Gross Ecosystem Product (GEP) accounting and Applications in China

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Outline

- What is GEP?
- How to Measure GEP?
- How to Apply GEP?
Gross Ecosystem Product, GEP

GEP is the aggregated value of final ecosystem goods and services supplied annually to people in given region, such as a country, a province, or a county.

Ecosystem asset, EA

EA is a natural asset providing ecosystem services to people, such as a forest, grassland, wetland, coral reef, farm, city park, and other natural or managed ecosystems.
GEP accounting framework

Criteria for GEP accounting

✧ GEP is a measurement of the aggregate monetary value of ecosystem-related goods and services in the accounted areas

✧ Measure use value of ecosystem services
  ✓ Direct use value: e.g., food, bio-energy, water resources
  ✓ Indirect use value: e.g., water retention, soil retention, pollutant purification, climate regulation

✧ Measure value of final ecosystem services
  ✓ Material services (ecosystem goods), regulating services, and non-material services

✧ First, measure biophysical value (quantity)
  ✓ E.g., amount of food production, amount of water purification, amount of flood protection

✧ Second, measure monetary value (value added per unit x quantity)
  ✓ The economic value of ecosystem services
Ecosystem services in GEP accounting

GEP accounting framework

Material services
- Food
- Medicinal herbs
- Water supply
- Energy
- Raw materials
- Others

Regulating services
- Water retention
- Water quality improvement
- Air quality improvement
- Soil retention
- Climate regulation
- Carbon sequestration
- Flood mitigation
- Pollination
- Pest control
- Coastal protection
- Sandstorm prevention

Cultural services
- Recreation and tourism
- Aesthetic benefits
GEP accounting framework

a) Accounting of bio-physical values of ecosystem goods and services
b) Pricing ecosystem goods or services
c) Accounting of economic values of ecosystem goods and services

\[ GEP = EMV + ERV + ECV \]

\[ GEP = \sum_{i=1}^{n} EM_i \times P_i + \sum_{j=1}^{m} ER_j \times P_j + \sum_{k=1}^{l} EC_k \times P_k \]

EMV: monetary value of ecosystem material services
ERV: monetary value of ecosystem regulating services
ECV: monetary value of ecosystem non-material (cultural) services.
GEP pilot accounting

Pilot GEP accounting in China
✓ 4 provinces
✓ 10+ cities/prefectures
✓ 100+ counties

Supported by SEEA-EA Program
✓ Guizhou Province
✓ Pu’er city, Yunnan Province
✓ Pear River Basin, Guangxi Pro.
Guizhou Province

- Located at south-western China
- 176,100 km² area, 36.8 million people
- Dominant ecosystem type is forest
- Globally significant area for biodiversity, home of many endangered species, such as gray snub-nosed monkey, black-necked crane.
- Karst region with highly sensitiveness to rock desertification
## GEP pilot accounting - Guizhou

