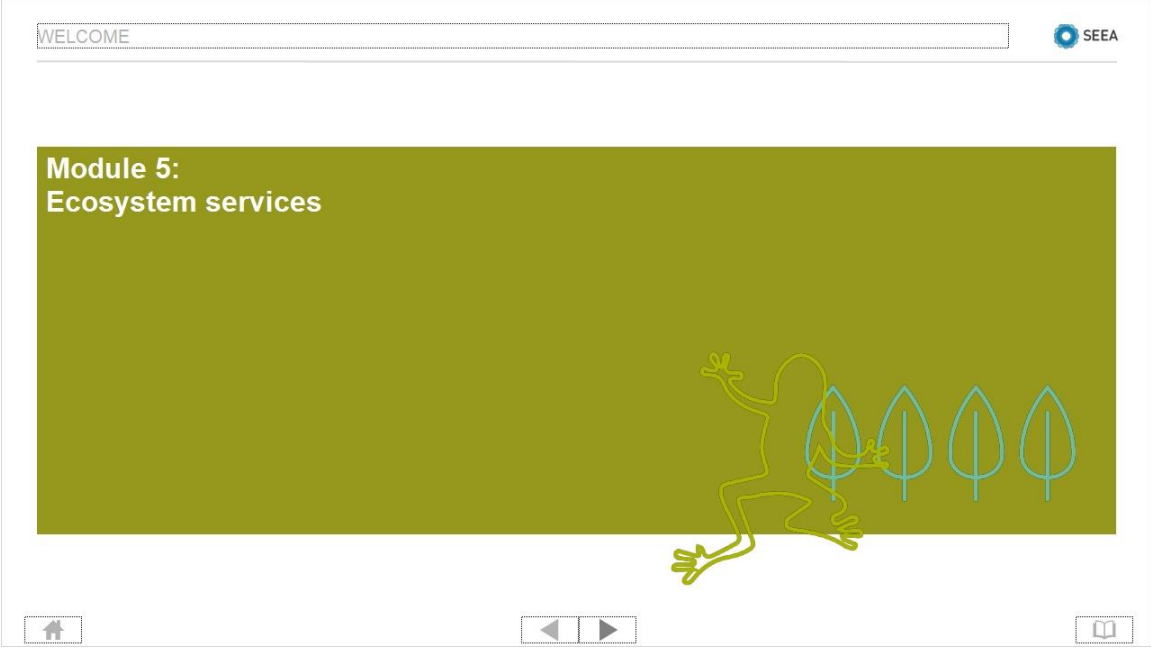
SEEA_EnvAcc_M5_EN

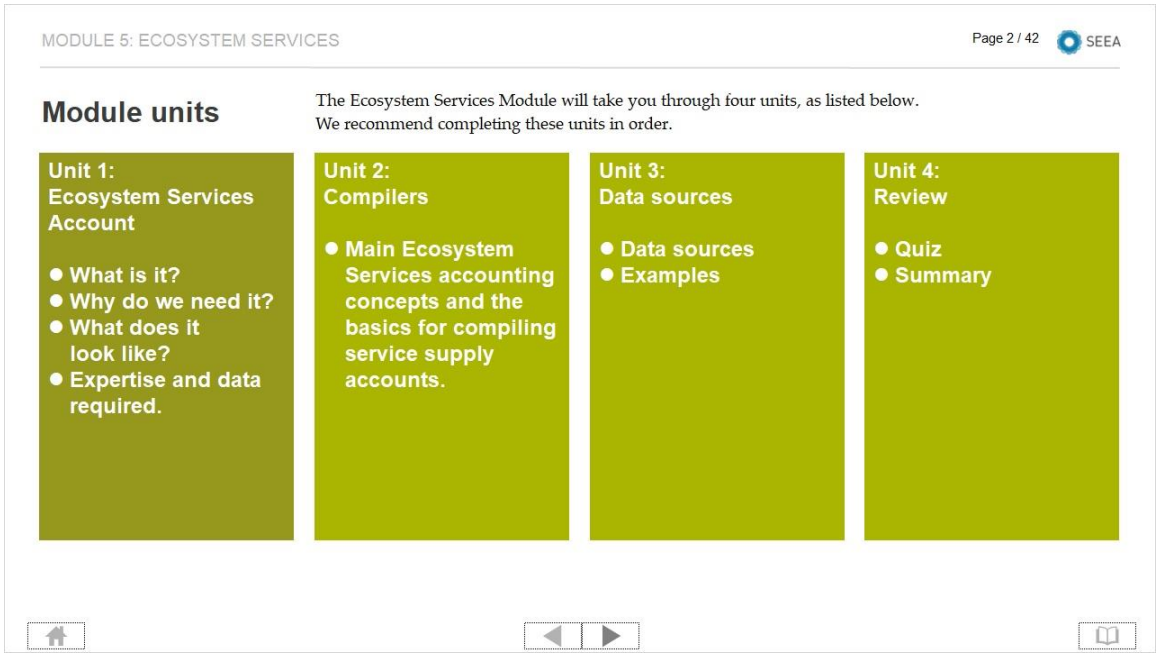
1. Module 1 - Introduction

1.1 Welcome

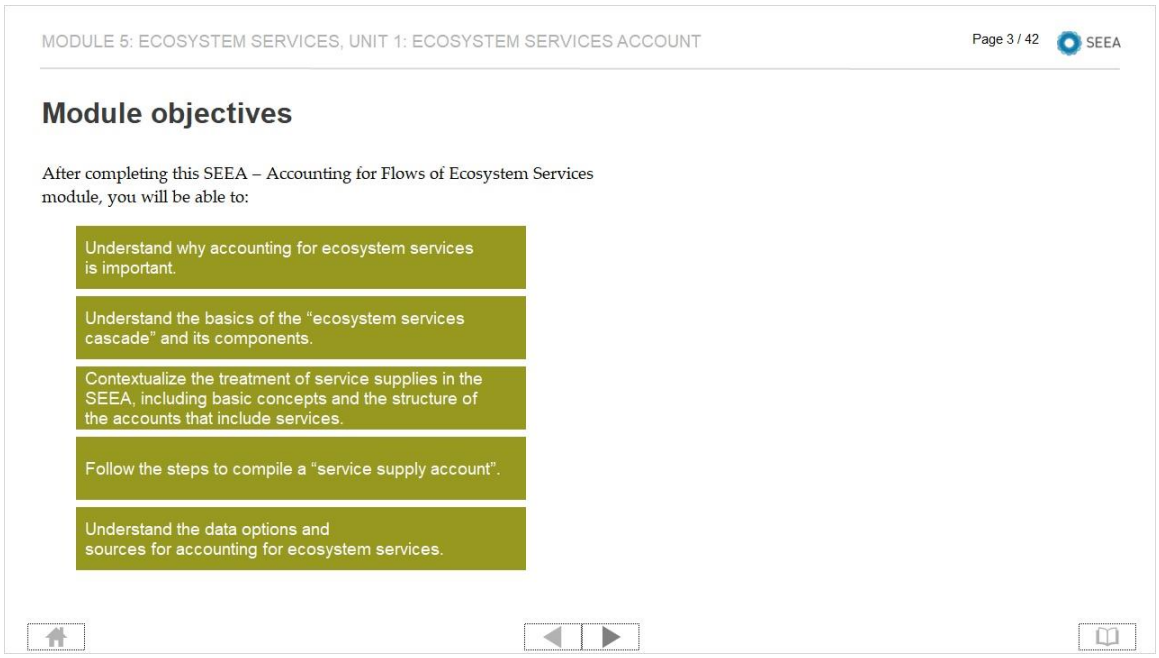


Notes:

1.2 Module units



1.3 Module objectives



1.4 What is Accounting for Flows of Ecosystem Services?

What is accounting for flows of ecosystem services?

Accounting for flows of ecosystem services is a way to provide detailed data on physical and monetary flows of "final" ecosystem services from ecosystems to beneficiaries.

We can apply valuation techniques to the flow of these ecosystem services to derive monetary measures; but in this module we restrict ourselves to accounting for ecosystem services in physical terms. In addition to final ecosystem services, there are intermediate ecosystem services i.e. flows within or between ecosystems such as a spawning ground provided by a mangrove forest for fisheries.

Final ecosystem services are directly used by (or affect) people.

1.5 Importance of Accounting for Flows of Ecosystem Services

Importance of accounting for flows of ecosystem services

Creating ecosystem services accounts is important because the flows of ecosystem services plays a vital role in the environment and the economy.

Ecosystem services accounts can be created for the following purposes:

- To inform policies that affect ecosystems' contributions to human well-being
- To assess trade-offs between development and conservation
- To link to standard economic production measures in SNA
- To link to other SEEA EEA accounts (condition, services use, monetary asset valuation)
- To asses trade-offs between the use of different ecosystem services within one basket of ecosystem services
- To inform land use planning
- As indicators:
  - Flows of individual services (physical and monetary)
  - Indices of aggregated services by ecosystem type

1.6 Accounting for Flows of Ecosystem Services Representation

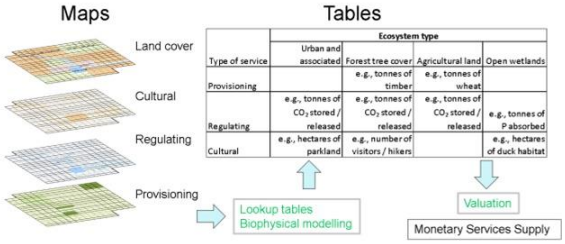
Accounting for flows of ecosystem services

What does a services supply account look like?

Various types of ecosystem services flows can be represented using maps and tables that contain spatially-detailed information from field studies, and biophysical modelling. Some services can be estimated using reference values from lookup tables.

In a complete account, for each ecosystem type (e.g., urban, forest tree cover, agriculture, open wetlands), it is specified what type of services they provide (e.g., provisioning, regulating, cultural).

Take a look at the table and see how the information is integrated when creating such accounts.



1.7 Accounting for Flows of Ecosystem Services Representation

Accounting for flows of ecosystem services representation

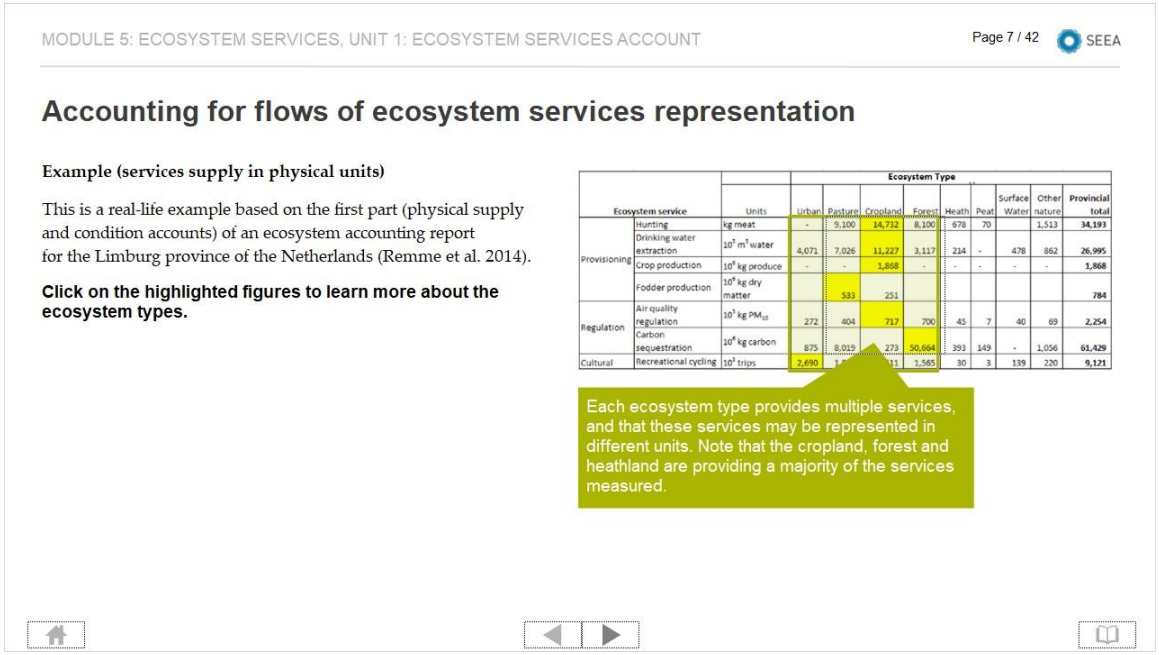
Example (services supply in physical units)

This is a real-life example based on the first part (physical supply and condition accounts) of an ecosystem accounting report for the Limburg province of the Netherlands (Remme et al. 2014).

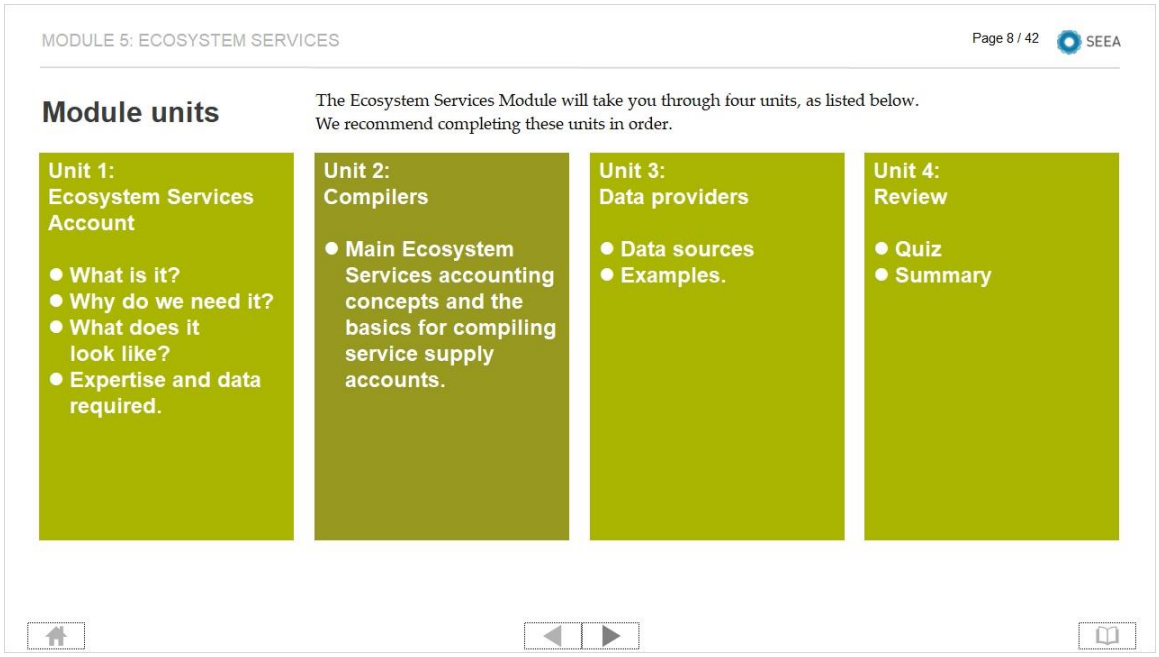
Click on the highlighted figures to learn more about the ecosystem types.

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

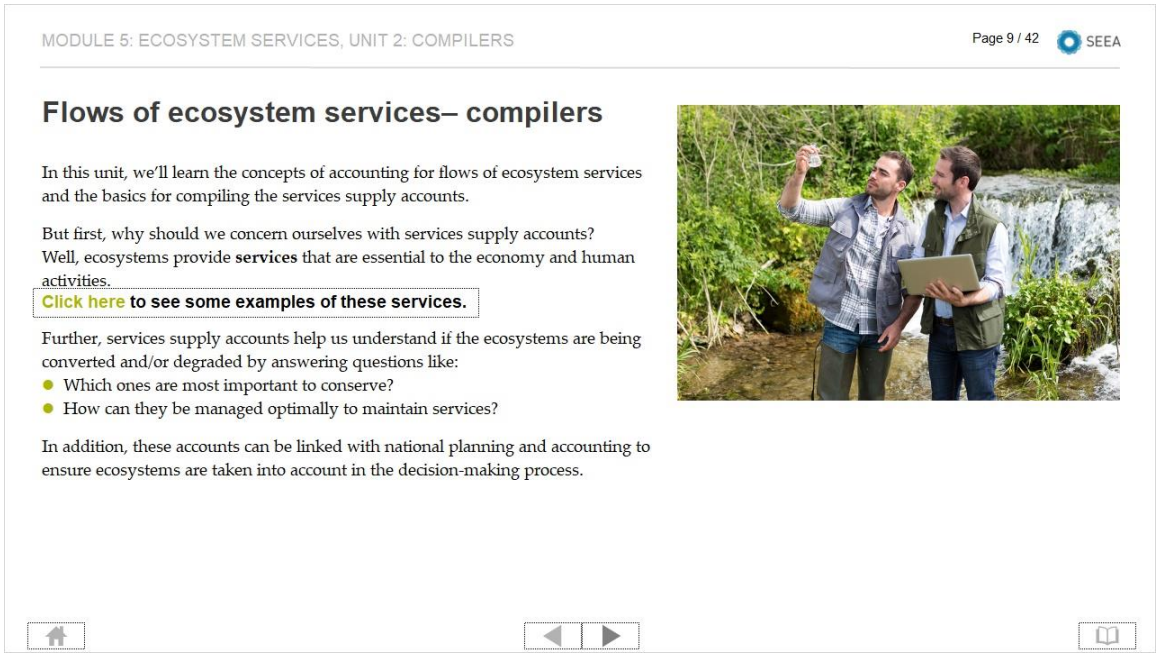
Explanation 1 (Slide Layer)



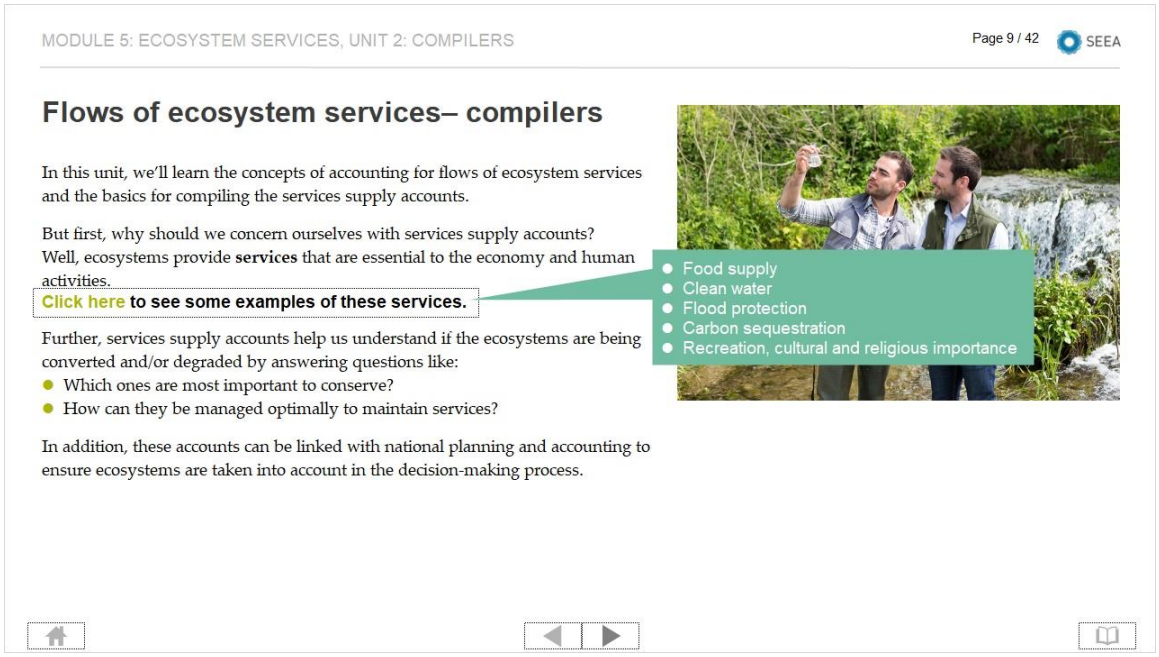
1.8 Module units



1.9 Unit 2



Explanation 1 (Slide Layer)



1.10 The Ecosystem Services Cascade

The ecosystem services cascade

People depend on ecosystems for food, clean water, flood protection, and much more. We generally think of ecosystems as separate from their services and the value we place on them. It's nice to have a forest near our home and to enjoy the wildlife. However, the forest is also important for flood protection, water purification, wild game, pollution regulation, carbon sequestration, wind regulation, etc.

Thus, the **ecosystem services cascade** is designed to analyze each ecosystem type in a way that enables us to understand, measure, and research their services.

After all, ecosystem services are how ecosystems contribute to benefits for people.

Let's move on and learn more about the ecosystem services cascade.

