

Human Activity and the Environment – Teacher’s Kit

Detailed lesson plan #1: Can the value of ecosystems and ecosystem goods and services be measured?



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The following symbols are used in Statistics Canada publications:

- | | |
|----------------|--|
| . | not available for any reference period |
| .. | not available for a specific reference period |
| ... | not applicable |
| 0 | true zero or a value rounded to zero |
| 0 ^s | value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded |
| P | preliminary |
| r | revised |
| X | suppressed to meet the confidentiality requirements of the <i>Statistics Act</i> |
| E | use with caution |
| F | too unreliable to be published |
| * | significantly different from reference category ($p < 0.05$) |

Detailed lesson plan #1

Can the value of ecosystems and ecosystem goods and services be measured?

Overview

This lesson explores valuation methods used to determine the value of ecosystems and ecosystem goods and services (EGS). Using the Statistics Canada publication *Human Activity and the Environment 2013: Measuring Ecosystem Goods and Services in Canada* (MEGS), the lesson introduces monetary and non-monetary methods of valuation. Using the example of a coffee shop and applying this example to ecosystems, learners recognize what makes something an asset. Learners identify various environmental assets, goods and services. They explore the concepts of use and non-use values by applying the MEGS 'Total Economic Value Framework.' Finally, learners identify measures that could be used to estimate the value of EGS found within a particular ecosystem.

Audience

- junior high school
- senior high school
- introductory post-secondary

Learning outcomes

- understand ecosystem accounting practices
- explore various ways of estimating the value of EGS
- learn to think critically about 'value' in relation to ecosystems

Curriculum links

- grades 7 to 12 geography (ecosystems), social studies (economics), biology (ecosystems), science, economics (accounting, valuation methods)
- post-secondary geography (ecosystems), environmental science (ecosystem accounting, ecosystem change)

Learning materials

- Lessons #1 to 3
- Statistics Canada publication, *Human Activity and the Environment 2013: Measuring ecosystem goods and services in Canada*
- Activity sheet #1: *Defining an asset*
- Activity sheet #2: *Categorizing asset values*
- Image collection

- Activity sheet #3: *Exploring use and non-use values for ecosystem goods and services*
- Briefing sheet #1: *Determining the value of ecosystem goods and services*
- Activity sheet #4: *Estimating the value of ecosystem goods and services*
- Assessment support #1: *Assessing the descriptions*

Instructions

Session one

To develop learner understanding of ecosystems, it may be useful to use the activities found in the Lesson #1: *What is an ecosystem?*

Learn about assets

Provide each learner with a copy of Activity sheet #1: *Defining an asset* and ask learners to imagine that they are owners of a small coffee shop. After reviewing the words at the top and bottom of the diagram, inform learners that the items on the top of the page are examples of assets, while the items at the bottom are not assets. Ask learners to compare the examples to help create a definition for the concept of an asset. Direct learners to write their definition in the middle of the page. Possible definitions include ‘a source of wealth,’ ‘an item of value,’ or ‘something that provides benefits.’

After reviewing learner responses, explore the basics of accounting by informing learners that all businesses and individuals can accumulate assets. Inform learners that assets are a source of wealth that will provide continuing benefits in the future. Financial assets can include cash, buildings, materials, supplies, land, patents, trademarks and other items. They can be used by businesses to create other valuable goods and services.

Prompt learners to consider what might increase the value of the coffee shop; possible responses might include accumulating more assets or not accumulating liabilities. Conversely, ask learners to consider what might decrease the value of the shop; possible responses include depreciation in the value of machinery, breakage of cups, or running out of coffee beans.

Categorize asset values

Inform learners that assets are of value to people because of the benefits derived from them, whether these benefits are enjoyed directly or indirectly (use value) or even in cases where they are not actually used (non-use value).

Provide each learner with a copy of Activity sheet #2: *Categorizing asset values*. Ask learners to consider which coffee shop assets provide benefits when they are used or consumed and which provide benefits even though they are not consumed. For example, almond milk is an example of an asset that derives its value from its use, while interior decorating creates value even though it is not consumed.

