Putting the economics into ecosystem accounting

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Date: February 23, 2015
Learning objectives

- Different ways to put economics into ecosystem accounts
- Ecosystem accounting requires exchange values
- Distinguish suitable methods for valuing *ecosystem services* and when to apply them
- Distinguish suitable methods for valuing *ecosystem assets* and when to apply them
Qualitative versus quantitative descriptions

<table>
<thead>
<tr>
<th>Service Group</th>
<th>Final Ecosystem Service</th>
<th>Mountains, Moorlands &amp; Heaths</th>
<th>Semi-natural Grasslands</th>
<th>Enclosed Farmland</th>
<th>Woodlands</th>
<th>Freshwaters – Openwaters, Wetlands &amp; Floodplains</th>
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</thead>
<tbody>
<tr>
<td>Provisioning</td>
<td>Crops</td>
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<td>Livestock/Aquaculture</td>
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<td>Fish</td>
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<td>Trees, standing vegetation, peat</td>
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<td></td>
<td>Water supply</td>
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<td>Wild species diversity</td>
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<tr>
<td>Cultural</td>
<td>Environmental settings: Local places</td>
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<td>Environmental settings: Landscapes/seascapes</td>
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</table>
How to put economics into accounting

Physical vs. monetary descriptions

- Physical information useful in itself
- Prerequisite for valuation

![Graph showing volume change in GDP, employment, and tap water use for production activity](image)

- GDP
- Water use

Why value?

To integrate environmental issues in economic decision making and development planning

Valuation is fit for purpose:

Different contexts require different value concepts

1. Assessment of welfare:
   E.g. cost benefit analysis, focus on utility

2. Assessment of economic activity:
   E.g. National accounts, focus on exchange value
Exercise:
Suppose you have 10 currency units, and you need to buy 1 bread, 1 kg of rice, and 1 kg of fish. Indicate your how much you like to pay for 1 kg of rice!

A. 1 unit
B. 2 units
C. 3 units
D. 5 units
E. 7 units
Valuation methods for ecosystem accounts

Suitable methods: identify or generate exchange values

- Should build on physical accounts

Unsuitable methods:

- Include consumer surplus
- Unable to value individual services (e.g. restoration)
- Simple benefit transfer approaches ("big numbers")
Problems with global benefit transfer studies

"For the entire biosphere, the value... is estimated to be in the range of US $16-54 trillion per year... Global gross national product total is around US $18 trillion per year."

High values where no beneficiaries are located (Siberia)
Three different principles for generating exchange values

1. Price of similar good or service

2. Estimate how much of the value of marketed goods or services are due to ecosystem services

3. Estimate cost of not having the ecosystem service
Objects of valuation

Ecosystem services

• Flows: during the year

Ecosystem capital

• Assets: stocks at beginning/end of year and changes therein

Ecosystem capital provides ecosystem services

• Can be multiple services

• Can be multiple beneficiaries
Provisioning services

1. Proxy market prices
   • The exchange value of a similar product on the market

2. Resource rent (RR)
   • Value added seen as return to all assets used in production
   • RR is a residual that measures return to ecosystem
Regulating services

1. Market prices
   E.g. PES, REDD

2. Avoided damage cost
   Damages if service not available
   E.g. flood protection from mangroves

3. Replacement costs
   Labor+capital of least cost alternative
   e.g. constructing breakwaters

4. Production function
   Isolate effect of input of service on output
   \[ Y = MFP(t) * F(C, L, E) \]
Production function

\[ Y = MFP(t) \times F(\text{Capital, Labor, ecosystem asset}) \]

\textbf{MFP} = \textit{Marginal Factor Productivity}
Value of coastline protection and erosion prevention

Average cost of constructing breakwaters: $ 875 per m

75-m-width mangroves protecting the shoreline would yield $ 12,300 per hectare for a 20-year period (at a discount rate of 10 %)

But this is an over-estimation!