1.11 The Ecosystem Services Cascade

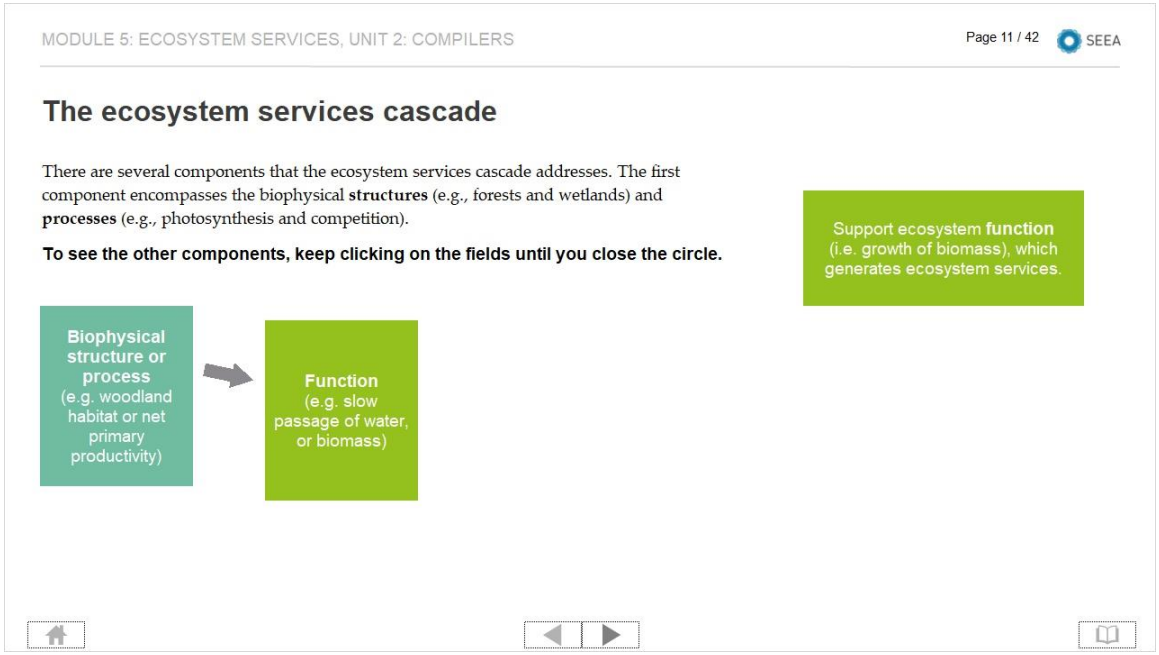
The ecosystem services cascade

There are several components that the ecosystem services cascade addresses. The first component encompasses the biophysical **structures** (e.g., forests and wetlands) and **processes** (e.g., photosynthesis and competition).

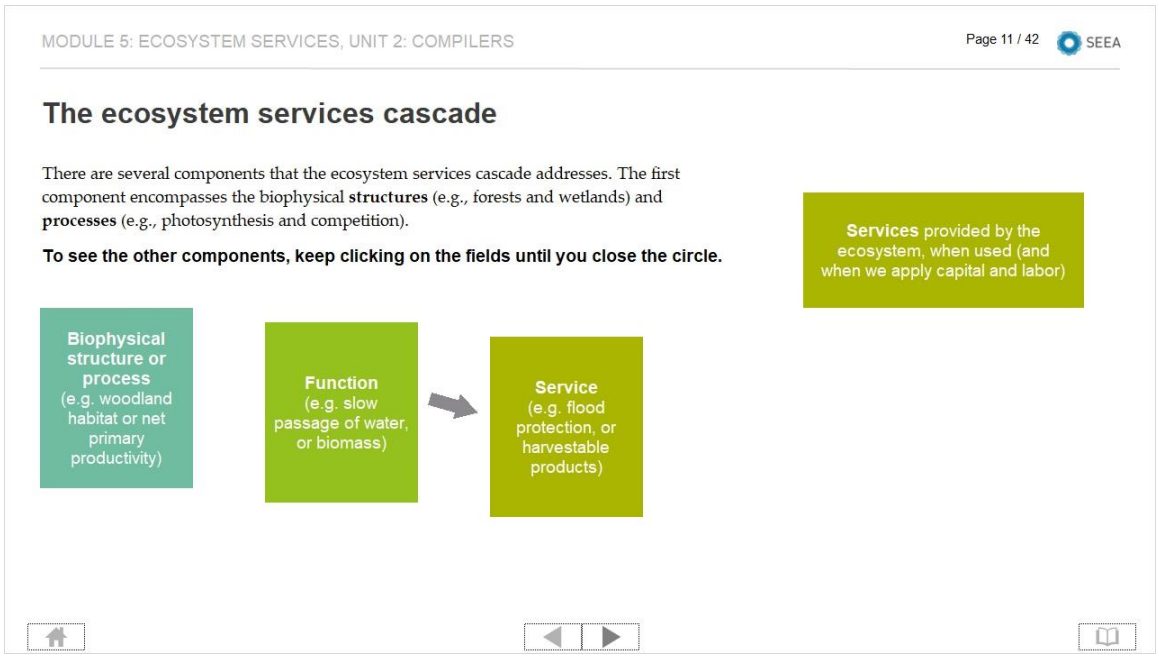
To see the other components, keep clicking on the fields until you close the circle.

Biophysical structure or process (e.g. woodland habitat or net primary productivity)

Function (Slide Layer)

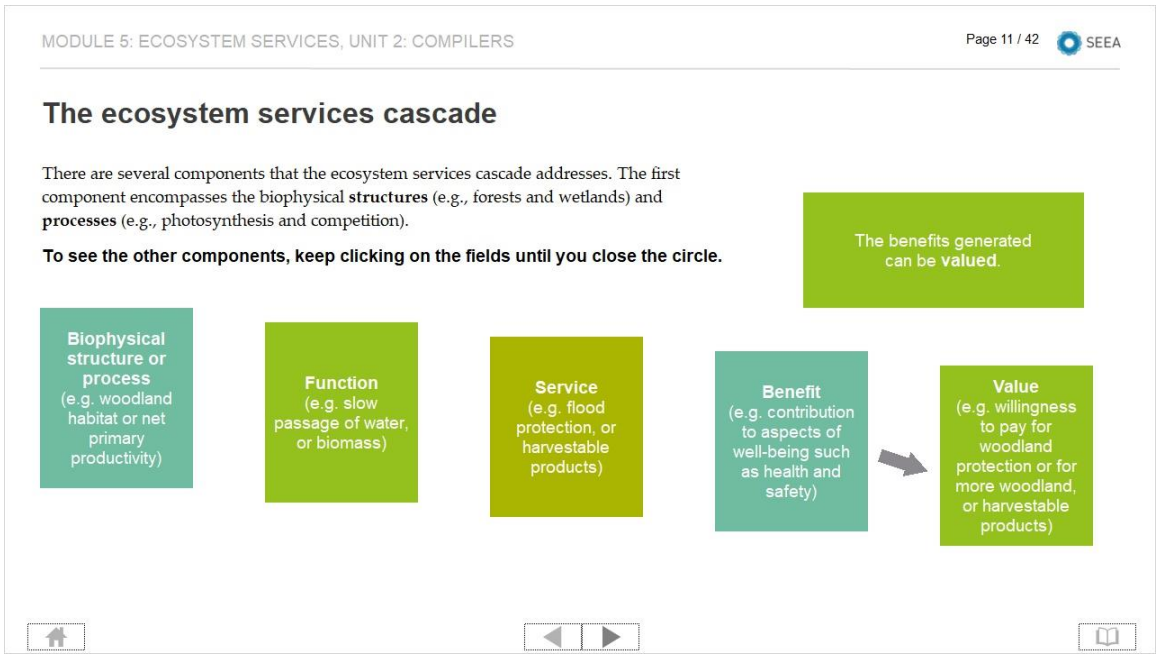


Service (Slide Layer)

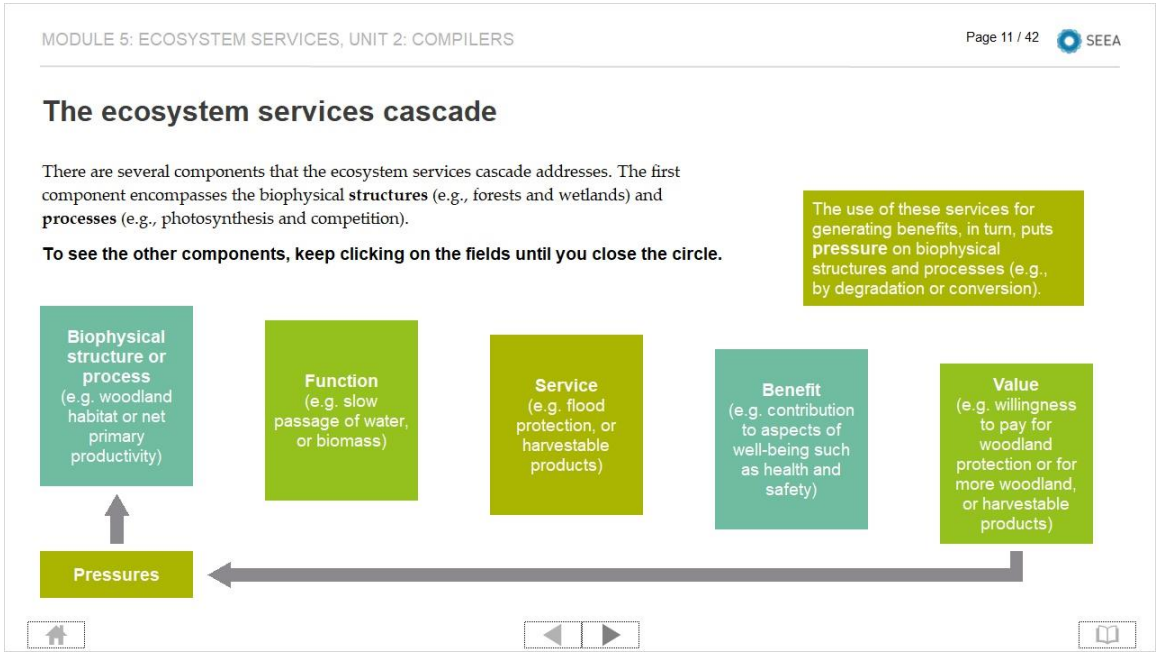


Benefit (Slide Layer)

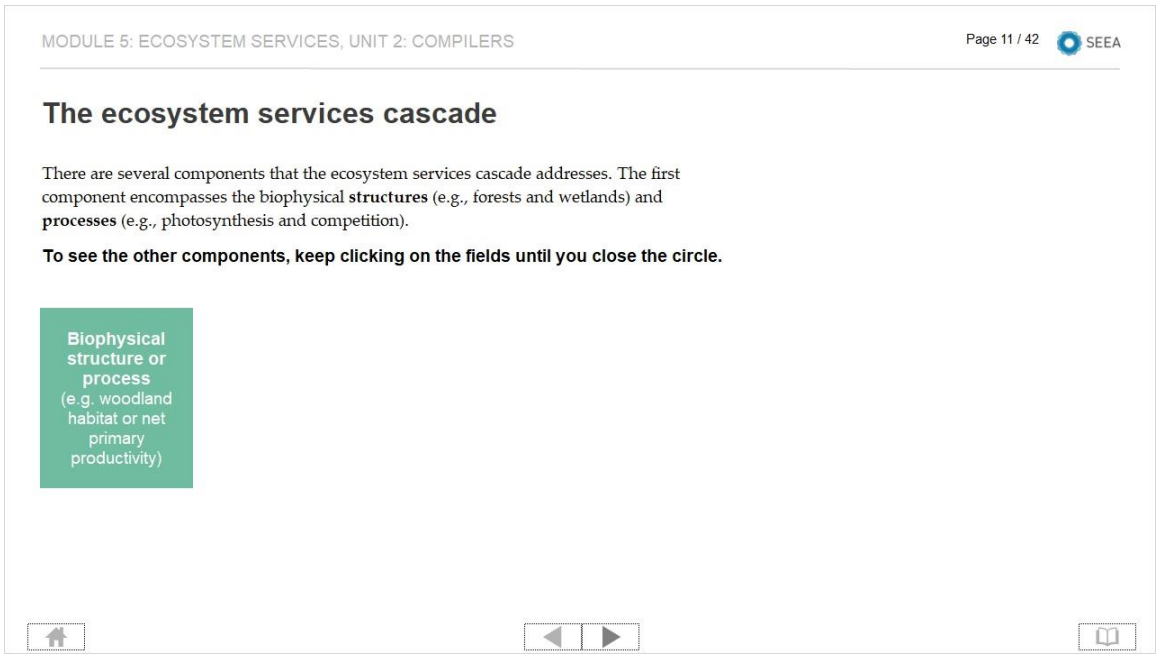
Value (Slide Layer)



Pressures (Slide Layer)



Kommentar ausblenden (Slide Layer)



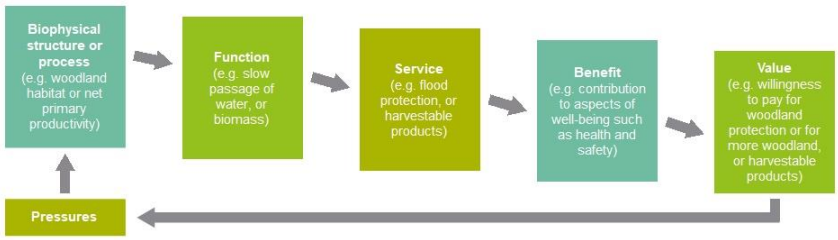
1.12 The Ecosystem Services Cascade

The ecosystem services cascade

Great! You have closed the ecosystem services cascade.

The components of the cascade are also often studied individually. For example, ecologists focus on processes and functions. Ecological economists will use the ecological information to study the services provided by ecosystems. Economists and sociologists are more interested in the benefits and values we assign to the services. The cascade model is a format in which these sciences can converge.

One last point, the ecosystem services cascade also helps us separate out measurements and work with experts in different areas of science and policy.



Source: Adapted from Haines-Young and Potschin, 2010.

1.13 Ecosystem Services

Ecosystem services

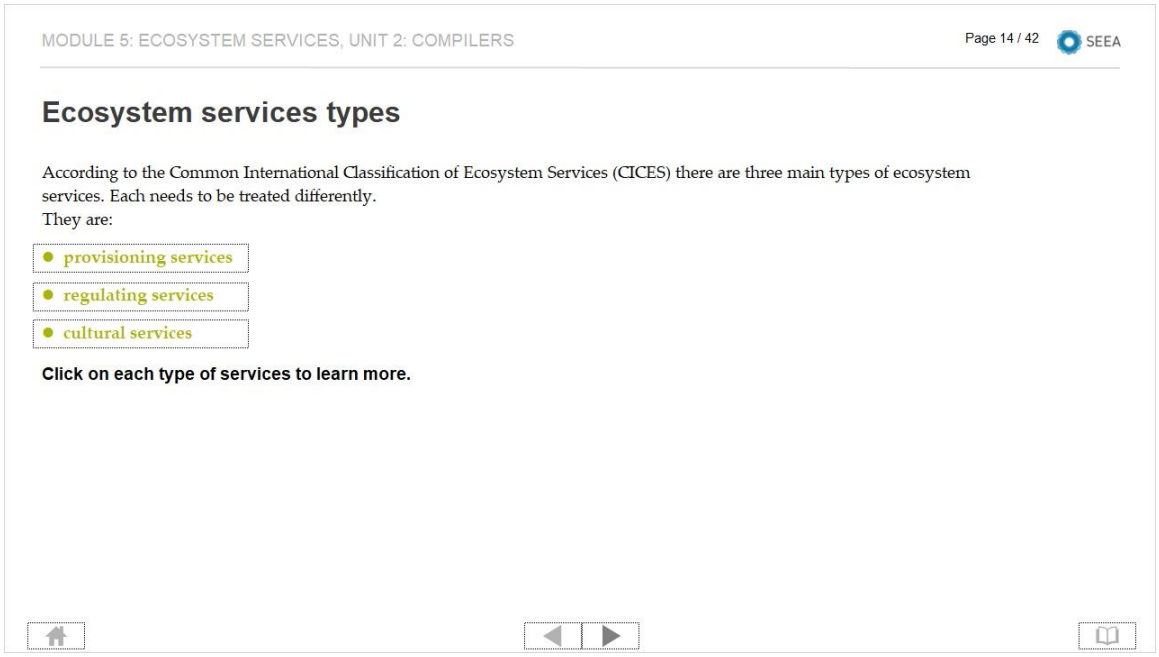
We pointed out earlier that ecosystem services are defined as contribution ecosystems provide to benefits for people. Ecosystem services are not to be equated with benefits, as is done in some other studies, as the generation of benefits usually requires also capital and labour.

So, how should we measure the ecosystem's contribution?

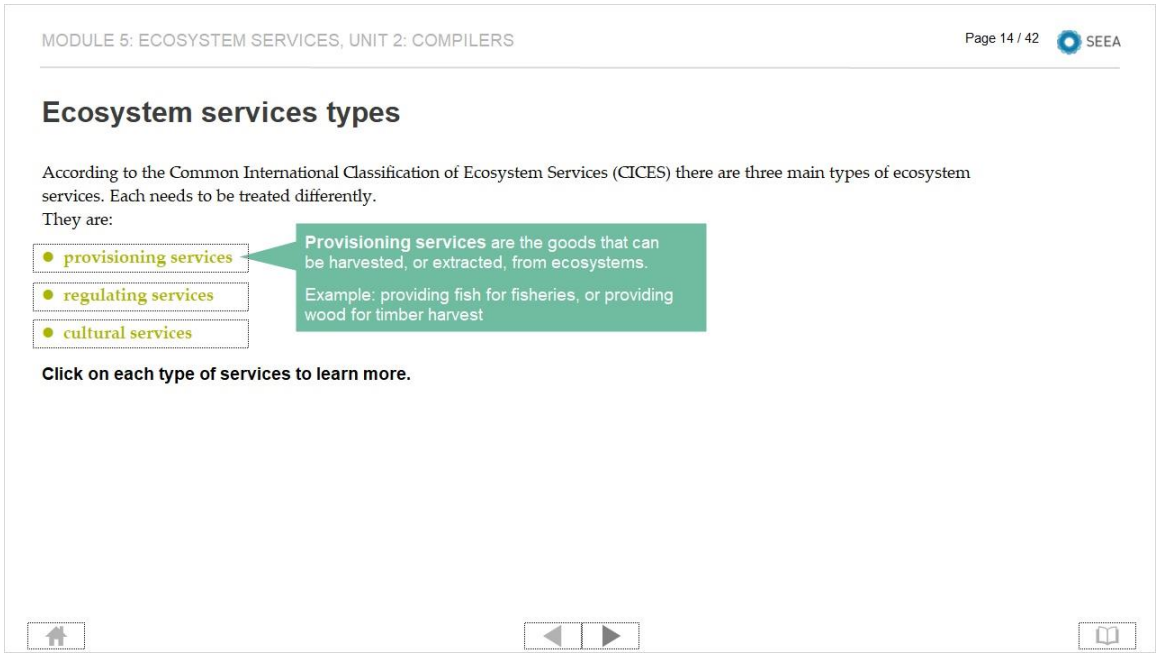
We need to calculate all the contributions from ecosystems, for example: **the crops = contributions of nature, equipment, inputs, labour, energy, etc.** As part of its contributions, nature provides biomass growth, nutrients, water, flood control, and pollination. Without these, there would be no crops.

In the services supply account, we **measure** the **physical services** (e.g., the addition to biomass of the crop) as this is our goal in this module.

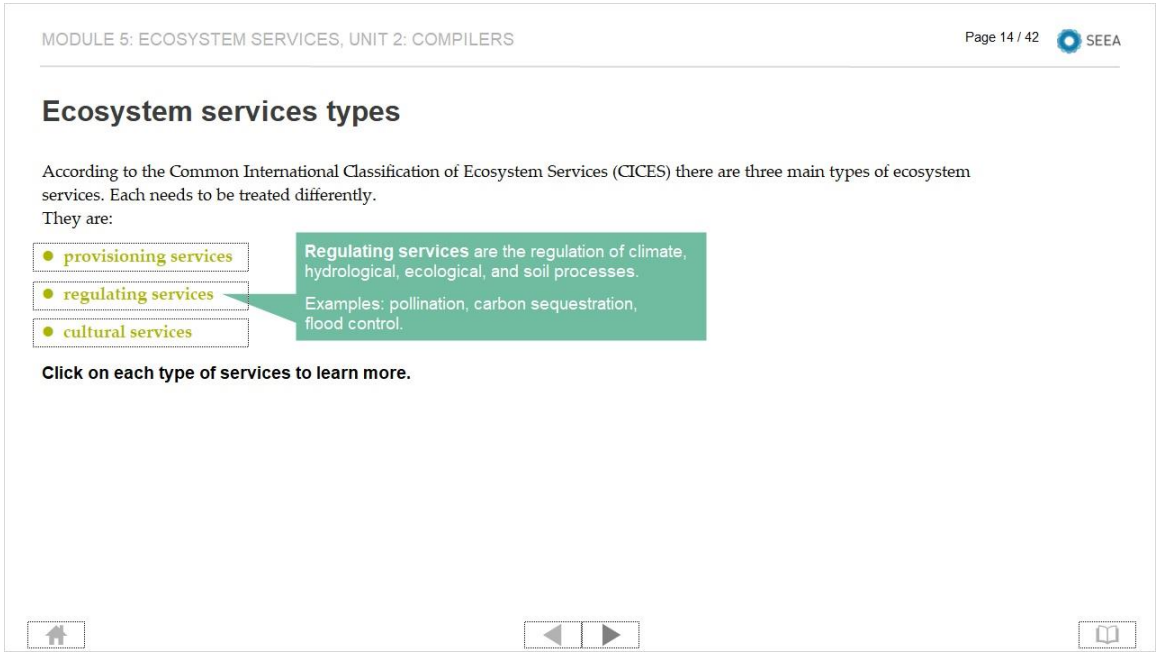
1.14 Ecosystem Services Types



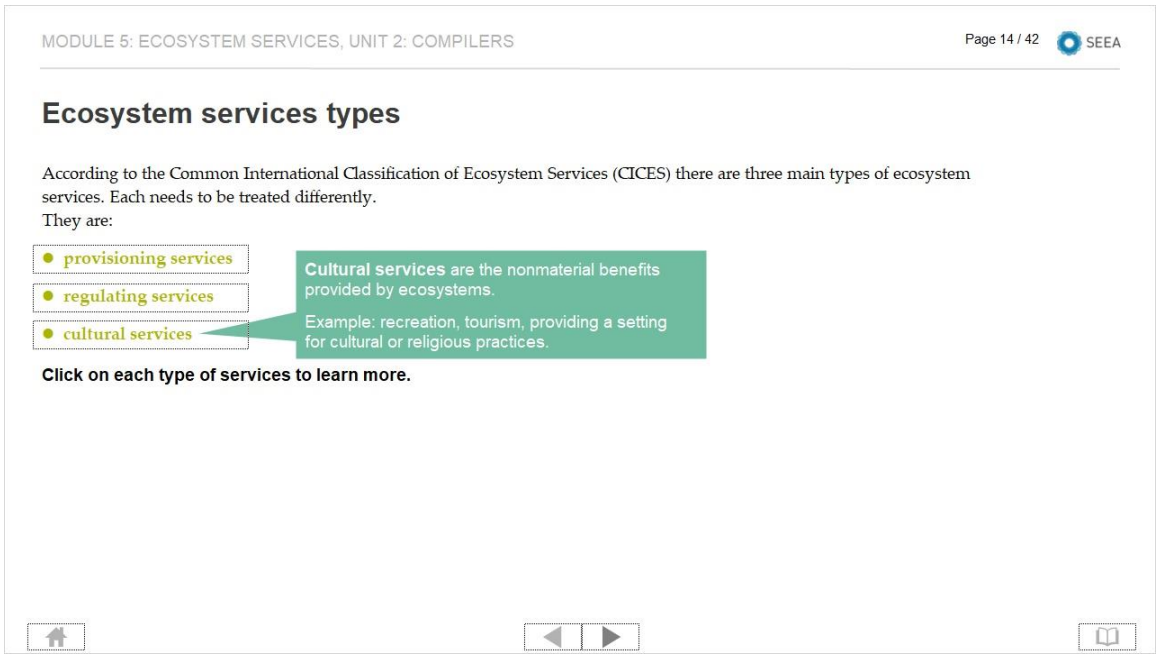
Explanation 1 (Slide Layer)