<table>
<thead>
<tr>
<th>Category</th>
<th>Products</th>
<th>Biophysical value</th>
<th>Monetary value (billion yuan)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agricultural products</strong></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Rice (x10^4 t)</td>
<td>445.65</td>
<td>118.59</td>
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</tr>
<tr>
<td>Wheat (x10^4 t)</td>
<td>24.83</td>
<td>4.42</td>
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<tr>
<td>Corn (x10^4 t)</td>
<td>415.43</td>
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<tr>
<td>Bean (x10^4 t)</td>
<td>15.99</td>
<td>5.98</td>
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<tr>
<td>Potato (x10^4 t)</td>
<td>141.43</td>
<td>35.24</td>
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<tr>
<td>Rapeseed (x10^4 t)</td>
<td>51.62</td>
<td>22.97</td>
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<tr>
<td>Peanuts (x10^4 t)</td>
<td>7.68</td>
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<tr>
<td>Sugarcane (x10^4 t)</td>
<td>52.24</td>
<td>2.14</td>
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<tr>
<td>Cigarette (x10^4 t)</td>
<td>37.02</td>
<td>65.90</td>
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<tr>
<td>Vegetable (x10^4 t)</td>
<td>1202.04</td>
<td>187.52</td>
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<tr>
<td>Apple (x10^4 t)</td>
<td>1.55</td>
<td>0.78</td>
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<tr>
<td>Pear (x10^4 t)</td>
<td>18.21</td>
<td>10.87</td>
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<tr>
<td>Orange (x10^4 t)</td>
<td>20.37</td>
<td>8.15</td>
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<tr>
<td>Banana (x10^4 t)</td>
<td>0.61</td>
<td>0.37</td>
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<tr>
<td>Bayberry (x10^4 t)</td>
<td>2.90</td>
<td>2.90</td>
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<tr>
<td>Kiwifruit (x10^4 t)</td>
<td>1.30</td>
<td>1.04</td>
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<tr>
<td>Persimmon (x10^4 t)</td>
<td>1.36</td>
<td>1.09</td>
<td></td>
</tr>
<tr>
<td>Tea (x10^4 t)</td>
<td>5.23</td>
<td>10.46</td>
<td></td>
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<tr>
<td><strong>Total (x10^4 t)</strong></td>
<td><strong>2445.46</strong></td>
<td><strong>565.23</strong></td>
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</tr>
<tr>
<td><strong>Husbandry products</strong></td>
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<tr>
<td>Beef meat (x10^4 t)</td>
<td>11.99</td>
<td>40.77</td>
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<tr>
<td>Lamb meat (x10^4 t)</td>
<td>3.40</td>
<td>15.37</td>
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<tr>
<td>Pork meat (x10^4 t)</td>
<td>148.09</td>
<td>196.23</td>
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<tr>
<td>Poultry meat (x10^4 t)</td>
<td>14.12</td>
<td>50</td>
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<tr>
<td>Milk (x10^4 t)</td>
<td>4.59</td>
<td>9.18</td>
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<tr>
<td>Egg (x10^4 t)</td>
<td>12.51</td>
<td>20.02</td>
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<tr>
<td>Bee honey (x10^4 t)</td>
<td>0.19</td>
<td>0.34</td>
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<tr>
<td>Others (x10^4 t)</td>
<td>0.10</td>
<td>0.95</td>
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<tr>
<td>Fishery goods</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Fish (x10^4 t)</td>
<td>8.79</td>
<td>13.82</td>
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### GEP pilot accounting-Guizhou

<table>
<thead>
<tr>
<th>Regulation Services</th>
<th>Indicators</th>
<th>Biophysical value</th>
<th>monetary value (billion yuan)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil retention</td>
<td>Fertilizer conservation (million t)</td>
<td>0.65</td>
<td>1.697</td>
</tr>
<tr>
<td></td>
<td>Silt decreasing (billion m³)</td>
<td>0.10</td>
<td>0.593</td>
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<tr>
<td>Water retention</td>
<td>water conservation (billion m³)</td>
<td>86.40</td>
<td>527.898</td>
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<tr>
<td>Flood mitigation</td>
<td>Lake conditioning (billion m³)</td>
<td>0.08</td>
<td>0.507</td>
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<tr>
<td></td>
<td>Reservoir conditioning (10 billion m³)</td>
<td>11.76</td>
<td>71.847</td>
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<tr>
<td>C sequestration</td>
<td>C fixation (million t)</td>
<td>368</td>
<td>441.600</td>
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<tr>
<td>Oxygen production</td>
<td>Oxygen production (million t)</td>
<td>276</td>
<td>276.000</td>
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<tr>
<td>Air purification</td>
<td>Industrial fumes (million t)</td>
<td>0.25</td>
<td>0.038</td>
</tr>
<tr>
<td></td>
<td>Dusts (million t)</td>
<td>0.09</td>
<td>0.013</td>
</tr>
<tr>
<td>Air purification</td>
<td>Industrial wastewater (million t)</td>
<td>32</td>
<td>0.067</td>
</tr>
<tr>
<td></td>
<td>Domestic wastewater (million t)</td>
<td>159</td>
<td>0.332</td>
</tr>
<tr>
<td>Climate regulation</td>
<td>Plant heat absorption (MJ)</td>
<td>$1.03 \times 10^9$</td>
<td>0.131</td>
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<tr>
<td></td>
<td>Surface water heat absorption (MJ)</td>
<td>$4.18 \times 10^{12}$</td>
<td>533.6</td>
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<tr>
<td>Pest control</td>
<td>Area of natural forest (km²)</td>
<td>52151.86</td>
<td>0.091</td>
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</table>
**Guizhou GEP: 2001.346 billion yuan**