After learners have grouped assets, review their responses by posing the following questions:

- Which assets provide benefits when they are used or consumed (e.g., coffee beans, almond milk)?
- Which assets provide benefits even though they are not used or consumed (e.g., art, goodwill)?
- Do some assets have both use and non-use value?

Learn about ecosystem assets

Guide learners in applying the coffee shop analogy to their thinking about what other organizations or areas, including the environment and ecosystems, might also have assets. Display or project one of the eight photographs of ecosystems in the Image collection, asking learners to carefully observe the image. Provide the following directions:

- Identify ecosystem features (e.g., forests, soils, water, wetlands, vegetation).
- Identify less visible or obvious features of the ecosystem such as micro-organisms, insects and air.
- Identify how these features might be thought of as ecosystem assets and how they might provide benefits to people.

Ask learners to consider what might decrease the value of the ecosystem assets; possible responses include water pollution or soil erosion. Record learner ideas on a whiteboard or flipchart.

Session two

To develop learner understanding of EGS, it may be useful to use the activities found in Lesson #2: *What are ecosystem goods and services?*

Learn about ecosystem goods and services

Display or project an image of an ecosystem (see Image collection). Inform learners that ecosystem assets can provide goods or services, or both. Guide learners in analyzing the types of goods and services that may be provided by the ecosystem displayed in the photograph. Provide the following directions:

- Identify what different types of goods and services might be generated from the ecosystem (e.g., provisioning, regulating, cultural).
- Identify examples of goods and services that might be generated from the ecosystem for each of the different types (e.g., timber, air purification, recreational opportunities).
- Identify less obvious uses (e.g., forests might provide scenery) as well as obvious uses (e.g., forests might provide timber).

Record learner ideas on a whiteboard or flipchart.

For more information on EGS classifications refer to 'Section 2.1.2 Classifying flows' in the [MEGS publication](#) (page 20).

Define use and non-use values

Ask learners to develop definitions for ‘use value’ and ‘non-use value’ of EGS. Guide learners with questions similar to:

- If cutting down trees, catching fish, and water purification are examples of use values, and scenery enjoyment is not an example of use value, what is the definition of use value?
- If a forest will be harvested in 30, 40 or 50 years, would we consider its value to be derived from use or non-use?
- If a wetland is left undeveloped, should the flood prevention services provided be considered a use or a non-use?

Possible definitions include:

- Use value: a benefit or value is generated from actual consumptive or non-consumptive use (direct use), potential future use (option use), as well as indirect use of a good or service.
- Non-use value: a benefit or value is generated that is independent of actual or potential future use. For example, bequest values may be generated from the satisfaction associated with preserving something for future generations, while existence value may be generated from the satisfaction associated with knowing that something exists, regardless of how it is used.

Review and refine learner suggestions. It may be useful to remind learners of the coffee shop analogy and how benefits can be generated from use or non-use.

Exploring use and non-use values for ecosystem goods and services

Next, provide each learner with a photo of an ecosystem (see Image collection for samples) and a copy of Activity sheet #3: *Exploring use and non-use values for ecosystem goods and services*. Using the previous discussion as a guide, encourage learners to identify obvious and less obvious features of the ecosystem featured in their assigned photo. For example, forests are an example of an obvious ecosystem feature while micro-organisms are less obvious. These features should be recorded in the top box.

Categorize ecosystem goods and services values

Ask learners to use their definitions of use value and non-use value to categorize the various EGS that may be provided by the identified ecosystem features in the appropriate boxes in Activity sheet #3. For example, if ‘forests’ were noted as a feature of an assigned ecosystem, ‘timber’ might be an EGS noted in the direct use category, ‘air purification’ an EGS in the indirect use category, ‘preservation of scenery’ in the future generations category, and ‘enjoyment of biodiversity’ in the existence category. Instruct learners to carefully consider each observed ecosystem feature, potential EGS and what type of benefits might be provided. For more information on use and non-use values refer to the ‘Total Economic Value framework’ in the [MEGS publication](#) (Figure 2.1, page 22).

Review learner responses and ask learners to consider whether it is possible for specific EGS to provide both use and non-use benefits. Setting the stage for the next activity, encourage learners to suggest how values of various benefits might be calculated and compared.