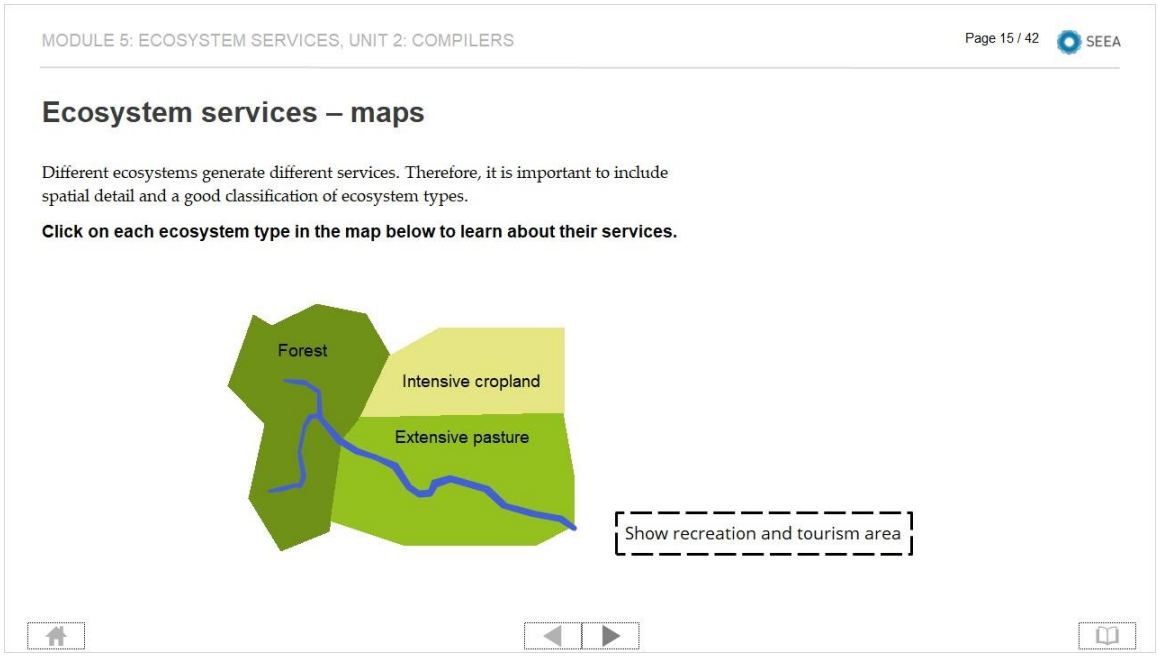
Explanation 2 (Slide Layer)



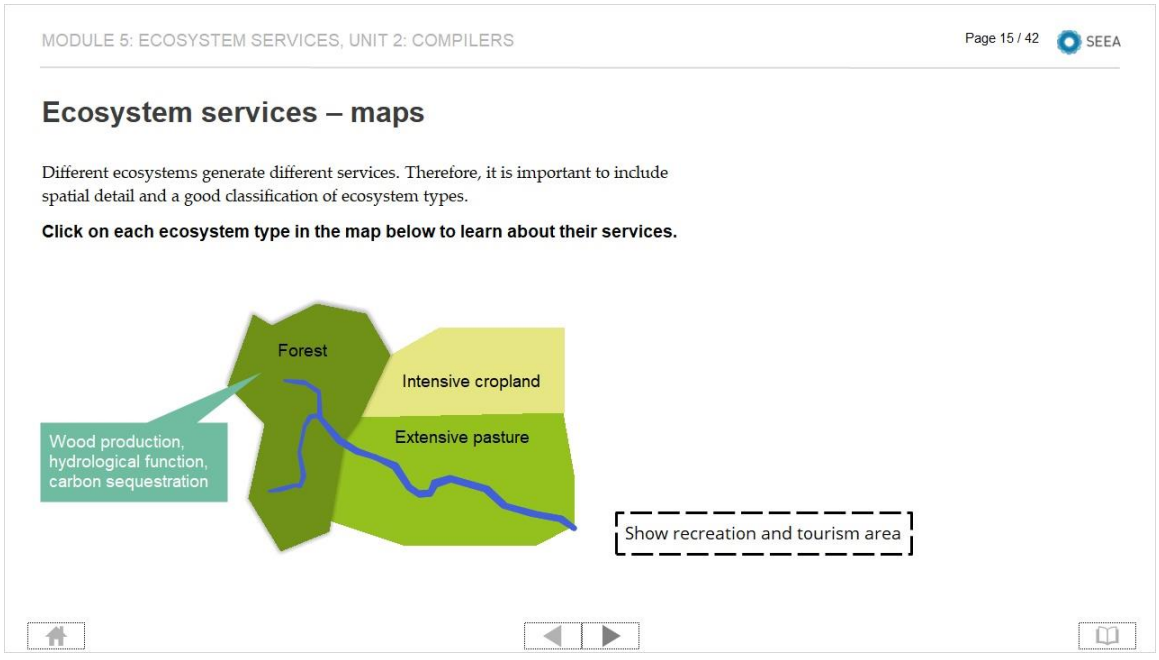
Explanation 3 (Slide Layer)



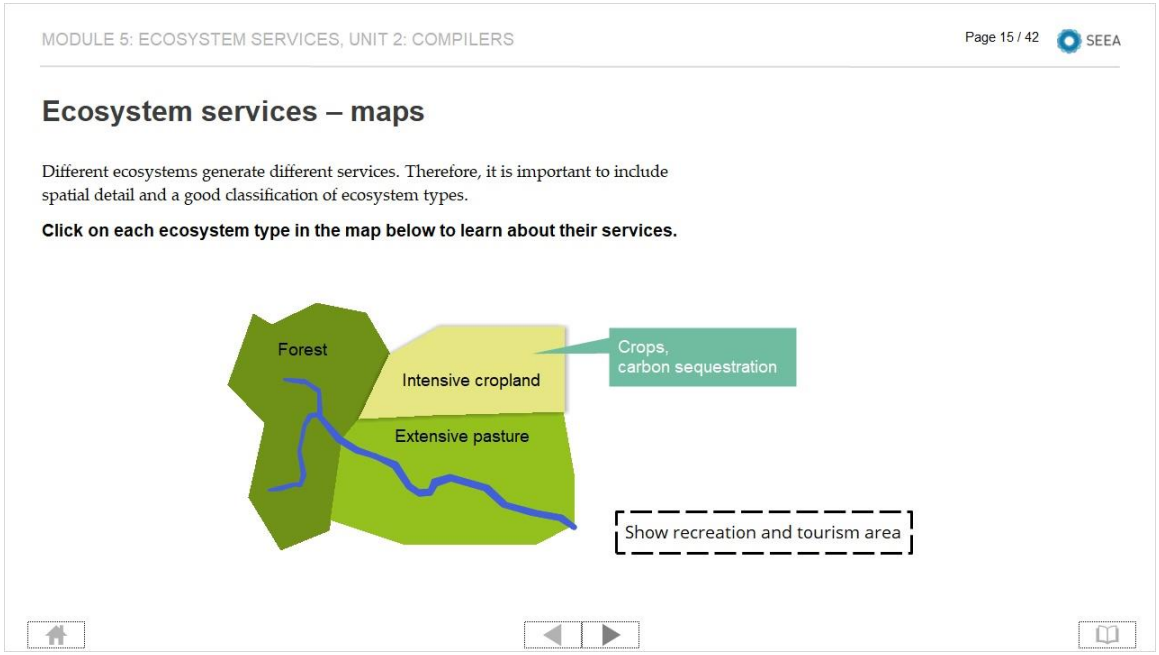
1.15 Ecosystem Services - Maps



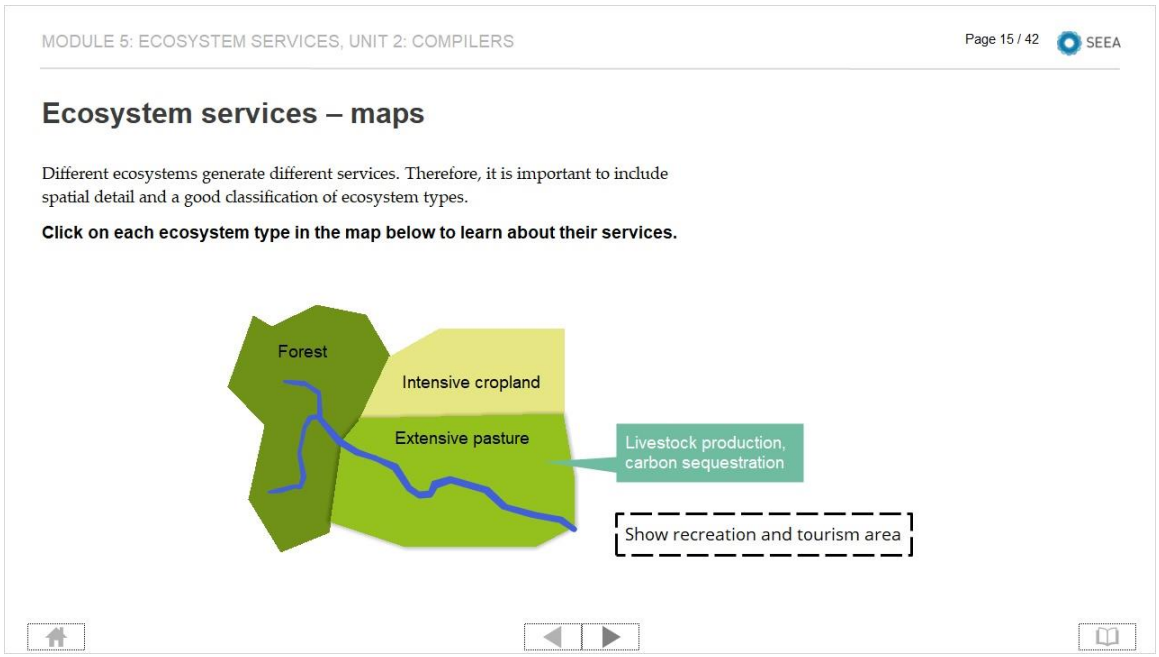
Explanation 1 (Slide Layer)



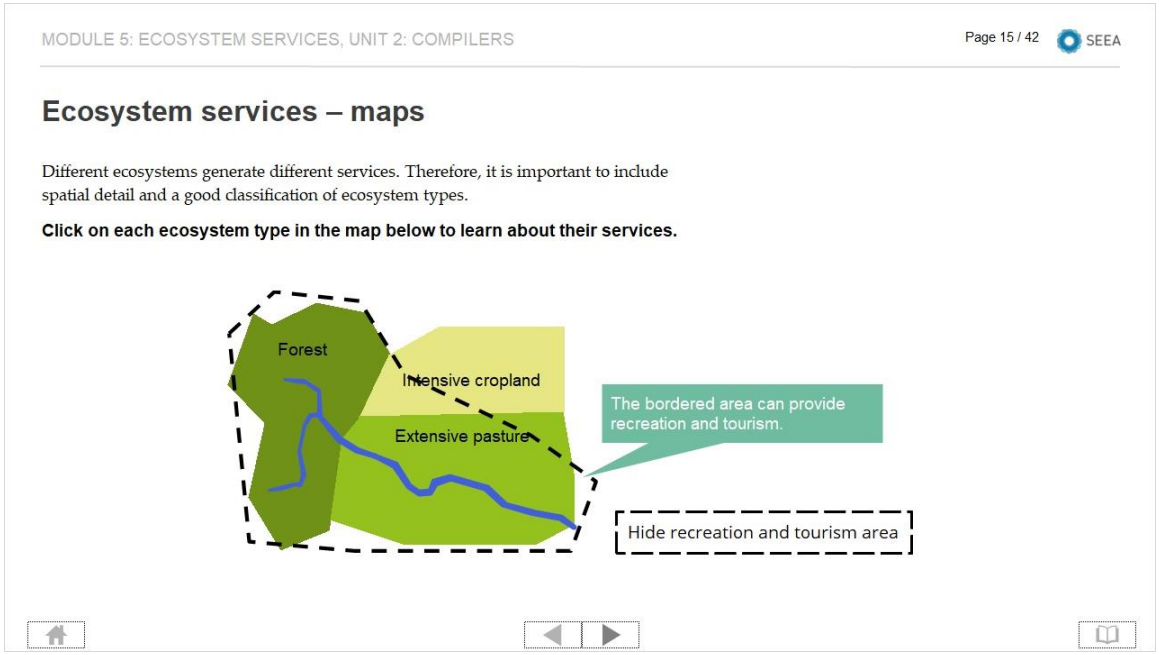
Explanation 2 (Slide Layer)



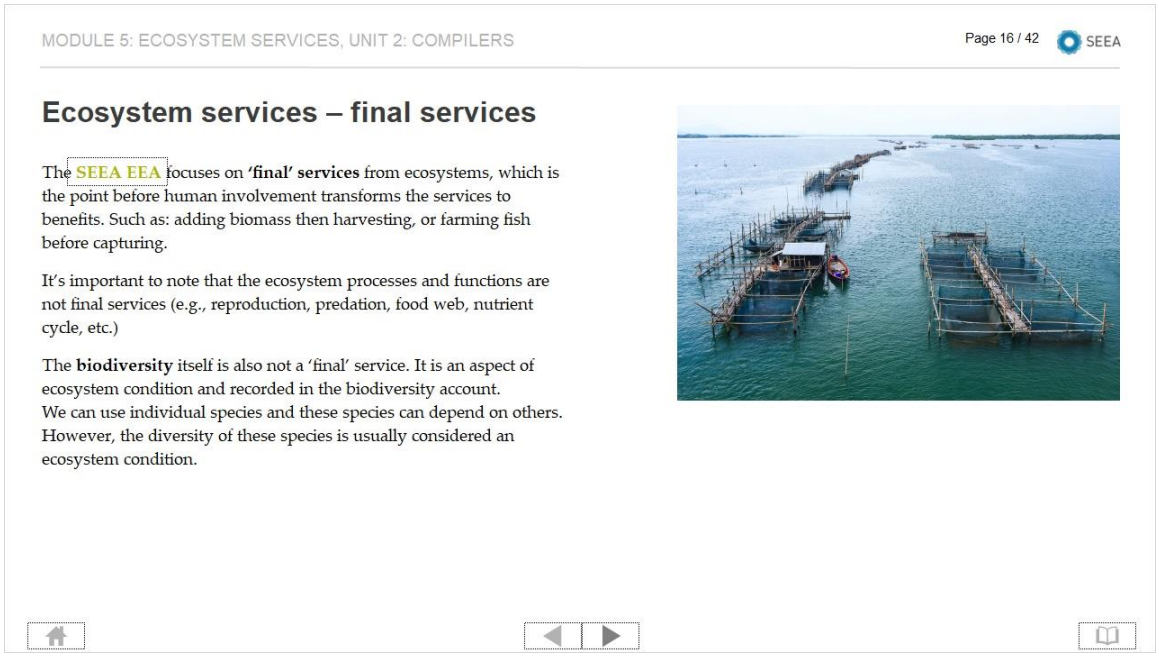
Explanation 3 (Slide Layer)



Explanation 4 (Slide Layer)



1.16 Ecosystem Services - Final Services



1.17 Ecosystem Services - Classifications

Ecosystem services – classifications

Ecosystem services can be classified based on different classification systems. The three most commonly used classifications for ecosystem accounting are:

- **Common International Classification of Ecosystem Services (CICES)**
  - Developed by the European Environment Agency
  - 'Multi-purpose classification' of potential final ecosystem services for accounting and assessment. Hierarchical, developed on basis of MA ESS categories.
- **Final Ecosystem Goods and Services Classification System (FEGS-CS)**
  - Developed by the US Environmental Protection Agency
  - Classification system focused on final ecosystem goods and services (FEGS) for measuring stocks. Explicitly links ecosystem services to an environmental type and a defined beneficiary.
- **National Ecosystem Services Classification System (NESCS)**
  - Developed by the US Environmental Protection Agency
  - Classifies the flows of final ecosystem services from environmental types to economic uses and users.

1.18 Ecosystem Services - Classifications

Ecosystem services – measures

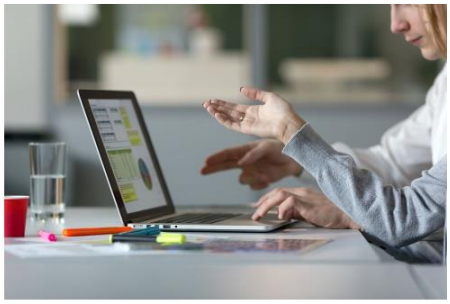
There are different methods for measuring ecosystem services.

We can measure the services directly through surveys or field studies (e.g., socio-economic survey on recreational use, field survey of available fish)

Or, we can use biophysical modelling with:

- **Lookup tables:** Take values from another location
- **Statistical approaches:** Estimate based on known explanatory variables
- **Geostatistical interpolation:** Estimate from known locations nearby
- **Process-based modelling:** use of models such as Invest, Aries, or SWAT, to model individual services based on a range of spatially explicit data sources

In the next few slides, we will go through an exercise to compile the services supply account.



1.19 Services Supply Account Exercise

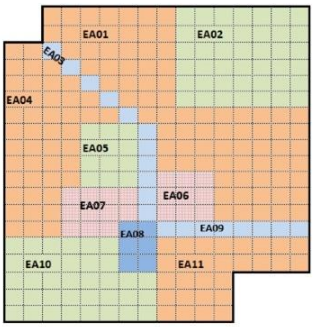
Services supply account exercise

Let's go further into compiling a **services supply account** by using the services supply data as shown in the table below. The table contains information about the different ecosystems types in each Ecosystem Accounting Area (EAA). A map of the various ecosystem assets is shown to the right.

The main goal of this exercise is to calculate missing services, calculate totals, and discuss the results as highlighted in yellow.

Services Supply Database

EU	Extent (ha)	(C) Crop tonnes/year	(R) Recreation trips/year	(W) Water m3/year	(S) Carbon Sequestration tonnes /ha/year	tonnes /year
EA01 = Herbaceous crops	500.0	18,700.0	500.0	600.0	20	
EA02 = Tree covered areas	262.5	0.0	1,500.0	500.0	30	
EA03 = Inland water bodies	68.8	0.0	1,600.0	15,000.0	5	
EA04 = Herbaceous crops	281.3				20	
EA05 = Tree covered areas	75.0				30	
EA06 = Artificial surfaces (urban)	56.3	0.0	500.0	500.0	0	
EA07 = Artificial surfaces (urban)	68.8	0.0	700.0	400.0	0	
EA08 = Shrubs..regularly flooded (wetland)	37.5	700.0	5,000.0	10,000.0	40	
EA09 = Inland water bodies	50.0				5	
EA10 = Tree covered areas	225.0				30	
EA11 = Herbaceous crops	175.0				20	
Total	**1,800.0**					



1.20 Services Supply Account Exercise

Services supply account exercise

The first step is to calculate the missing services values (i.e., crop, recreation, and water) for the different ecosystem assets (EAs) **4, 5, 9, 10** and **11**.
The unknown services values are calculated by using the values for the EAs of the **same ecosystem type (ET)**. Before doing the maths, check the examples below.

Click on the highlighted boxes to see two calculations examples.