Taking into account that around 30 % of the coastal areas would actually be worthwhile such an investment, the amount reduces to $ 3,700

(Sathirathai and Barbier, 2001)
Cultural services

Hedonic pricing method

Estimate effect of amenities on property prices

Travel cost approach

Impute values through opportunity cost (time and goods)
How to choose your method?

1. **Is there a direct (proxy) market value for the service?**
   Use this value (with adjustments)

2. **Is there a market good to which the service contributes?**
   - Product: resource rent or production function
   - Asset: resource rent or hedonic price method

3. **If not, choose method based upon:**
   - Type of service you are valuing (regulating / cultural)
   - Data availability
Inserting into accounts

Let’s say we have valued the water provisioning services from forests to farmland with the resource rent method, on a national scale. Now we want to integrate this value into the national accounts. How do you think that would affect GDP?

A. GDP would be higher
B. GDP would stay the same
C. GDP would fall

64% 24% 12%
Inserting into accounts

National accounts

Production function value

Proxy market value

Resource rent value

Replacement costs
Valuation of ecosystem assets

- Market (e.g. fish quota rates, insured value)

- Net Present Value of flows from the asset

\[ \text{NPV} = ES_0 + \sum_{t=1}^{\infty} ES_t / (1 + r)^t \]
Net present value

The value of the asset equals the discounted flow of services from the asset

\[ NPV = 100 + \frac{70}{1+0.1} + \frac{55}{(1+0.1)^2} = 209 \]
Resource rent - Example from Namibia

Objective: assess the value of mineral resources

Why: assess the extent to which minerals are being used to build a sustainable economy.

Choice of method:

- No market transactions available for mineral deposits
- Provisioning service: statistically observable = value added of companies engaged in extraction -> resource rent approach

Data sources:

- Physical data about reserves / extraction etc.
- Company data about revenues, costs, fixed assets etc.
Resource rent - Namibia

Output (basic prices) 5721

Value added 3477

Costs 2244

Wages 731

Depreciation 645

Rate of return 631

Resource rent 1483
Balance sheet: Example from Australia

Some assets valued through market prices

Others as NPV

The value of land may reflect a range of ES, but not all (externalities)

<table>
<thead>
<tr>
<th>$ Billions</th>
<th>Jun-2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total assets</td>
<td>10742</td>
</tr>
<tr>
<td>Non-financial</td>
<td>9378</td>
</tr>
<tr>
<td>Produced</td>
<td>4880</td>
</tr>
<tr>
<td>Non-produced</td>
<td>4498</td>
</tr>
<tr>
<td>Natural resources</td>
<td>4495</td>
</tr>
<tr>
<td>Land</td>
<td>3619</td>
</tr>
<tr>
<td>Mineral and energy resources</td>
<td>863</td>
</tr>
<tr>
<td>Standing timber</td>
<td>2</td>
</tr>
<tr>
<td>Spectrum</td>
<td>12</td>
</tr>
<tr>
<td>Permissions to use natural resources</td>
<td>3</td>
</tr>
<tr>
<td>Financial assets</td>
<td>1364</td>
</tr>
<tr>
<td>Total liabilities</td>
<td>2158</td>
</tr>
</tbody>
</table>

Source: 5204.0 Australian System of National Accounts
Exercise: balance sheet

What is the importance of land for Australia’s net worth? (Net worth = total assets less total liabilities)

Suppose we are able to value all ecosystem services.

Make list of possible ecosystem services and what valuation method could be used to value them.

How would that be included in the balance sheet?
Exercise: resource rent

Estimate the resource rent for a hypothetical farm using the following data:

• Sales: 500
• Seeds, fertilizers: 40
• Wages: 200
• Value of machinery: 400; remaining lifetime: 10 years
• Rate of return: 8%
• Investment: 50
• Product based tax: 10
Key messages

Various ways of accounting for ecosystem services

- Qualitative vs. quantitative
- Physical vs. monetary

When valuing always keep context in mind:

- Exchange value is the unifying concept within the SNA
- Object of valuation: ES or ecosystem capital
- Flows: p*q (volumes derived from biophysical modelling)

A range of feasible valuation methods exists

- Choice of method depends on service and data availability