Session three

To develop learner understanding of valuation methods it may be useful to use the activities found in Lesson #3: *How can the value of ecosystem goods and services be measured?*

Learn about valuation methods

Begin an exploration of the methods used to determine the value of EGS by informing learners that much like estimating the value of assets found in a coffee shop, there are also methods that can be used to estimate the value of goods and services derived from or produced by ecosystems.

Provide each learner with a copy of Briefing sheet #1: *Determining the value of ecosystem goods and services* while also directing learners to read pages 19 to 23 of the [MEGS publication](#) (Section 2, Ecosystem accounting). Provide the following questions to focus reading:

- In what ways might estimating the value of a coffee shop's assets be similar to estimating the value of ecosystem assets and EGS? Possible responses include: both consider the value or contributions that an asset can provide to people; both might be valued in monetary (\$) terms.
- In what ways might it be more difficult to estimate the value of ecosystem assets and EGS? Possible responses include: many EGS are not bought or sold, it can be challenging to place a monetary value on EGS.

Invite learners to share their thoughts on the questions and the concept of ecosystem accounting, encouraging them to consider why it is important to understand the value of ecosystems and EGS.

For more information on monetary valuation techniques refer to the [MEGS publication](#), page 21 and page 86 (Appendix B).

For more information on non-monetary valuation techniques refer to the [MEGS publication](#), page 9.

Applying valuation methods

Display or project Image 1 (photo of two small water bodies separated by a strip of terrestrial land, from Image collection) and provide each learner with a copy of Activity sheet #4: *Estimating the value of ecosystem goods and services*. Invite the class to carefully examine the photograph and observe any possible goods and services that the pictured ecosystem might offer or provide. These observations should be recorded in the left hand column ('Observation: what are the potential goods or services?') Possible observations could include timber, fresh water, fish, clean air, scenery, erosion control, habitat and recreation.

Next, guide learners in considering what types of monetary and non-monetary measures might be used to estimate the value of the goods and services identified in the picture. Review the examples of measures that have been provided on the chart, and then work with learners to co-create another example in each category. Guide learners in continuing the process with each of the goods and services identified and noted in the chart. Encourage learners to remember to consider both use and non-use benefits.

Review learner responses by having them consider questions such as the following:

- Can either valuation method be used to produce valid estimates for all EGS?
- Which valuation method might be more appropriate for estimating the value of the EGS in this ecosystem?

After discussing these questions, direct learners to the bottom of the chart and have them consider which EGS might provide the most value for society, whether this value is estimated in monetary or non-monetary terms. Review learner responses, discussing any apparent differences in their assessments.

Session four

Exploring the value of an ecosystem

Provide each learner with an image of an ecosystem (see Image collection) and a copy of Activity sheet #4: *Estimating the value of ecosystem goods and services*. Alternatively, ask learners to find their own images or use a local ecosystem. Instruct learners to use the same process as in Session three and to identify possible measures that could be used to estimate the value of EGS in their selected ecosystems.

After possible measures have been identified, inform learners that their challenge is to develop a thoughtful and plausible description of the value of EGS found in an ecosystem. Work with learners to develop the requirements that correspond to the criteria. For example:

- Thoughtful: the description includes mention of potential monetary and non-monetary measures as well as use and non-use benefits.
- Plausible: the description is supported by evidence in images, maps and/or charts.
- Detailed: the description includes detail of obvious and non-obvious ecosystem features and related EGS.

To assess learner descriptions, consider using Assessment support #1: *Assessing the description*.

Activity sheet #1

Defining an asset

These are assets:

cash in the bank sound system website
art on the wall coffee beans muffins
delivery bicycle coffee cups spoons
coffee grinder the building trademarks
muffin recipes coffee maker goodwill

My definition of an asset is:

These are not assets:

money the shop owes on the mortgage
the store next door the barista's pets
money owed on the shop credit card
electricity

Activity sheet #2

Categorizing asset values

Determine whether the following coffee shop assets provide benefits as a result of use or non-use (for example, almond milk provides benefits when it is consumed and used while interior decorating provides benefits even though it does not get used or consumed). Assets might be placed in one or both columns.