Services Supply Database

EU	Extent (ha)	(C) Crop tonnes/year	(R) Recreation trips/year	(W) Water m3/year	(S) Carbon Sequestration tonnes /ha/year	tonnes /year
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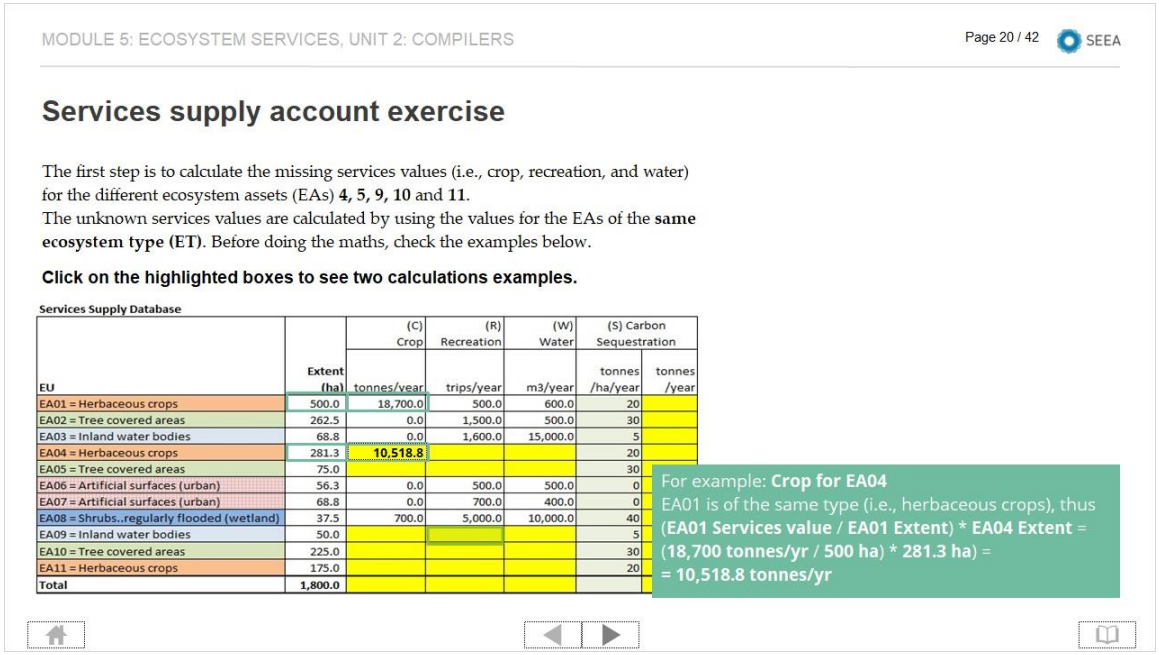
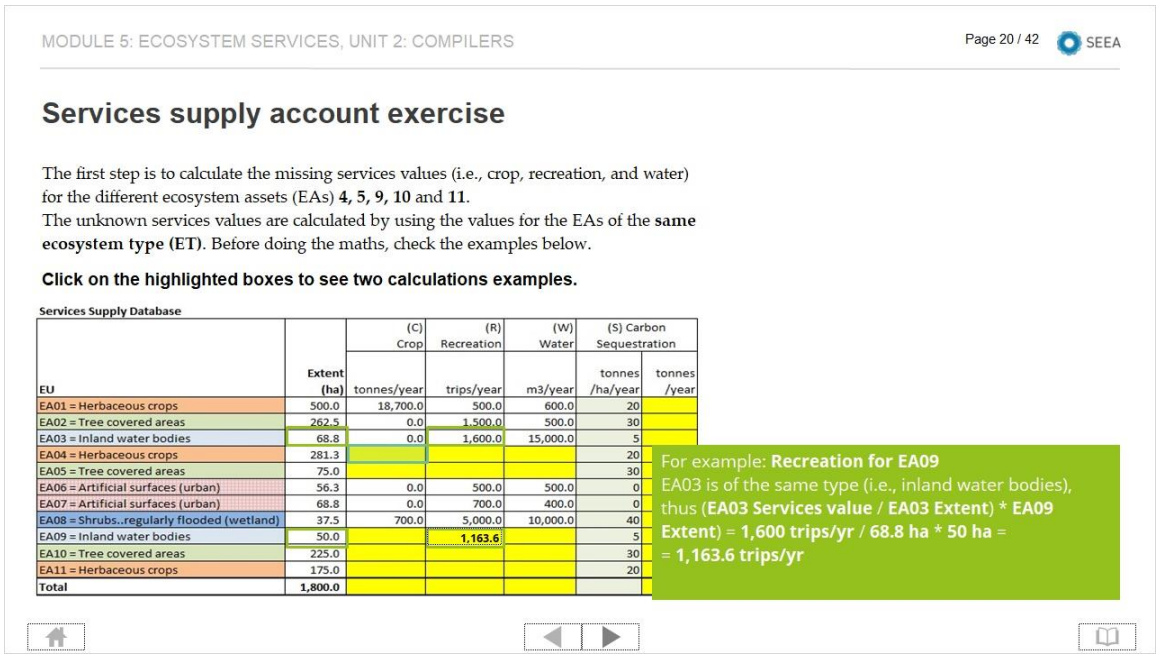
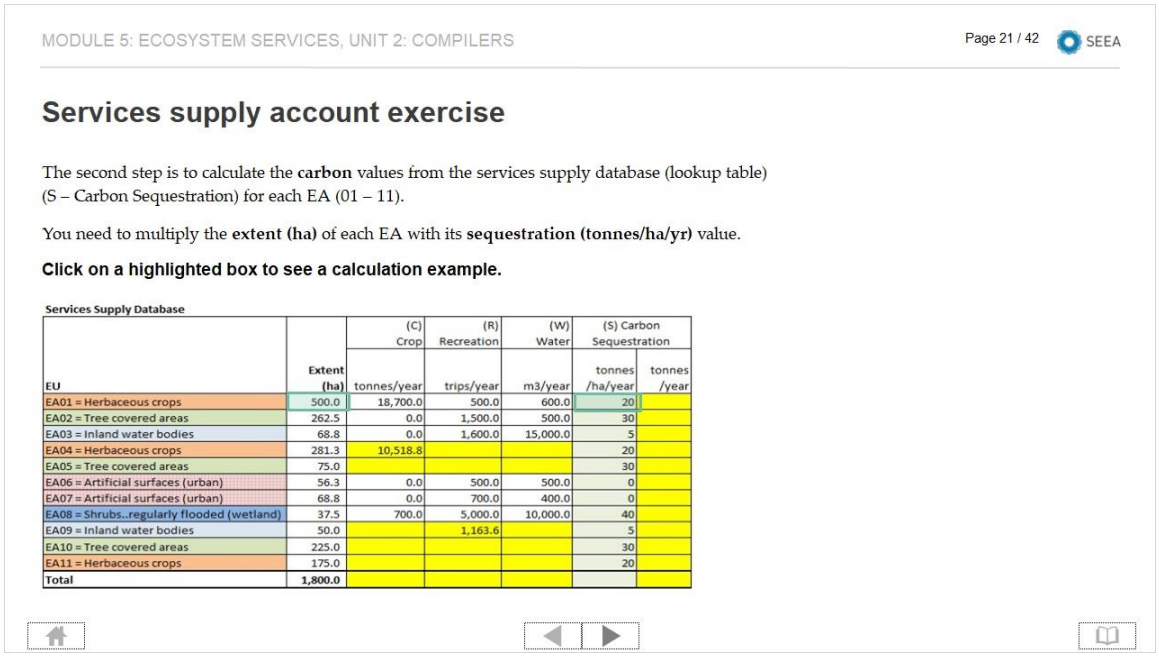
Example 1 (Slide Layer)



Example 2 (Slide Layer)



1.21 Services Supply Account Exercise



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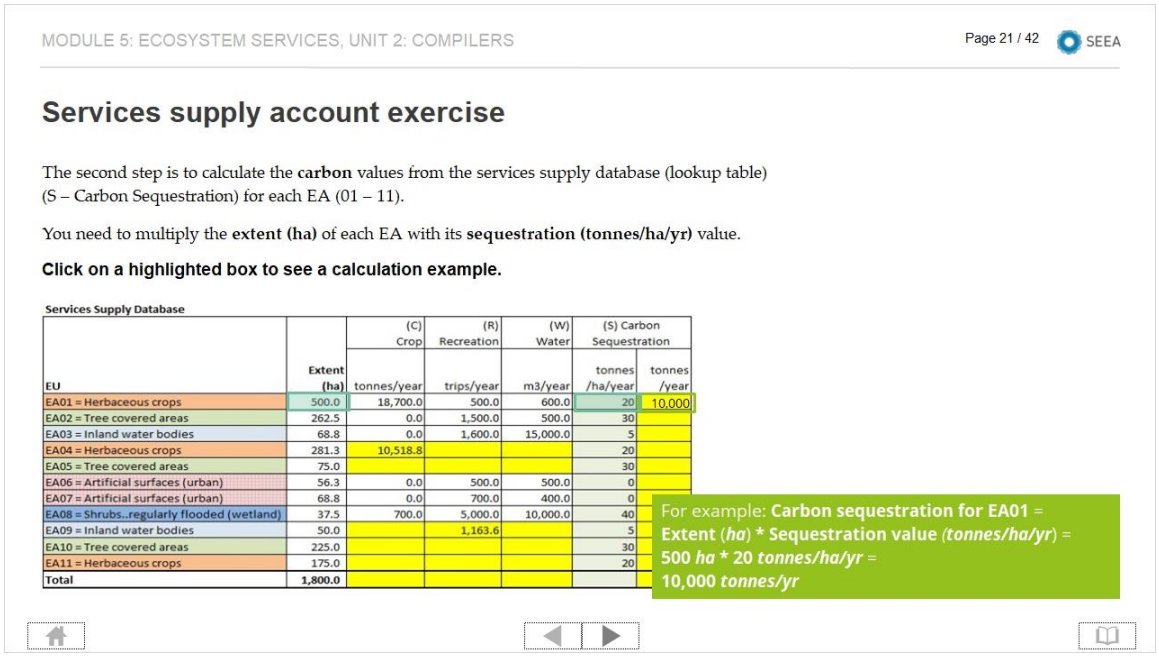

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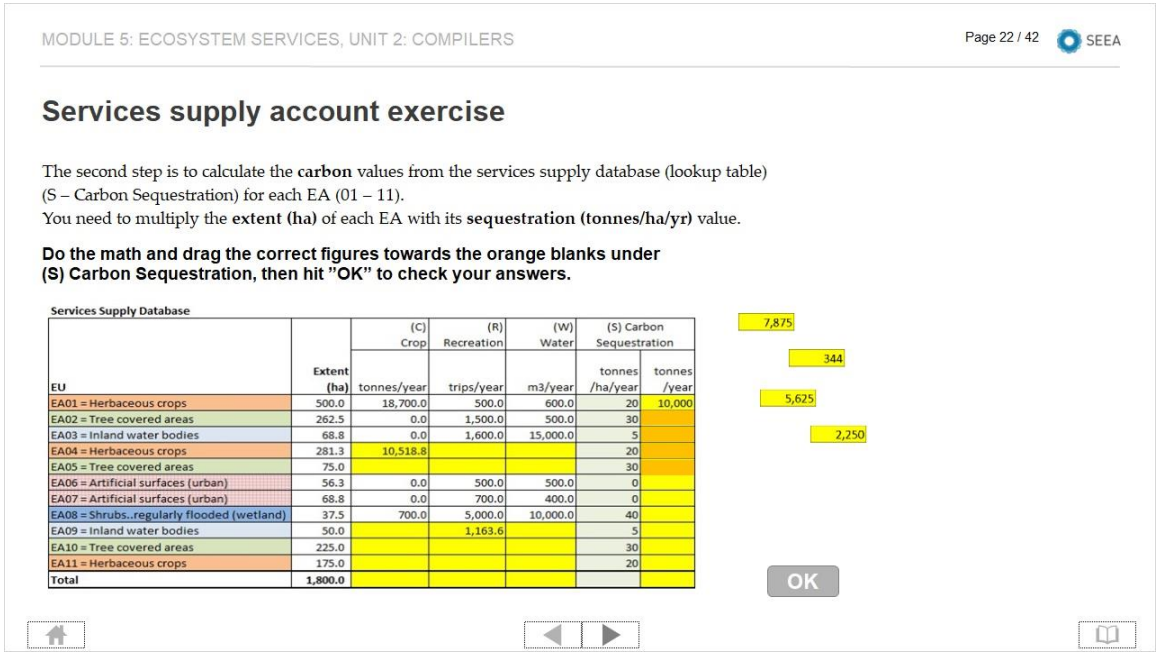
Total	1,800.0					

1.22 Services Supply Account Exercise

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



Drag Item	Drop Target
Picture 2	Rectangle 1
Picture 3	Rectangle 2
Picture 4	Rectangle 3
Picture 5	Rectangle 4

Drag and drop properties
Snap dropped items to drop target (Stack random)
Delay item drop states until interaction is submitted

Feedback when correct:

You’re doing great so far.

Keep going and move on to the totals in the next slides.

For EA02:

Extent (ha) * Sequestration value (tonnes/ha/yr) =

= 262.5 ha * 30 tonnes/ha/yr =

= 7,875 tonnes/yr

Feedback when incorrect:

Then keep going and move on to the

totals in the next slides.

For EA02:

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= 262.5 ha * 30 tonnes/ha/yr =

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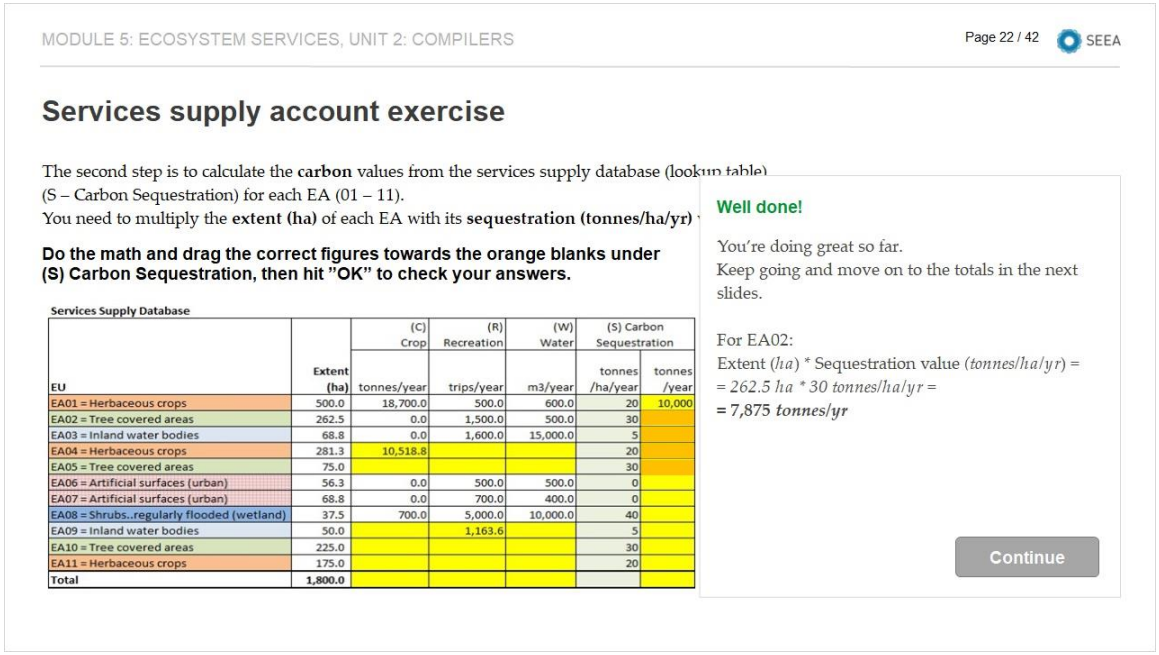
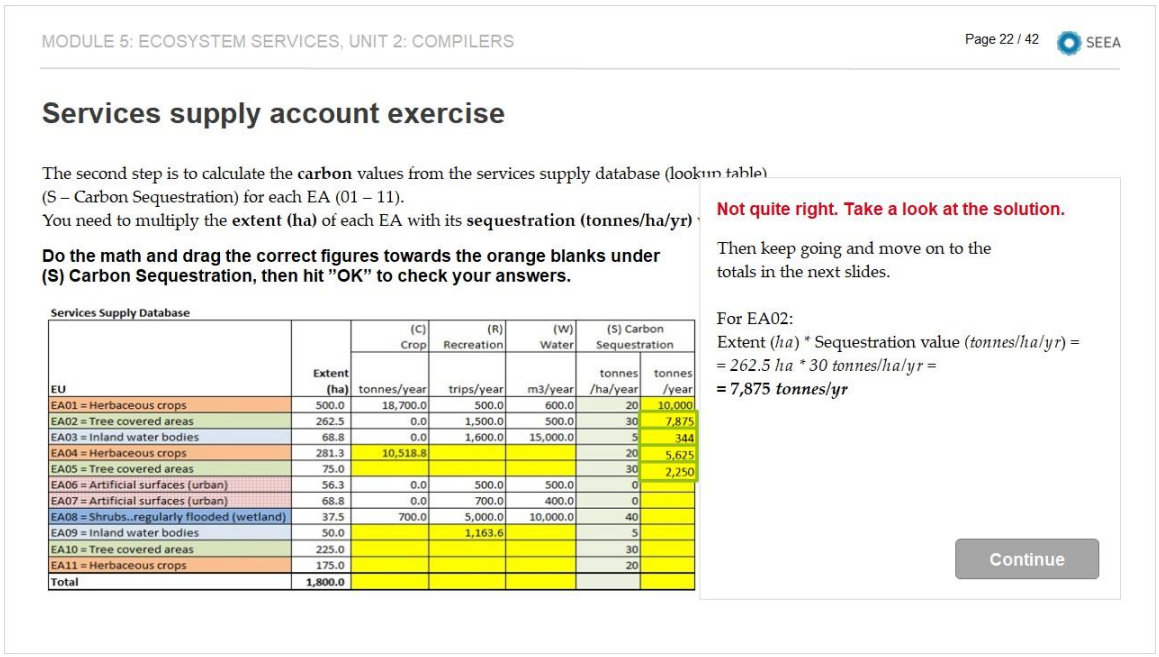
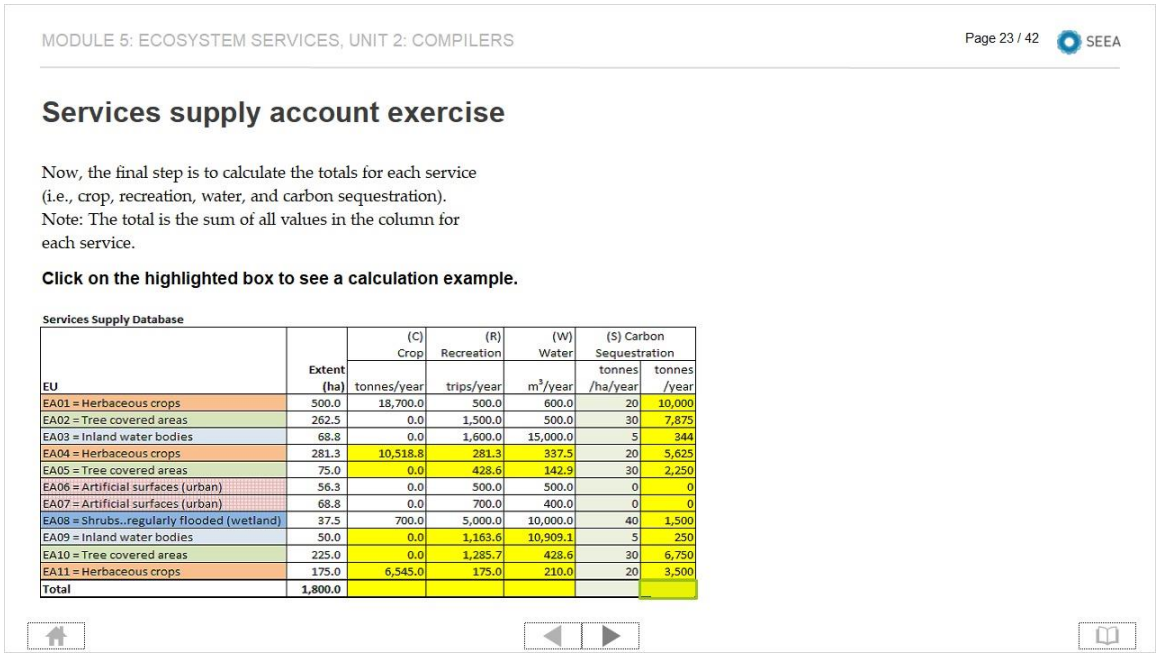
Correct (Slide Layer)



Incorrect (Slide Layer)

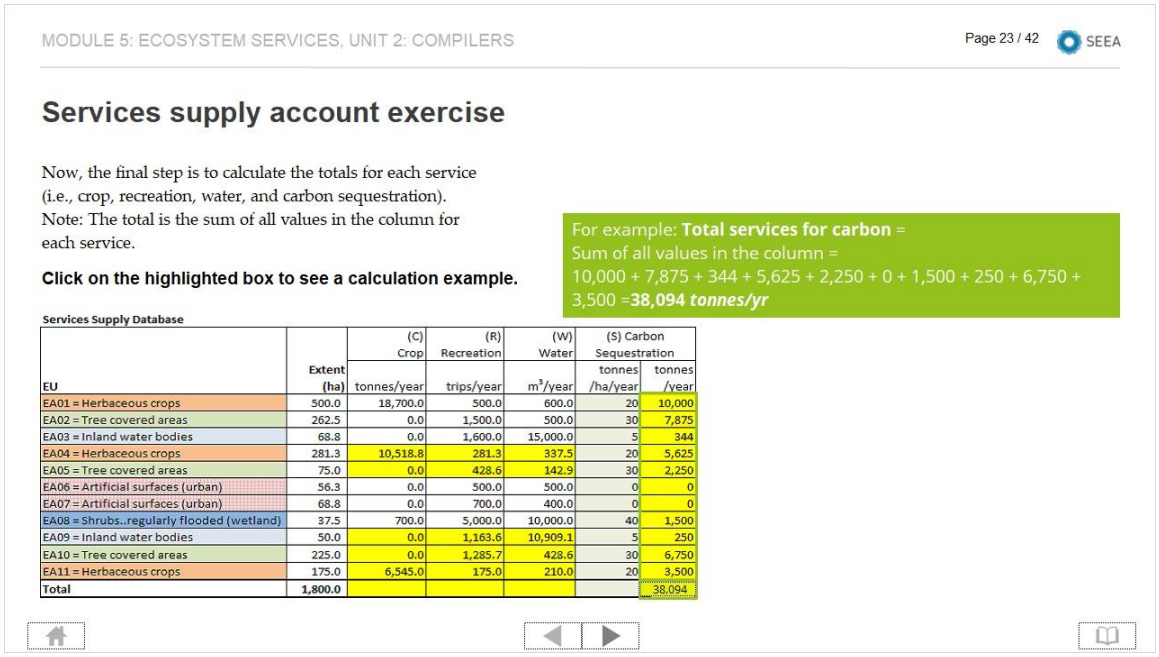


1.23 Services Supply Account Exercise



EU	Extent (ha)	(C) Crop tonnes/year	(R) Recreation trips/year	(W) Water m^3/year	(S) Carbon Sequestration tonnes /ha/year	(S) Carbon Sequestration tonnes /year
EA01 = Herbaceous crops	500.0	18,700.0	500.0	600.0	20	10,000
EA02 = Tree covered areas	262.5	0.0	1,500.0	500.0	30	7,875
EA03 = Inland water bodies	68.8	0.0	1,600.0	15,000.0	5	344
EA04 = Herbaceous crops	281.3	10,518.8	281.3	337.5	20	5,625
EA05 = Tree covered areas	75.0	0.0	428.6	142.9	30	2,250
EA06 = Artificial surfaces (urban)	56.3	0.0	500.0	500.0	0	0
EA07 = Artificial surfaces (urban)	68.8	0.0	700.0	400.0	0	0
EA08 = Shrubs..regularly flooded (wetland)	37.5	700.0	5,000.0	10,000.0	40	1,500
EA09 = Inland water bodies	50.0	0.0	1,163.6	10,909.1	5	250
EA10 = Tree covered areas	225.0	0.0	1,285.7	428.6	30	6,750
EA11 = Herbaceous crops	175.0	6,545.0	175.0	210.0	20	3,500
Total	**1,800.0**					