<table>
<thead>
<tr>
<th>Categories</th>
<th>Economic values (billion yuan)</th>
<th>Ratio</th>
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<tbody>
<tr>
<td>Ecosystem goods</td>
<td>208.345</td>
<td>10.4</td>
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<tr>
<td>Regulating services</td>
<td>1379.313</td>
<td>68.9</td>
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<tr>
<td>Cultural services</td>
<td>413.688</td>
<td>23.7</td>
</tr>
<tr>
<td>Total</td>
<td>2001.346</td>
<td>100</td>
</tr>
</tbody>
</table>
Applications of GEP accounting

Ecosystem assets
Ecosystems (forests, wetland, grassland, etc.), plants and wildlife
ecological patterns, structures, processes

Gross Ecosystem Product
Ecosystem services
(material, regulating, non-material)

Decision Implementation
Protection, restoration, compensation, sustainable management

Decision-making contexts at county, city, provincial and national levels
- Evaluation of government policy and performance
- Land use and infrastructure planning
- Financial compensation for ecosystem services suppliers
Applications of GEP accounting

Applications of GEP in key realms ~

by central government, provinces, cities, companies

✦ Evaluating government policy and performance in conservation. **NDRC, MEE, Inner-Mongolia, Guizhou, Qinghai, Zhejiang, Shenzhen, Shunde, Tonghua**

✦ Providing the basis for determining financial compensation for the provision of ecosystem services. **Lishui, Pu’er, Zhejiang**

✦ Evaluating sustainable development (harmony of people and nature), **Shenzhen, Zhuhai**

✦ Bringing the value of ecosystem services and trends into public and private sector decision making and investment planning. **Zhejiang, Lishui, Fuzhou, Alibaba**

✦ Measuring nature’s contribution to people, and to other parts of China. **Qinghai, Ganzhi**
Applications of GEP accounting

Future arrangements for GEP accounting and applications

- NDRC, NBS with related governmental agencies are preparing Guideline of GEP Accounting, and Guideline of Ecosystem Asset and hopefully release soon.
  - CAS-RCEES provided technic support for formation Guideline of GEP and Ecosystem Asset Accounting, and develop GEP and EA Accounting software.
  - Based on SEEA-EA framework, and pilot study in Guangxi and Guizhou under project of NCAVES,
- NDRC and NSB will support pilots for GEP Accounting and Applications in China
  - Six Mechanisms
    - Mechanism of ecosystem product survey and monitoring
    - Mechanism of GEP / ecosystem asset accounting and applications
    - Marketing mechanism of ecosystem products
    - Mechanism of compensation for ecosystem products
    - Implementation mechanism for value realization of ecosystem products
    - Promotion mechanism for value realization of ecosystem products
Findings

✧ GEP converts ecosystem services into a common monetary metric that is easy to interpret, provides visibility, and gives prominence to the values of nature and their contributions to human well-being.
✧ GEP can provide decision makers with clear and compelling evidence of the monetary value of ecosystem services.
✧ GEP can be applied for evaluation of government policy and performance, and land use and infrastructure planning.
✧ GEP can provide the basis for determining financial compensation for the provision of ecosystem services.
✧ The Qinghai results demonstrate that it is feasible to produce an estimate of GEP with available data and methods: That is, that there is a tractable approach to producing estimates of GEP, not just in Qinghai but all across China, and indeed for all countries in the world.
Findings and challenges

Challenges

✧ **Data limitations.** Current environmental monitoring systems are not designed for ecosystem service evaluation and accounting.

✧ **Models** for quantifying many ecosystem services are in early stages of development. Focus initially on a core set of services for which science is advanced and robust.

✧ **Pricing of ecosystem services.** There are no market prices for most ecosystem services.

✧ **Accounting value.** Lack of data that allows attribution of value added between nature- and human-contributed inputs.

✧ **The set of ecosystem services** in pilot GEP accounting in China is incomplete. In Qinghai GEP accounting, for instance, we did not include the value of oxygen generation (O₂ is extremely important in Qinghai and Tibetan Plateau), many human health benefits from nature, and cultural services other than ecotourism.
Suggestions

✓ **Standardize** accounting methods to compute GEP internationally

✓ **Update existing monitoring system** for the purpose of providing data for GEP accounting

✓ **Pilot GEP accounting in different countries**, in pragmatic ways that drive investment in green, inclusive development.
Thanks

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