Coffee shop assets	
cash in the bank sound system website art on the wall coffee beans muffins delivery bicycle coffee cups spoons coffee grinder the building trademarks muffin recipes coffee maker customer goodwill	
Provide benefits when used or consumed	Provide benefits even though they are not used or consumed
<i>almond milk</i>	<i>interior decorating</i>

Activity sheet #3

Exploring use and non-use values for ecosystem goods and services

Ecosystem features:			
<p align="center">Use value</p> <p><i>Benefit or value is generated from the actual consumptive or non-consumptive use, potential future use, or indirect use of a good or service</i></p>		<p align="center">Non-use value</p> <p><i>Benefit or value is generated that is independent of actual or potential future use.</i></p>	
Direct use value	Indirect use value	Bequest value	Existence value
Ecosystem good or service	Ecosystem good or service	Ecosystem good or service	Ecosystem good or service

Briefing sheet #1

Determining the value of ecosystem goods and services

There are two ways of determining the value of ecosystem goods and services (EGS):

1. **Monetary valuation:** estimating and calculating the dollar value of EGS. There are three main methods of monetary valuation:
 - i. *Revealed preference methods* examine the choices people make to identify preferences and priorities. For example, travel costs to desirable locations can be used to estimate willingness to pay for recreational services. Similarly, comparing property values close to and far from parks can be used to measure the value people place on an area or ecosystem.
 - ii. *Market based approaches* use market prices of commodities to estimate the value of EGS that are not traded in a market. For example, the value of fish in a stream might be estimated by comparing the value of fish in the stream to the value of fish sold in a market. Similarly, the costs of substitutes, required mitigation or restoration expenses can be used as indicators of the value of EGS.
 - iii. *Stated preference valuation* uses information about people's environmental preferences gathered through the use of surveys, questionnaires, or interviews. For example businesses may be willing to pay for air scrubbers or people might accept compensation for a reduction in air quality.
2. **Non-monetary valuation:** social, cultural or physical measures can also be used to assess the value of ecosystems and their benefits. These may include non-monetary values such as lives saved, nutrients processed by wetlands, as well as simply the existence of the EGS.

Both monetary and non-monetary valuation methods can be used to estimate EGS values, whether the benefit enjoyed is through use or non-use. For example, a monetary value of directly using trees could be estimated by using market prices of lumber or other forest products. Similarly a monetary value might be estimated for the enjoyment of scenery provided by a forest, by estimating a community's willingness to pay to preserve it.

Monetary and non-monetary valuation methods can also be used to estimate the value of the same thing. For example, a monetary value of a forest might be the estimated value of future timber harvests. Non-monetary values might include the number of people who use the forest for recreational purposes or the physical size, in square kilometers, of the forest.

For more information on valuation techniques, see pages 21 to 22 and Appendix B (page 86) of the [MEGS publication](#).

Activity sheet #4

Estimating the value of ecosystem goods and services

Name of area or ecosystem:		
Observation potential goods or services	Monetary valuation measures	Non-monetary valuation measures
<i>lumber</i>	<i>-the market value of the forest products that could be produced</i>	<i>-the number of board feet of lumber</i>
EGS value assessment		
<p>The EGS in this ecosystem that might have the highest value for society is (regardless of whether it is estimated using monetary or non-monetary valuation methods):</p> <p>Reasons that support this choice:</p>		

Assessment support #1

Assessing the descriptions

	Outstanding	Very good	Competent	Satisfactory	In-progress
Plausible description	The description is highly plausible and highly justifiable in light of the evidence provided.	The description is clearly plausible and justifiable in light of the evidence provided.	The description is plausible and adequately justifiable in light of the evidence provided.	The description is somewhat plausible but barely justifiable given the evidence provided.	The description is implausible and not justifiable given the evidence provided.
Detailed description	The description is highly detailed and includes thorough details of obvious and non-obvious ecosystem features and related EGS.	The description is detailed and includes thorough details of obvious and some non-obvious ecosystem features and related EGS.	The description is adequately detailed and includes adequate details of obvious and some non-obvious ecosystem features and related EGS.	The description is somewhat detailed and includes basic detail of obvious and some non-obvious ecosystem features and related EGS.	The description is not detailed and is missing details of obvious and non-obvious ecosystem features and related EGS.