Example 1 (Slide Layer)



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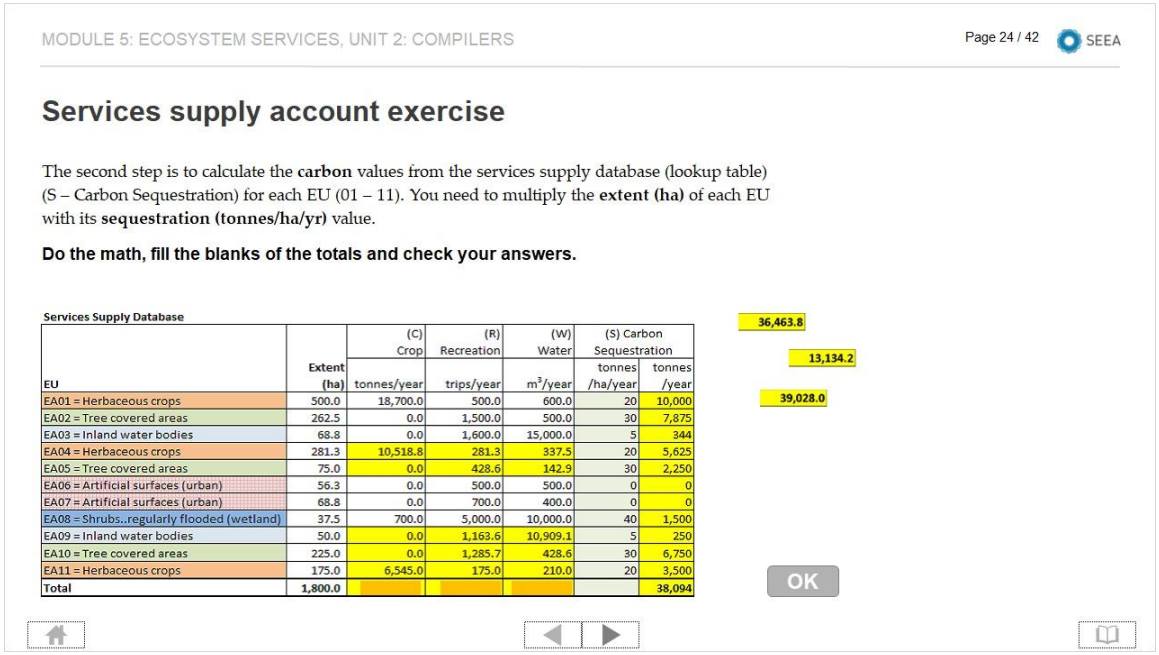
EA11 = Herbaceous crops	175.0	6,545.0	175.0	210.0	20	3,500
Total	**1,800.0**					38,094

1.24 Services Supply Account Exercise

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



MODULE 5: ECOSYSTEM SERVICES, UNIT 2: COMPILERS

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Services supply account exercise

The second step is to calculate the **carbon** values from the services supply database (lookup table) (S – Carbon Sequestration) for each EU (01 – 11). You need to multiply the **extent (ha)** of each EU with its **sequestration (tonnes/ha/yr)** value.

Do the math, fill the blanks of the totals and check your answers.

Services Supply Database

EU	Extent (ha)	(C) Crop tonnes/year	(R) Recreation trips/year	(W) Water m^3/year	(S) Carbon Sequestration tonnes /ha/year	(S) Carbon Sequestration tonnes /year
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Total	1,800.0					38,094

36,463.8

13,134.2

39,028.0

OK

Drag Item	Drop Target
Picture 2	Rectangle 1
Picture 3	Rectangle 2
Picture 4	Rectangle 3

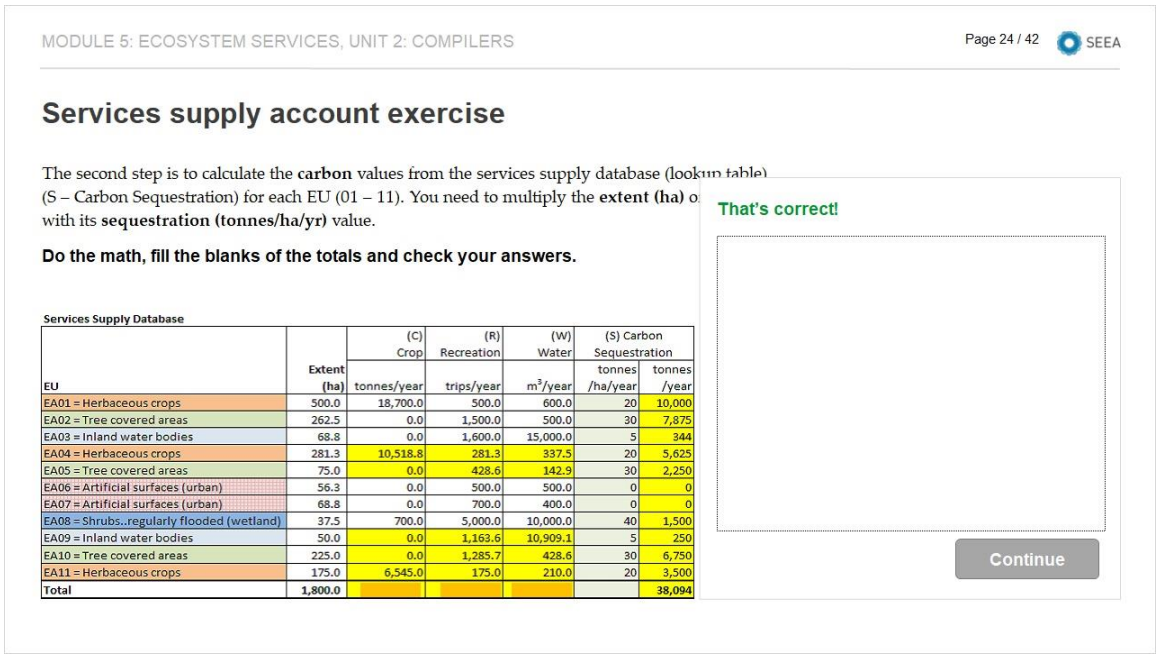
Drag and drop properties
Snap dropped items to drop target (Stack random)
Delay item drop states until interaction is submitted

Feedback when correct:

Feedback when incorrect:

Take a look at the solution.

Correct (Slide Layer)



Services Supply Database

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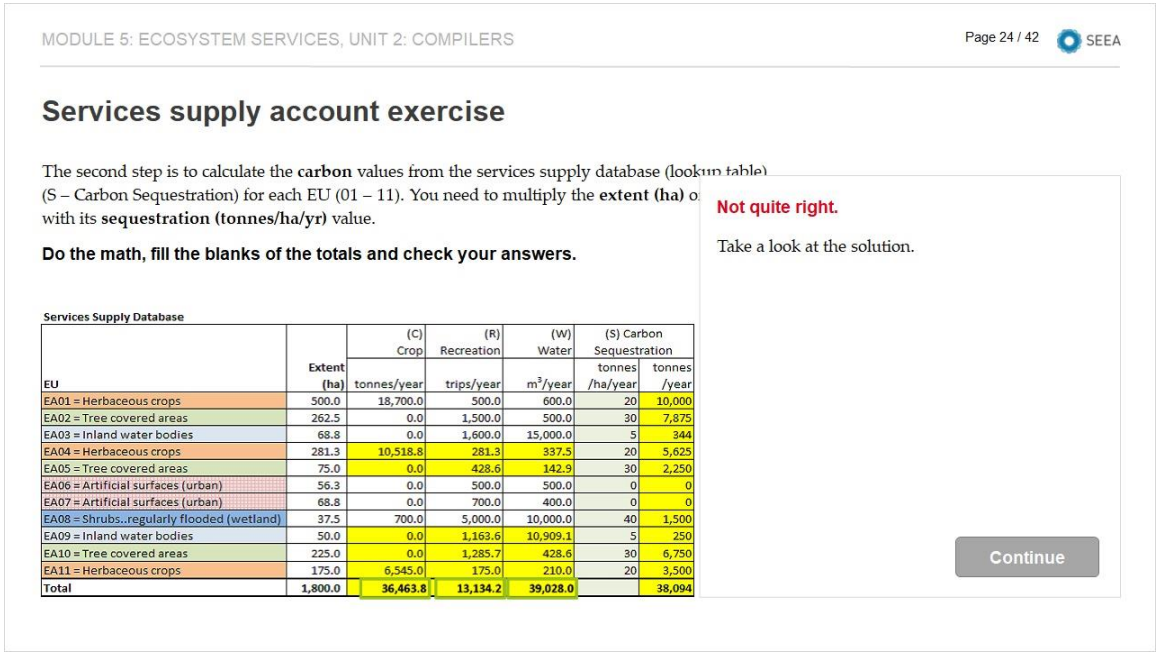

Services Supply Database

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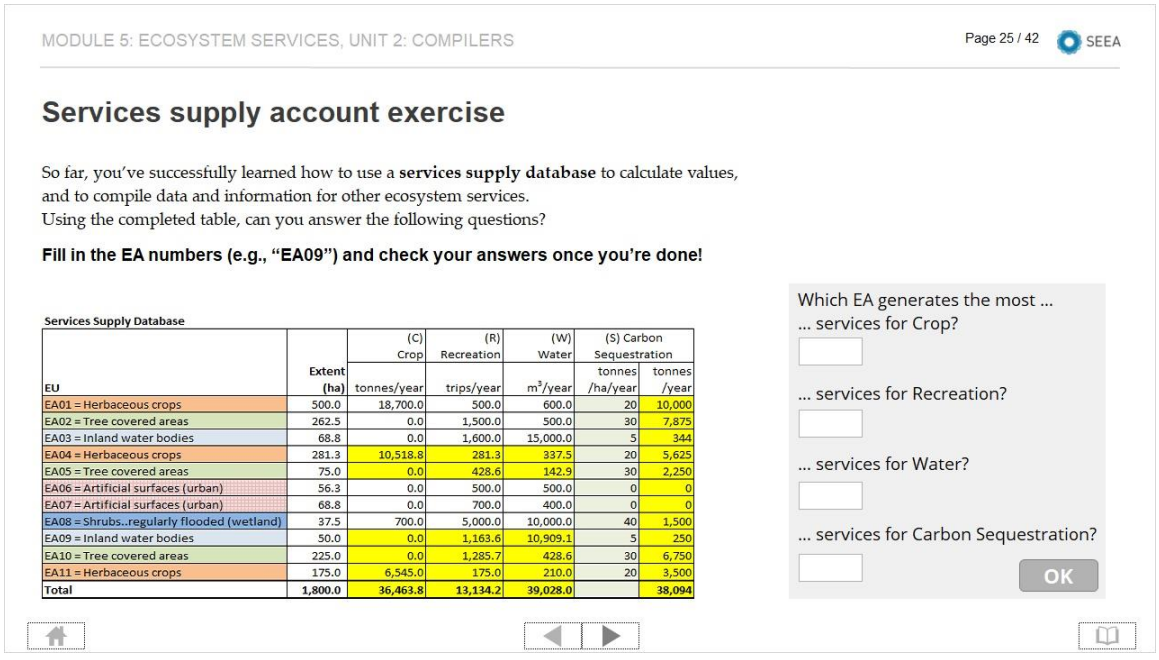
Total	1,800.0	36,463.8	13,134.2	39,028.0		38,094

1.25 Services Supply Account Exercise



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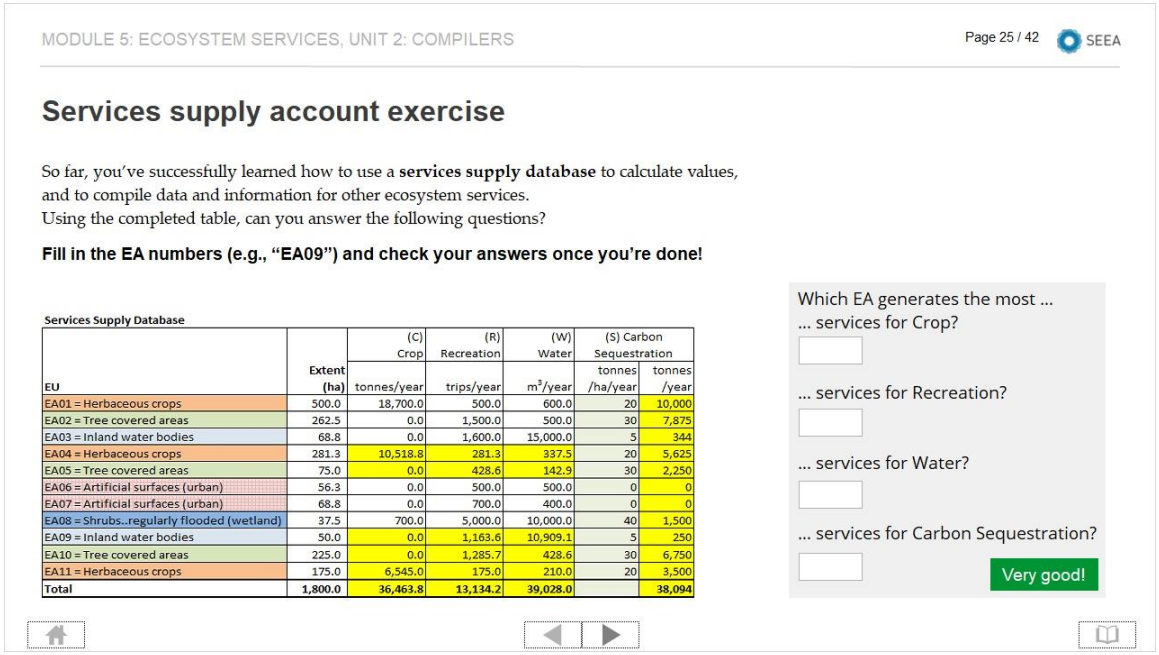

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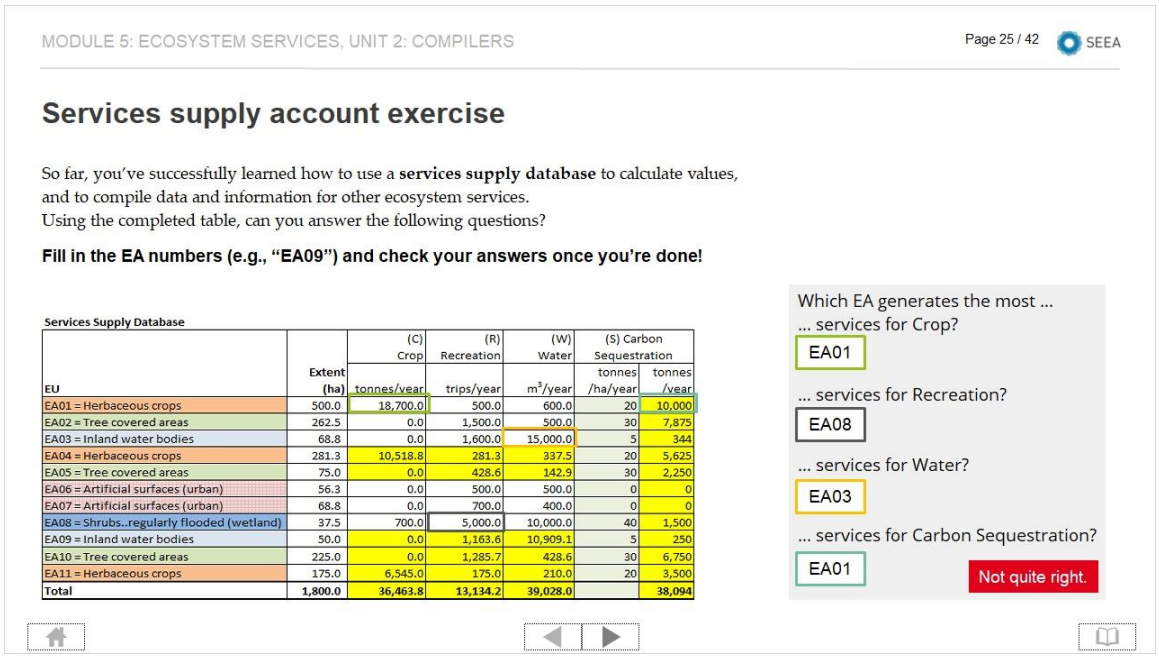
Incorrect (Slide Layer)



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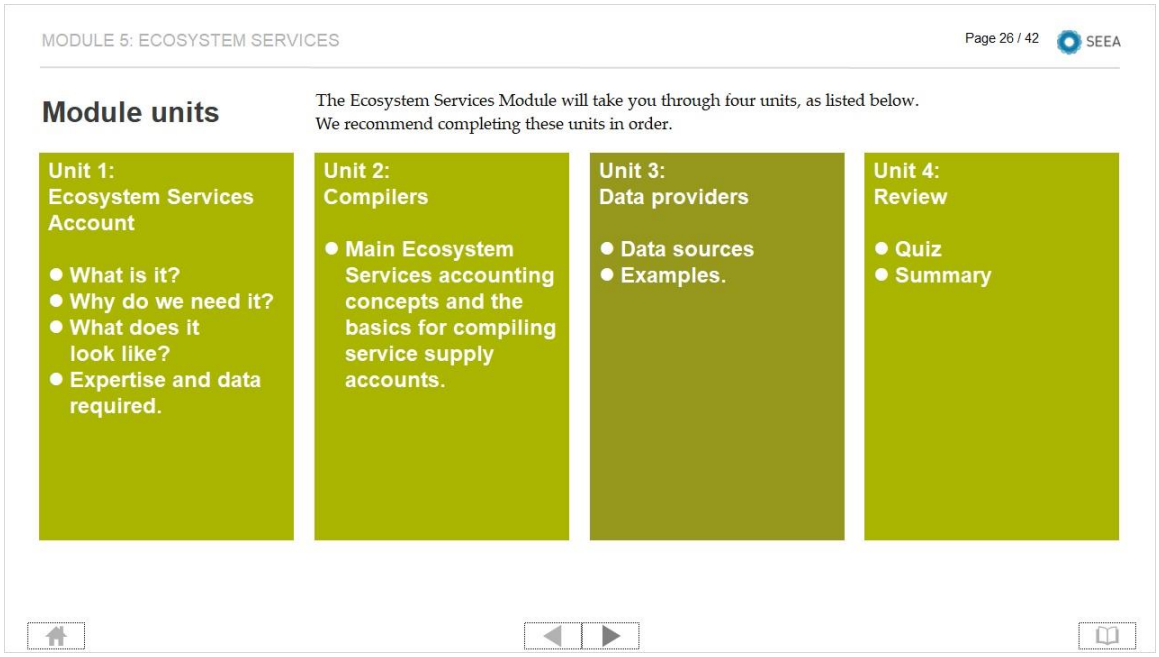
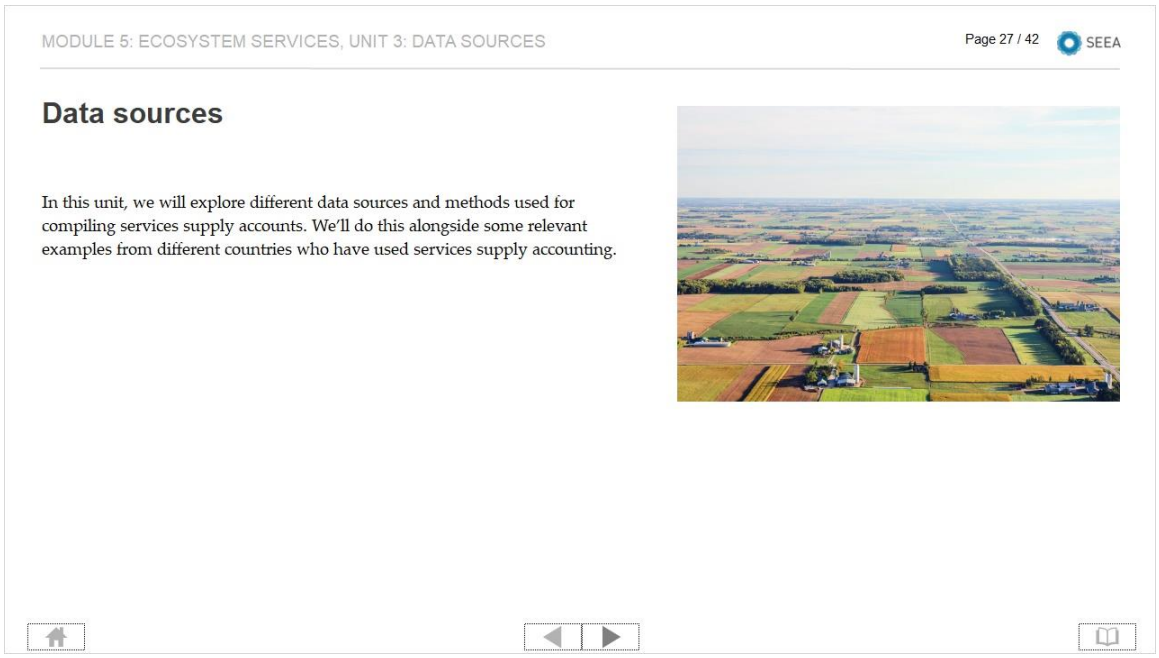
1.26 Module units



1.27 Unit 3



1.28 Data of Interest

Data of interest

Services Supply Account: You should be aware that a full **services supply account** is more complex than the simplified exercise that you practiced earlier.

The full services supply account will have to take into account:

- More services (48 "final" services in CICES)
- More types of data (tonnes, risks, visitors, air quality, cultural significance, etc.)
- Less frequently measured data that require models to estimate figures
- High variability among ecosystem types and region (e.g., salt marsh carbon = 650 to 1750 t CO_2/ha/year)

It can be good to **not include** all ecosystem services, but you should consider those high priority services to figure out whether you need measurements or estimates.

1.29 Ecosystem Services Accounting Example

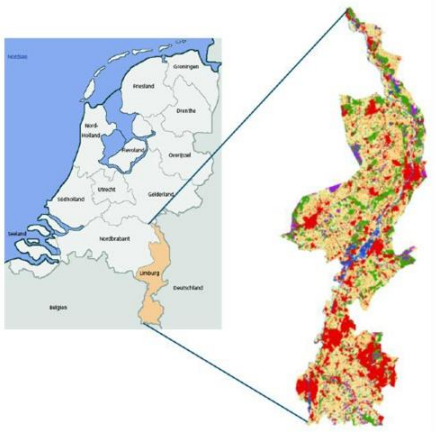
Ecosystem services accounting example

Netherlands Example

The ecosystem service account study was developed for the Limburg province in the Netherlands. It analysed seven ecosystem services. The study area is 2,200 km², and there are 1.1 million inhabitants.

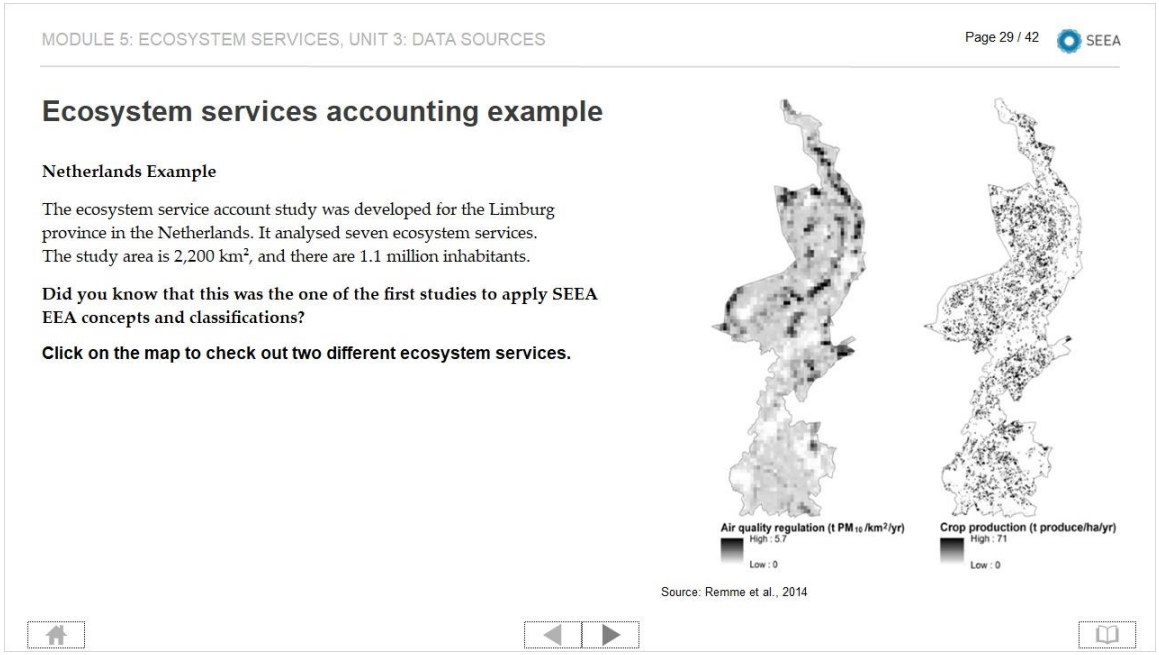
Did you know that this was the one of the first studies to apply SEEA EEA concepts and classifications?

Click on the map to check out two different ecosystem services.

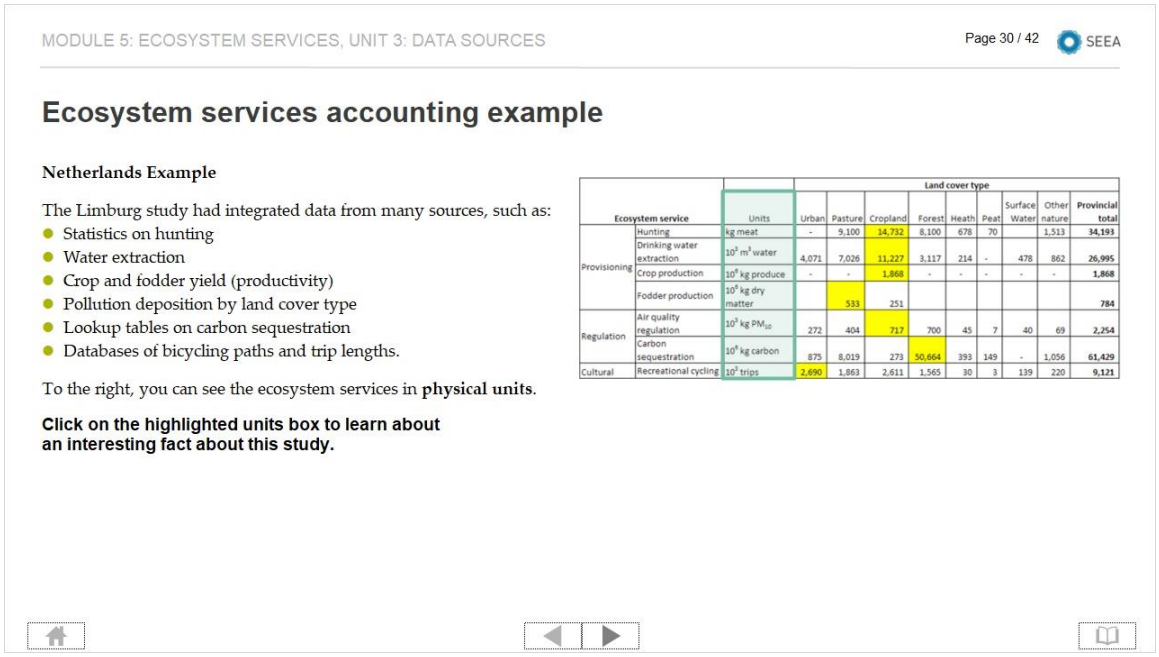


Source: Remme et al., 2014

Maps (Slide Layer)



1.30 Ecosystem Services Accounting Example



Explanation 1 (Slide Layer)

Ecosystem services accounting example

Netherlands Example

The Limburg study had integrated data from many sources, such as:

- Statistics on hunting
- Water extraction
- Crop and fodder yield (productivity)
- Pollution deposition by land cover type
- Lookup tables on carbon sequestration
- Databases of bicycling paths and trip lengths.

To the right, you can see the ecosystem services in **physical units**.

Click on the highlighted units box to learn about an interesting fact about this study.

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

Note that these units of measures are very different. This means that you cannot add or compare between services. To overcome this issue, you can create an index, like in the SEEA EEA Condition Account example.

1.31 Ecosystem Services Accounting Example

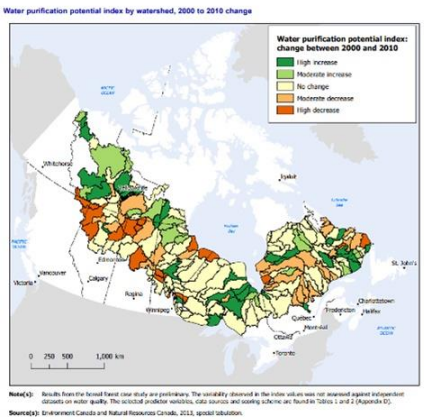
Ecosystem services example

Canada example

A study was conducted in Canada to estimate the change in water purification potential by drainage area for the boreal forest between 2000 and 2010. They used a modelling approach based on "condition" data to estimate the generation of the ecosystem services.

Here are some of the indices that were used:

- Percent of forest cover
- Percent of agricultural land
- Percent of riparian forest
- Percent of wetlands
- Percent of anthropogenic disturbance
- Percent of burn area
- Edge & linear density (fragmentation)
- Human footprint
- Slope
- Nitrogen & sulphur exceedance (from atmospheric deposition)



Source: Statistics Canada, 2013, Human Activity and the Environment
To zoom in, please click the image.

1.32 Ecosystem Services Accounting Example

Ecosystem services example

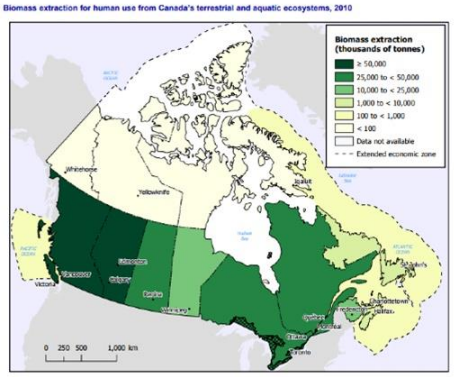
Canada example

As shown in the map, the net biomass extraction for human use from terrestrial and aquatic ecosystems was estimated in thousands of tonnes.

The different ecosystem services were:

- Agricultural crops
- Livestock and poultry
- Milk, maple products and honey
- Forestry
- Fisheries (inland and marine)

It is important to note that in this study, many biomass-related services were added into one indicator.



Source: Statistics Canada, 2013, Human Activity and the Environment
To zoom in, please click the image.

1.33 Ecosystem Services Accounting Example

Ecosystem services example

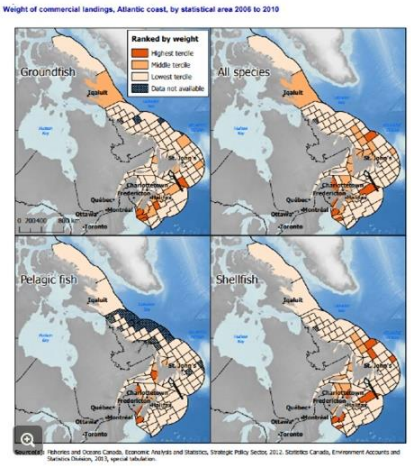
Canada example

In addition, the study estimated the weight of commercial fish landings by marine statistical area on both the east and west coasts. These statistical areas were defined by Fisheries and Oceans Canada.

The study included groundfish, pelagic fish, shellfish, and all species.

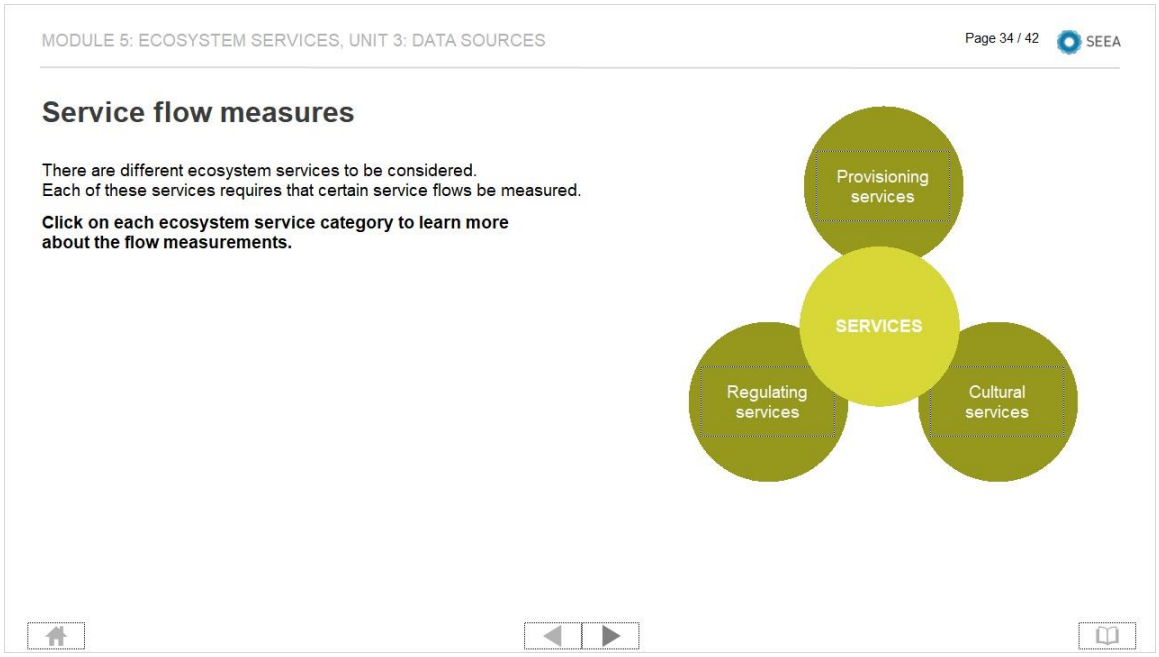
It is worth mentioning that this was one of the first estimates of commercial fish catch by marine statistical area.

The map shows that different areas of the ocean are generating different levels of provisioning services for fish catches.

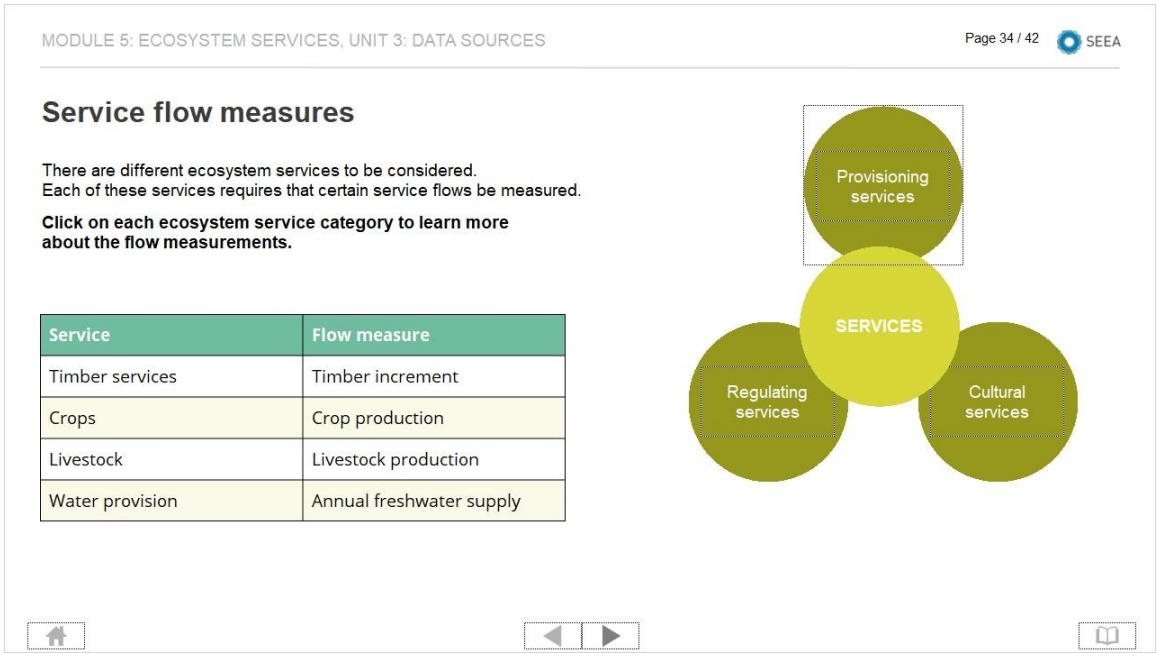


Source: Statistics Canada, 2013, Human Activity and the Environment

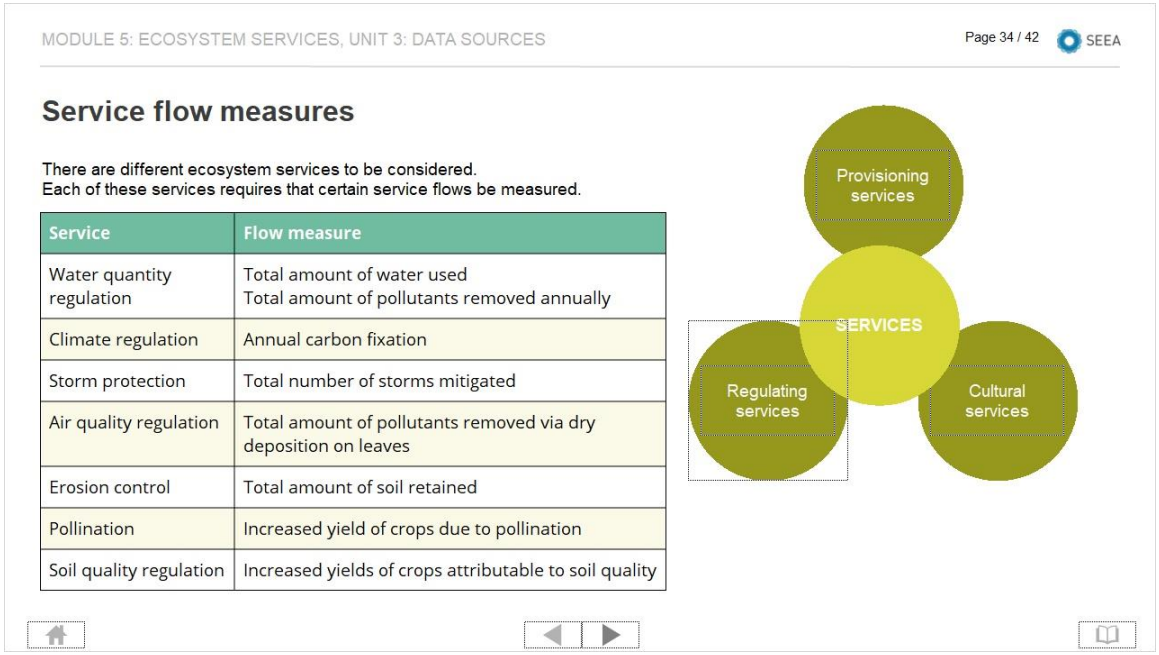
1.34 Service Flow Measures



Explanation 1 (Slide Layer)

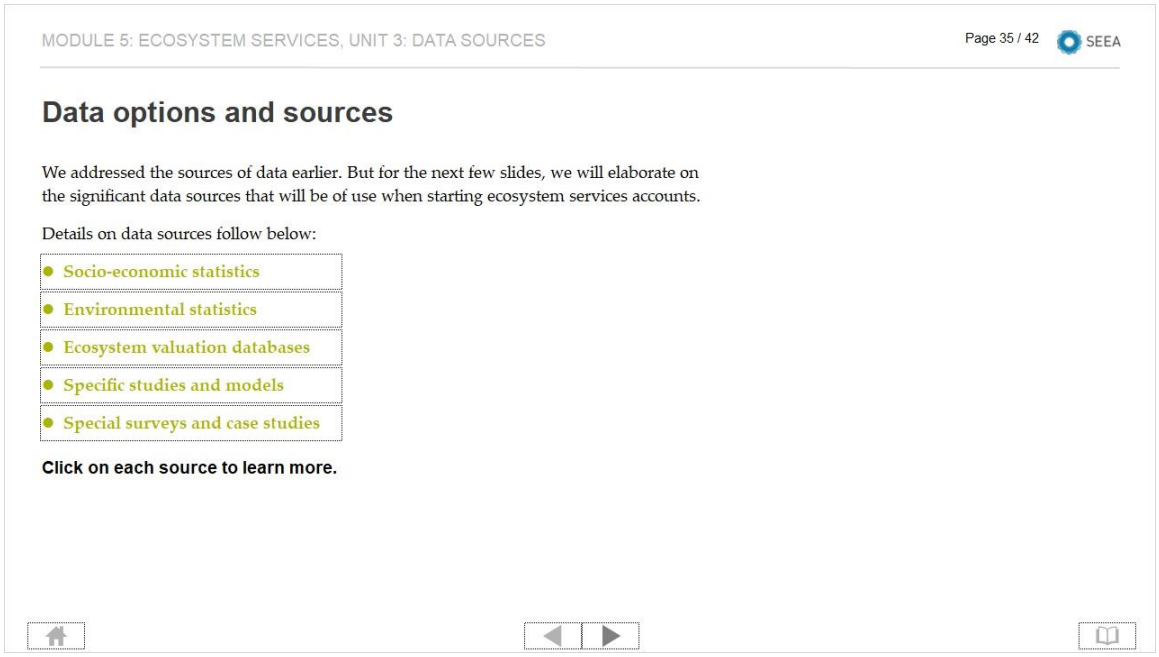


Explanation 2 (Slide Layer)

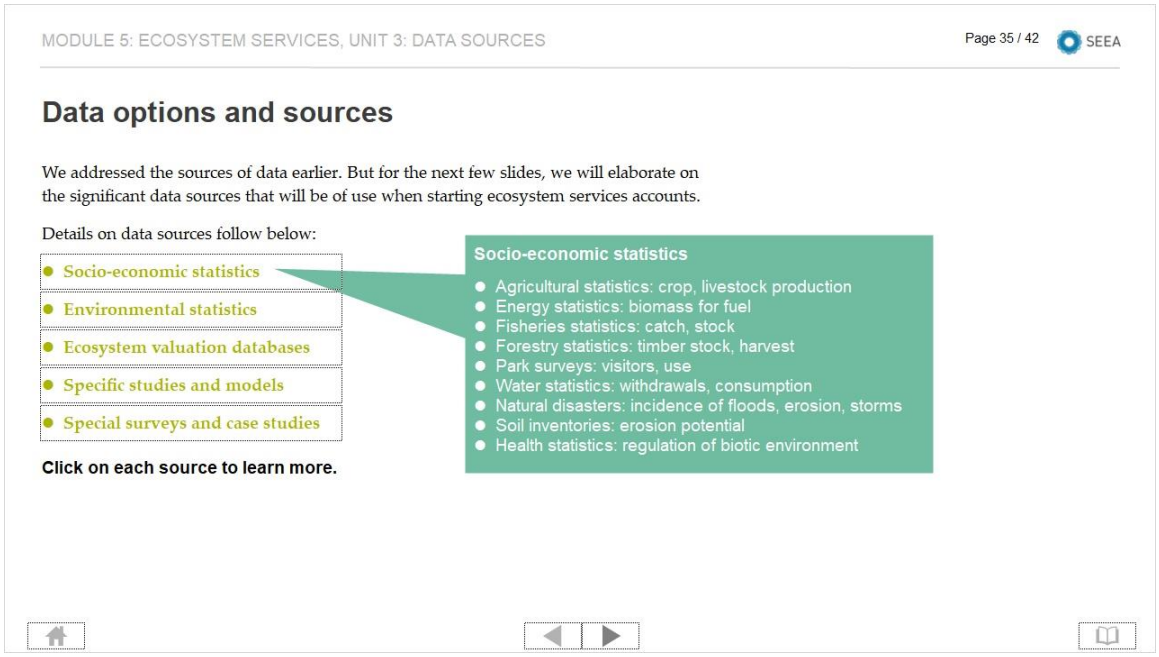


Explanation 3 (Slide Layer)

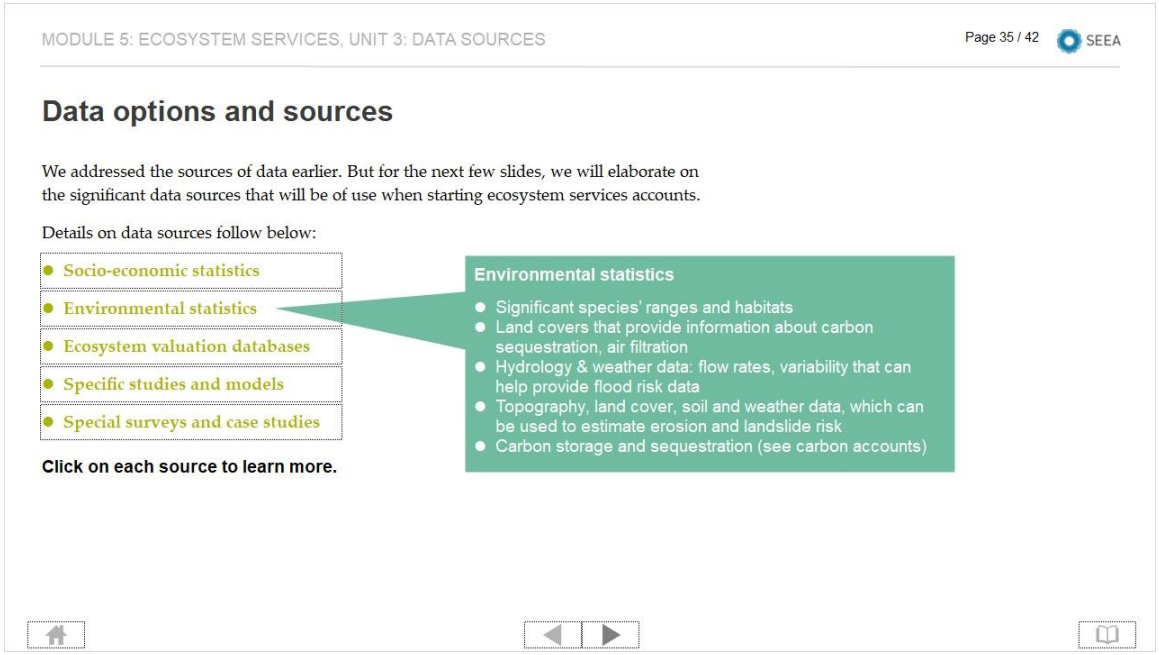
1.35 Data Options and Sources



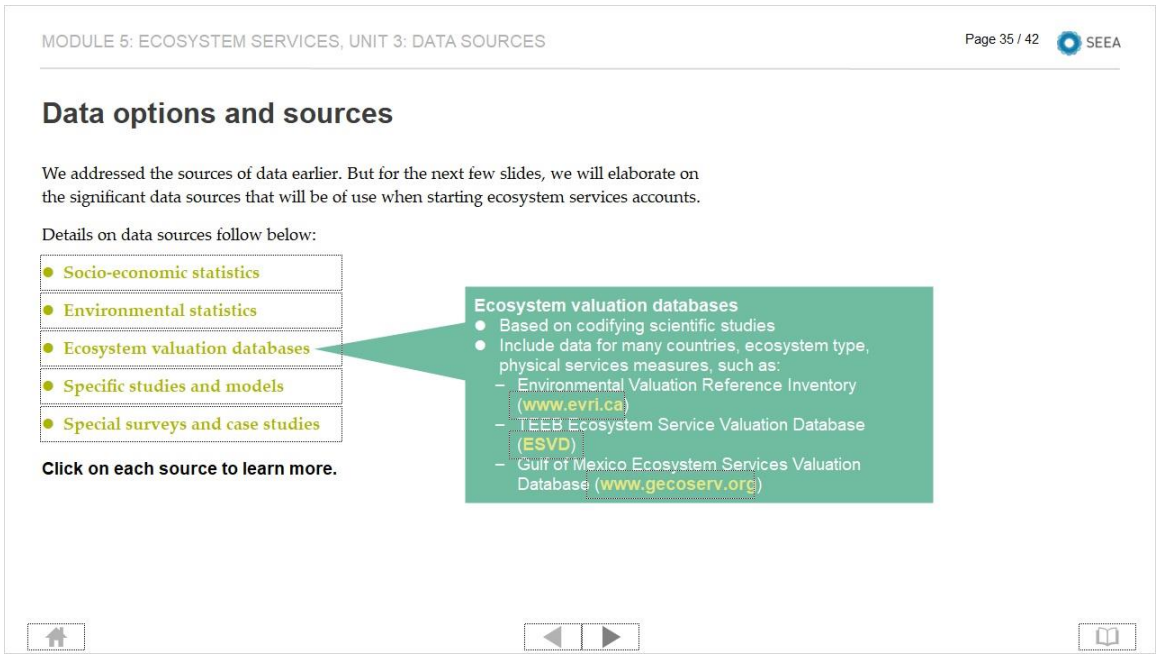
Explanation1 (Slide Layer)



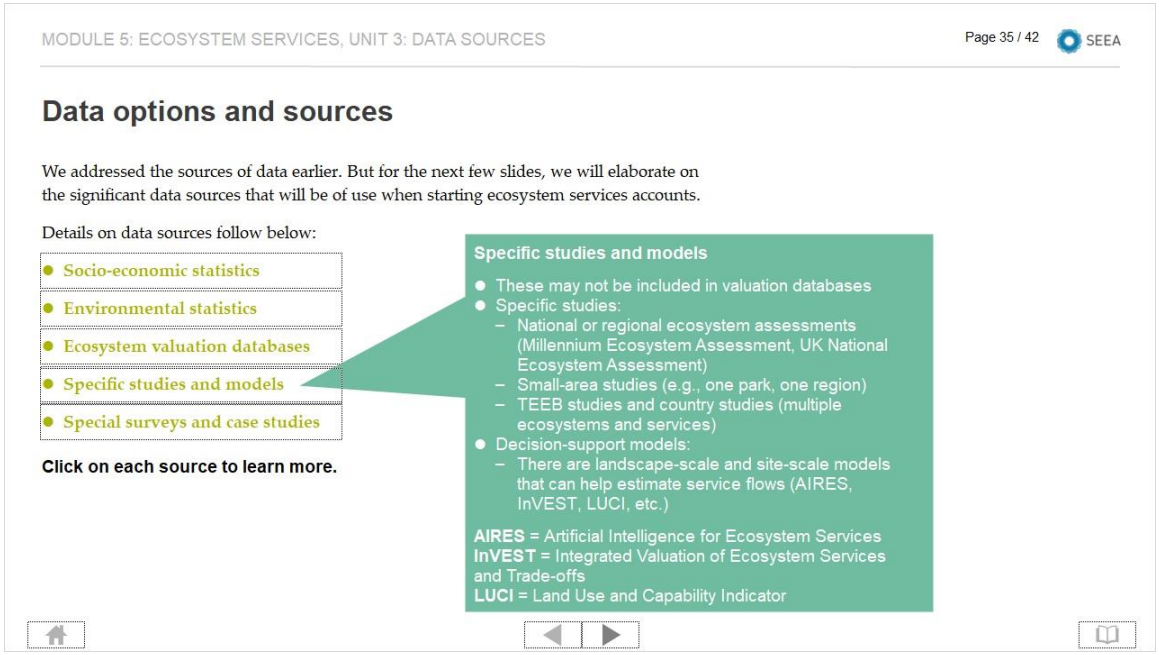
Explanation 2 (Slide Layer)



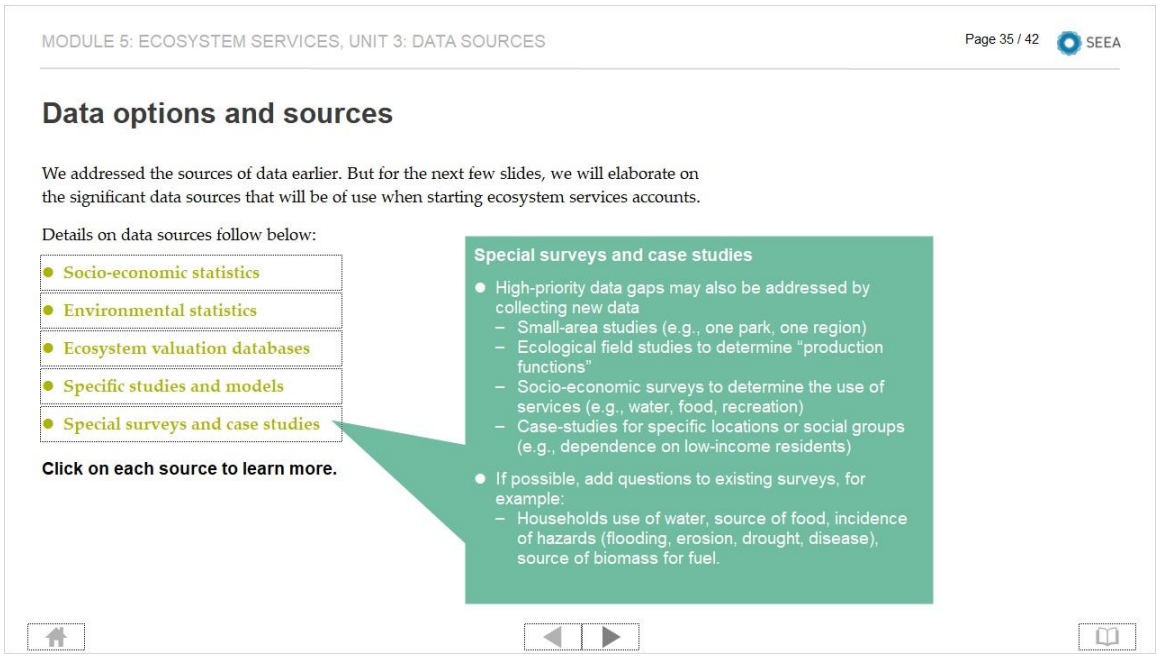
Explanation 3 (Slide Layer)



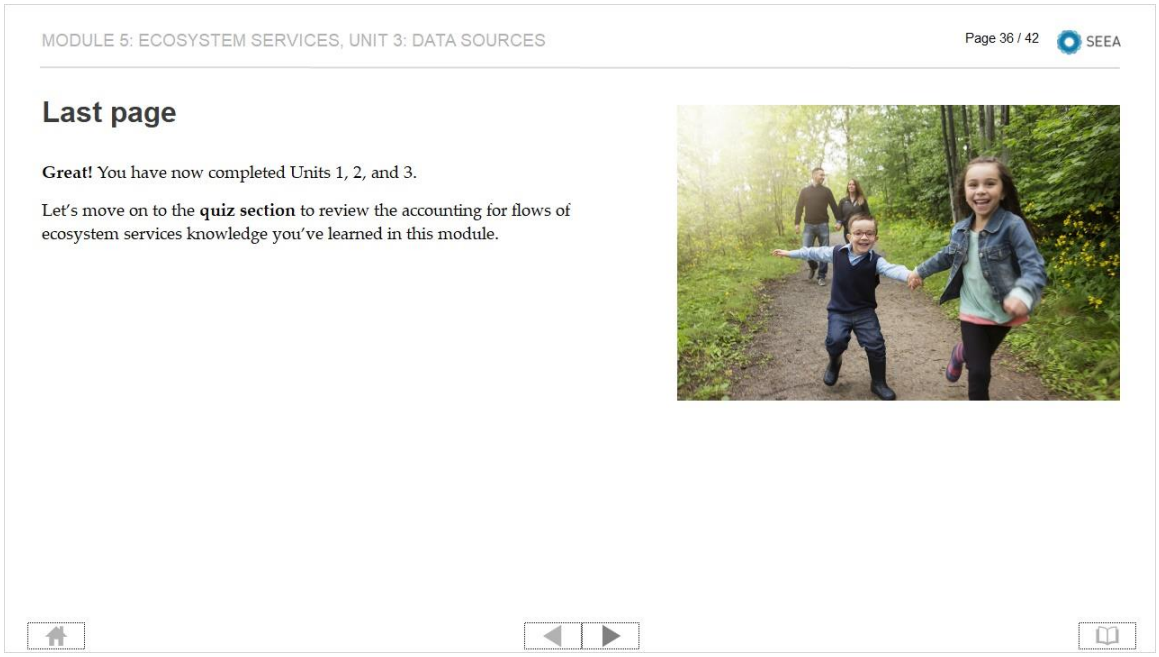
Explanation 4 (Slide Layer)



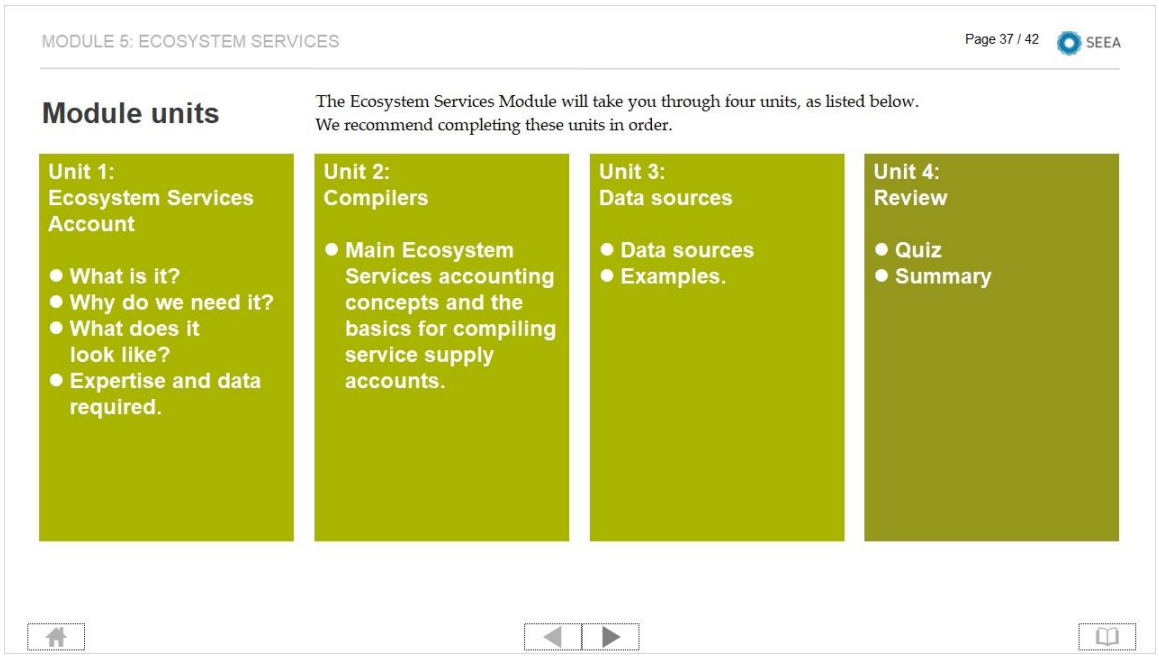
Explanation 5 (Slide Layer)



1.36 Last page

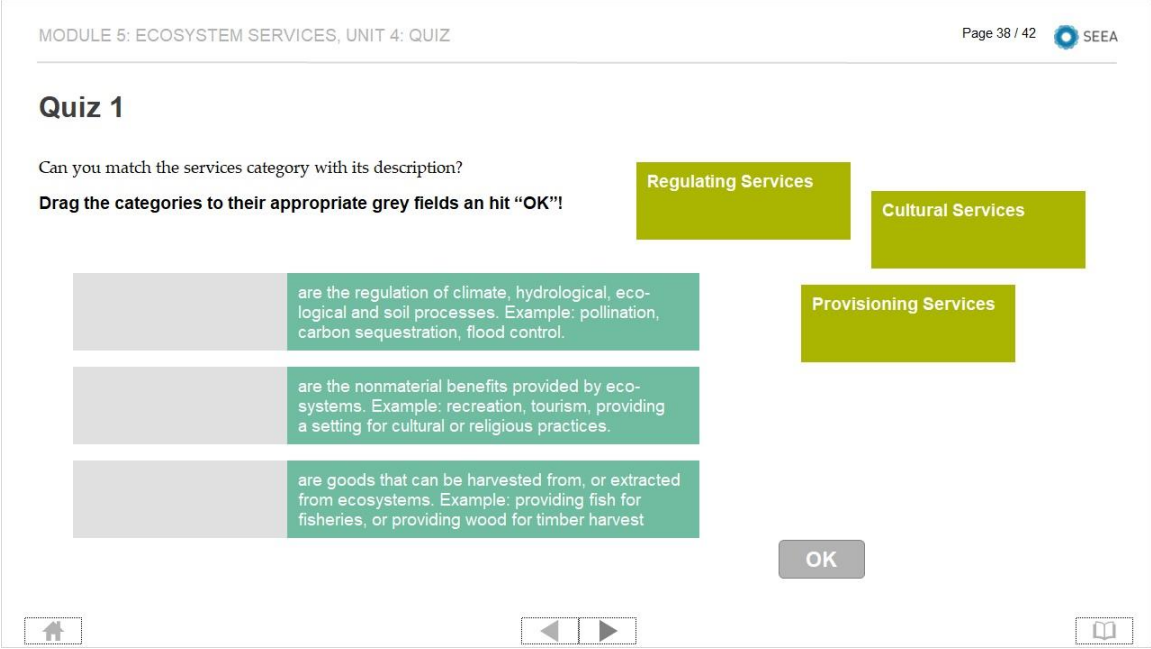


1.37 Module units



1.38 Drag and Drop

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



Drag Item	Drop Target
Regulating Services	Rectangle 1
Cultural Services	Rectangle 2
Provisioning Services	Rectangle 3

Drag and drop properties
Snap dropped items to drop target (Stack random)
Delay item drop states until interaction is submitted

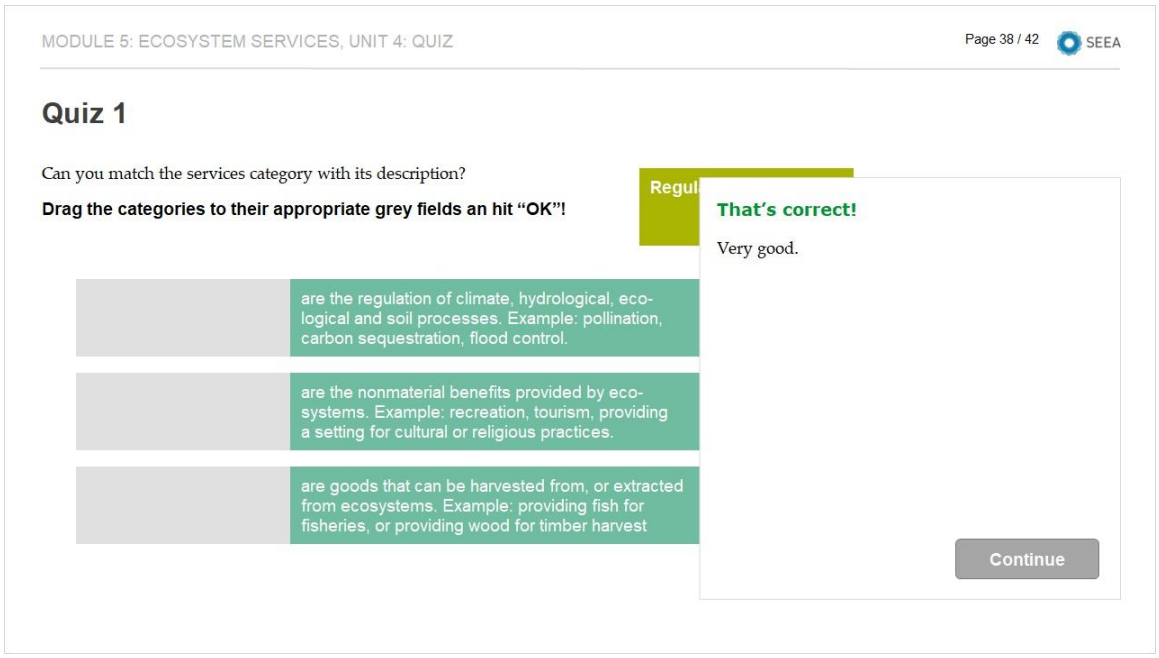
Feedback when correct:

Very good.

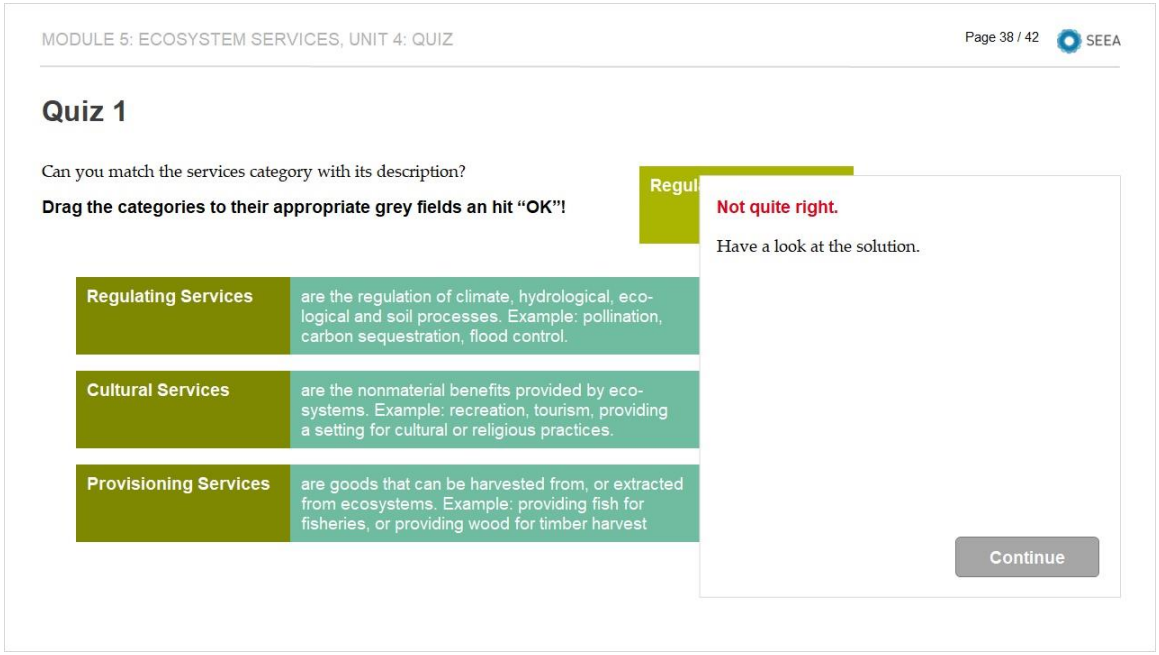
Feedback when incorrect:

Have a look at the solution.

That’s correct! (Slide Layer)

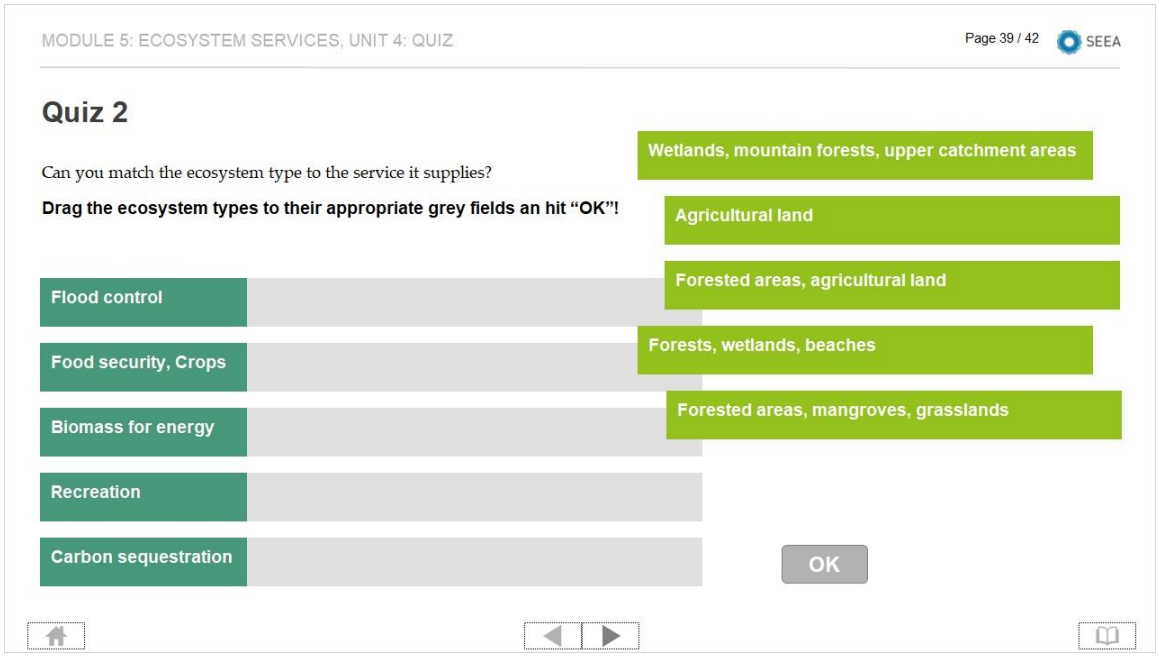


Not quite right. (Slide Layer)



1.39 Drag and Drop

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



Drag Item	Drop Target
Wetlands, mountain forests, upper catchment areas	Rectangle 1
Agricultural land	Rectangle 2
Forested areas, agricultural land	Rectangle 3
Forests, wetlands, beaches	Rectangle 10
Forested areas, mangroves, grasslands	Rectangle 12

Drag and drop properties
Snap dropped items to drop target (Stack random)
Delay item drop states until interaction is submitted

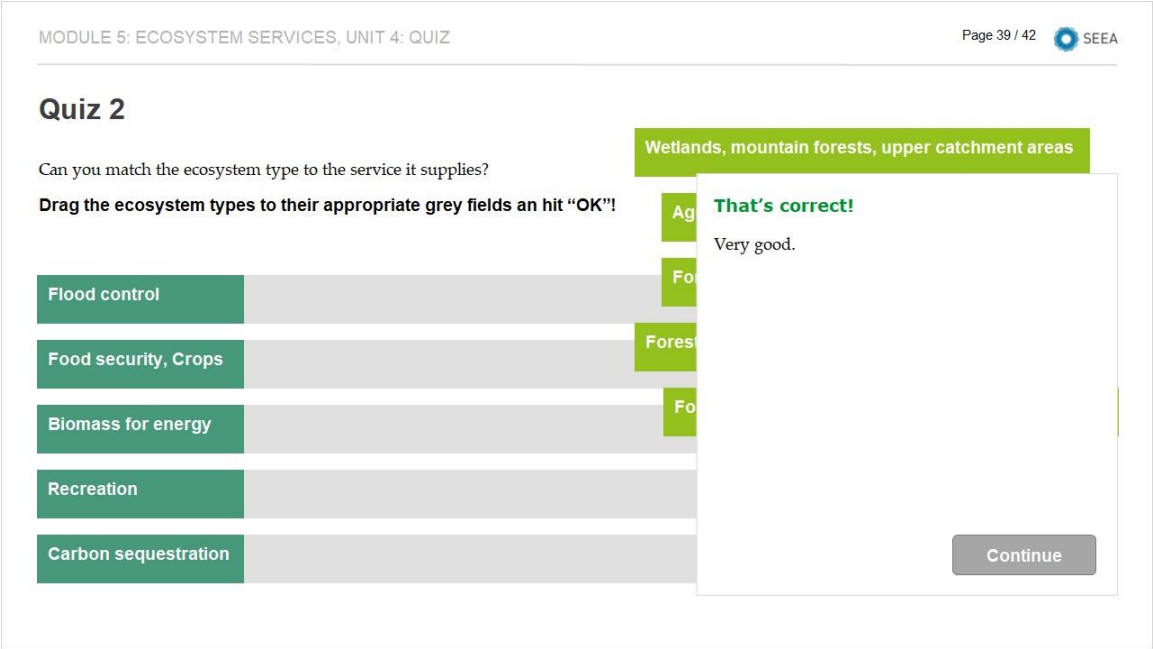
Feedback when correct:

Very good.

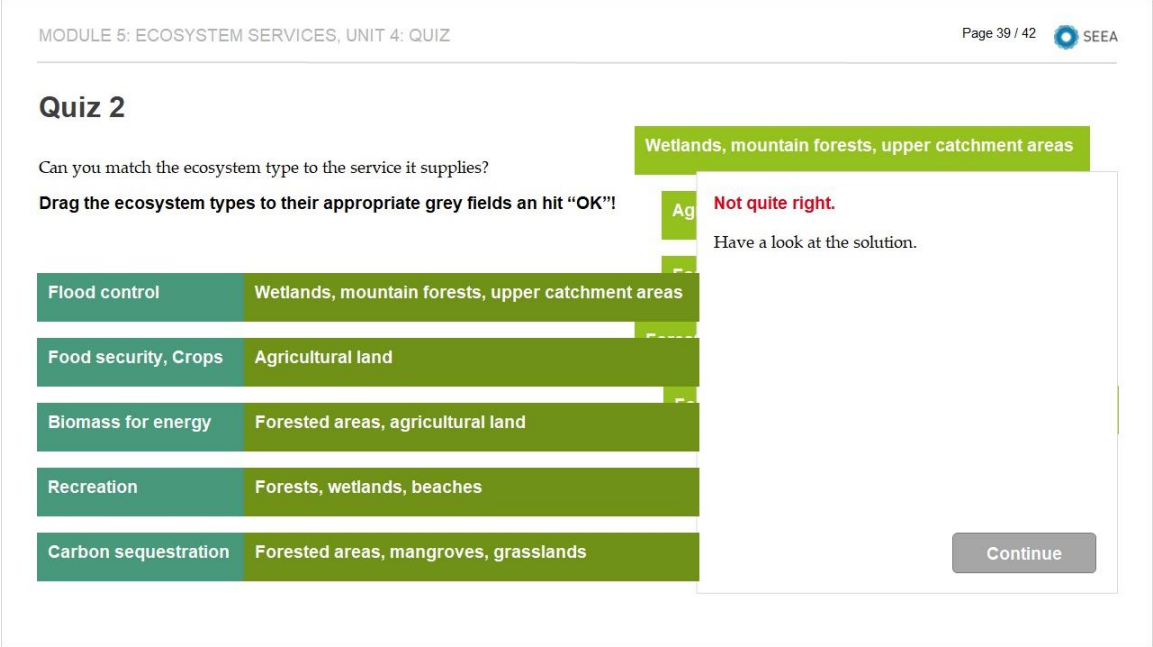
Feedback when incorrect:

Have a look at the solution.

That’s correct! (Slide Layer)

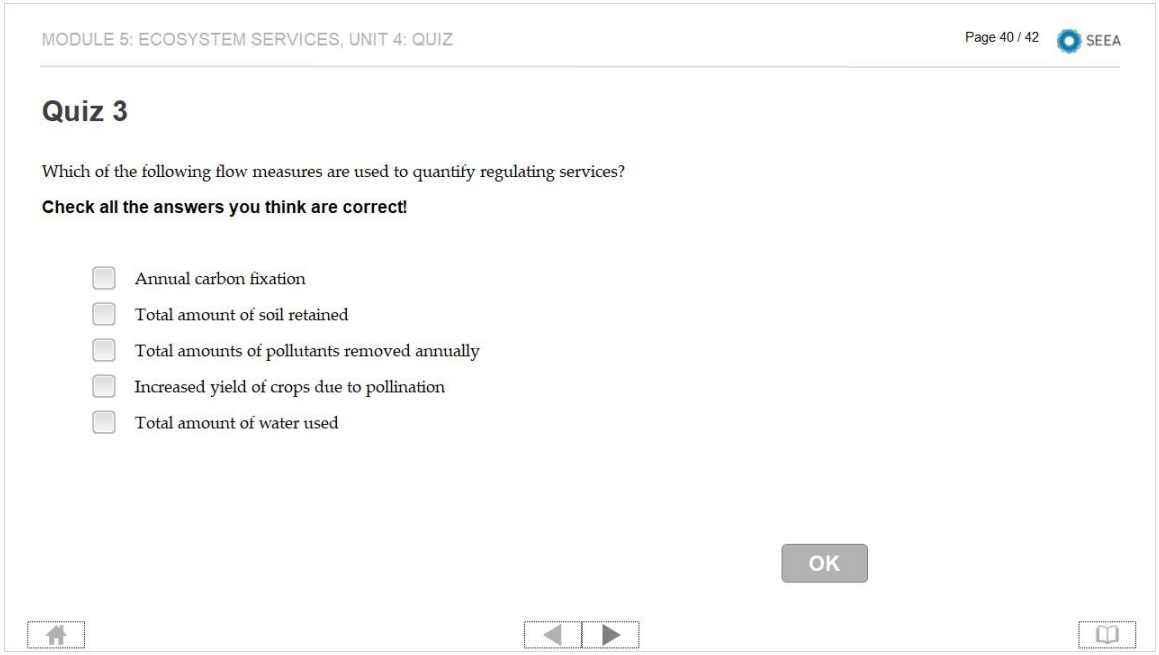


Not quite right. (Slide Layer)



1.40 Pick Many

(Pick Many, 10 points, 1 attempt permitted)



Correct	Choice
X	Annual carbon fixation
X	Total amount of soil retained
X	Total amounts of pollutants removed annually
X	Increased yield of crops due to pollination
X	Total amount of water used

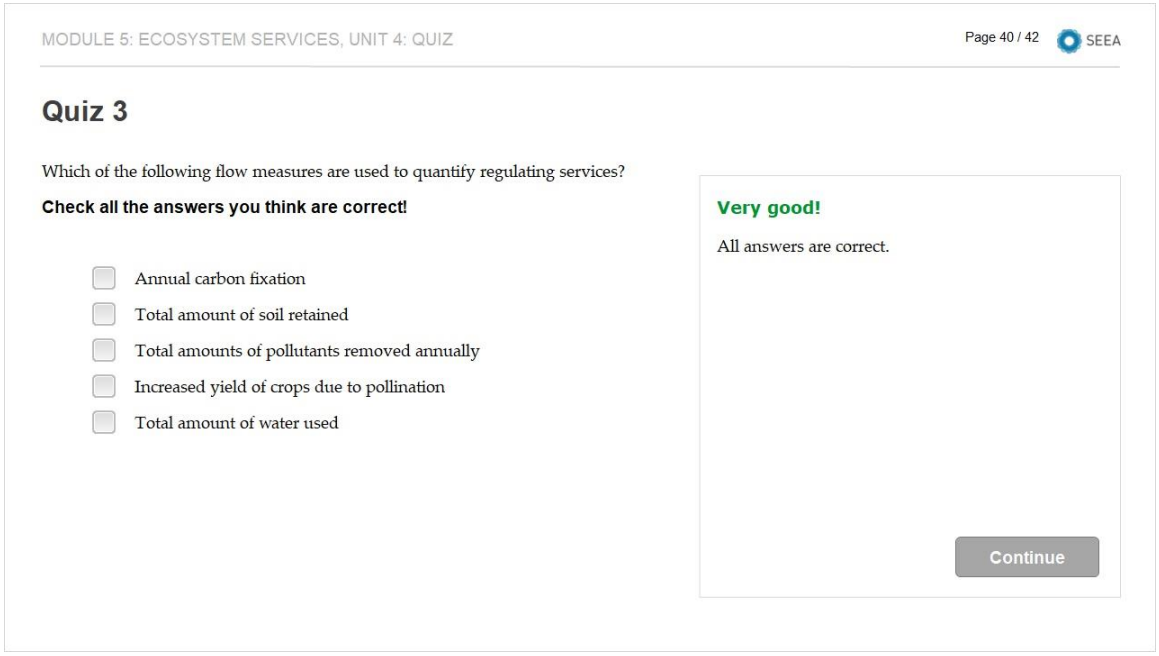
Feedback when correct:

All answers are correct.

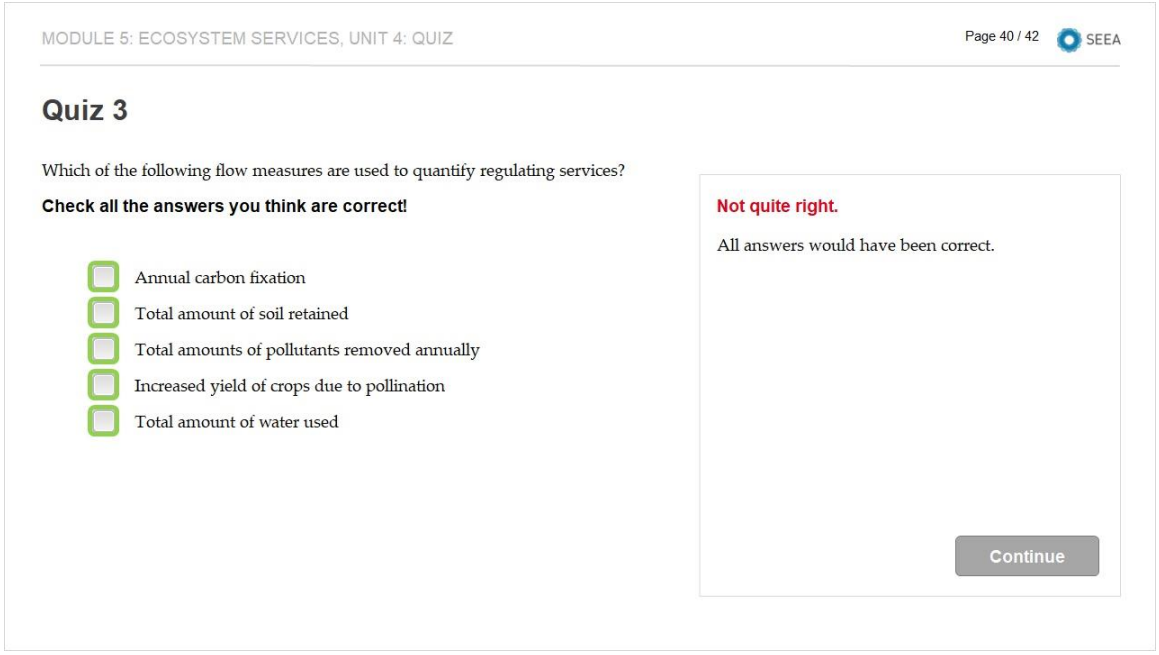
Feedback when incorrect:

All answers would have been correct.

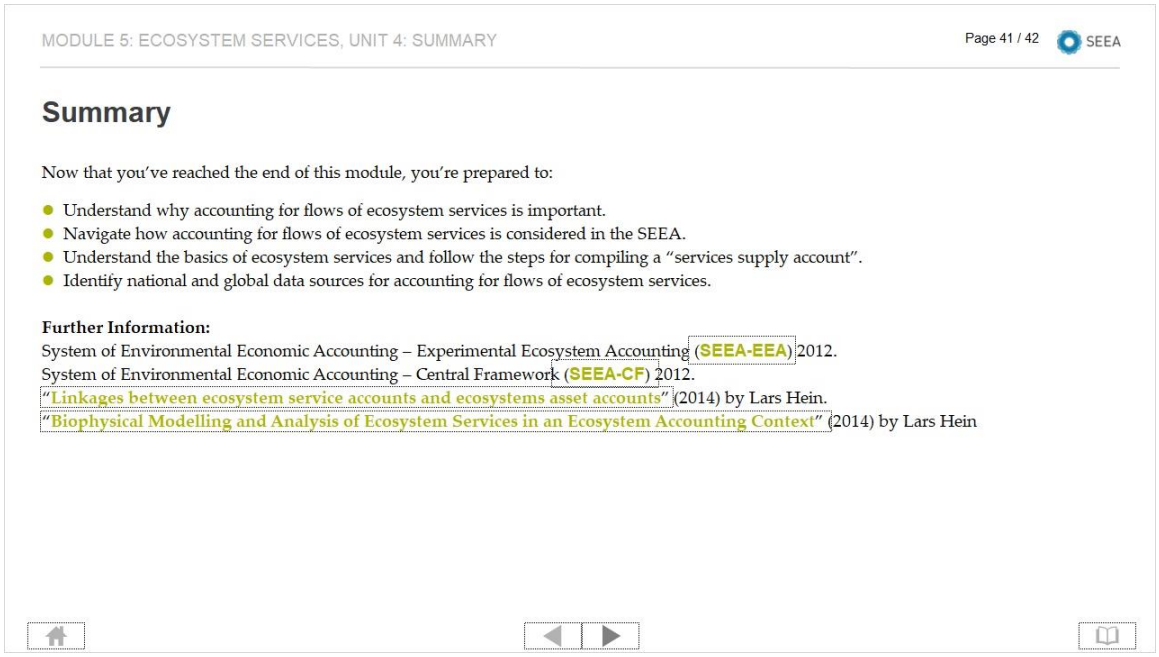
Very good! (Slide Layer)



Not quite right. (Slide Layer)



1.41 Untitled Slide



1.42 Untitled Slide