Mainstreaming ecosystem services and biodiversity into Conservation Policy in China

Zhiyun Ouyang

Research Center for Eco-Environmental Sciences
Chinese Academy of Sciences

November, 18-19, Kampala, Uganda
Contents

- Background
- China ecosystem survey and assessment
- Mapping ecosystem services of China
- Linking ecosystem services to policy-making
- Investment in natural capital
- GEP accounting
Background

China’s environment is facing increasing challenges from:

- **Huge population**: 1.38 billion
- **Fast urbanization**: Urban rates 59% in 2018, 36% in 2000
- **Massive natural resource exploitation**
  - Coal mining: 3.7 billion tons
  - Fresh water withdrawn: 326.3 billion M³
- **Ecosystem service decline and wildlife habitat lost**
  - Soil erosions and rocky desertification,
  - Frequency of sandstorm, flooding
- **Vicious-circle of ecosystem degradation and poverty**
In both 18\textsuperscript{th} and 19\textsuperscript{th} National Congress of the Communist Party declared China’s Dream

- Harmonizing people and nature
- Building the ecological civilization of the 21\textsuperscript{st} century

Key issues: how to coordinate conservation and development?
- Where we must protect to ensure sustainable supply of ecosystem services?
- How to achieve natural capital conservation & poverty alleviation?
- How to evaluate the development achievements, not only GDP?
Background

Ecosystem Service Science

- Evaluation methods of ecosystem services
- Ecosystem structure, process and services

Ecosystem survey & assessment

- Mapping ecosystem services

Linking ecosystem services with policy making

- Ecological protection redline
- Key ecological function areas
- Ecological compensation
- National park system
- Ecological capacity

Eco-security & Eco-civilization
China ecosystem survey and assessment
China ecosystem survey and assessment

- **Scales:** Provincial (31)—Regional—National scales
- **Ground survey sites:** 114,500
- **Model:** InVEST and others
- **Goals:** Build an overall image of ecosystem status of China
  - Ecosystem distribution and patterns
  - Ecosystem quality and their changes
  - Ecosystem services and their changes
  - Identify crucial areas for ecosystem services
China ecosystem patterns and changes

China ecosystem composition and patterns

Grassland, forest, cropland and desert were made of 82.8% of total area of China
China ecosystem patterns and changes

Changes of ecosystem composition and pattern

**Urbanization regions:** Yangtze river delta, Jing-Jin-Ji, Zhujiang river delta, Liaodong peninsula, Shangdong peninsula

**Cropland expansion region:** North-eastern plain, DaxinganLing, in North-eastern China, Oasis surroundings in Xingjiang, Coastal regions in northern Jiangsu.

**Forest restored regions:** Loess Plateau, the surroundings of Sichuan Plain, Zhejiang, Guizhou, Chongqing
Mapping ecosystem services of China

- Food production
- Water retention
- Soil retention
- Sand storm prevention
- Carbon sequestration
- Flood mitigation
- Biodiversity conservation
We translated biophysical supply of ecosystem services into importance of service provision by weighting supply by the number of people affected.
Changes of ecosystem service pattern in China

A. Spatial pattern of ecosystem service improve

B. Spatial pattern of ecosystem service decreased

All ecosystem services evaluated increased between 2000 and 2010, with the sole exception of habitat provision for biodiversity.

Linking ecosystem services to policy making

- Identify crucial areas of ecosystem services
- Figure out conservation gabs
- Initiate and supporting new conservation policy
Linking ecosystem services to policy making

Identify crucial areas of ecosystem services in China

<table>
<thead>
<tr>
<th>Importance</th>
<th>Land area</th>
<th>Soil retention</th>
<th>Water retention</th>
<th>Sand storm prevention</th>
<th>Biodiversity conservation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$10^4$km²</td>
<td>%</td>
<td>%</td>
<td>%</td>
<td>%</td>
</tr>
<tr>
<td>Very high</td>
<td>343.6</td>
<td>35.8</td>
<td>66.3</td>
<td>60.8</td>
<td>37.3</td>
</tr>
<tr>
<td>High</td>
<td>204.6</td>
<td>21.3</td>
<td>22.0</td>
<td>21.8</td>
<td>27.0</td>
</tr>
<tr>
<td>Medium</td>
<td>161.2</td>
<td>16.8</td>
<td>9.1</td>
<td>11.9</td>
<td>19.2</td>
</tr>
<tr>
<td>Normal</td>
<td>246.8</td>
<td>25.7</td>
<td>2.5</td>
<td>5.4</td>
<td>16.5</td>
</tr>
</tbody>
</table>

The table showed that about 35% land with high level of ecological importance provide about 60% of ecosystem regulating services.
Linking ecosystem services to policy making

Figure out conservation gabs

Protected Areas not well match with biodiversity and ecosystem service pattern
Linking ecosystem services to policy making

Ecological Protection Redline

- The very high important areas are planned as Ecological Protection Redline (EPR) to protected strictly for providing ecosystem services and wildlife habitat
- EPR: 35% of China

Guideline for ecological redlining by MEP and NDRC
Linking ecosystem services to policy making

Ecosystem function conservation areas

- 63 areas with critical ecosystem services were identified as Ecosystem function conservation areas (EFCAs) released in 2015 by MEP and CAS.
- Total 63 EFCAs, 49% of China.
Linking ecosystem services to policy making

In order to push conservation in key ecological function areas, the center government launched ecological financial transfer program based on ecosystem service pattern.

The budget was increased to 62.7 billion yuan in 2017 from 6.0 billion yuan in 2008.

<table>
<thead>
<tr>
<th>Year</th>
<th>Budgets (billions RMB)</th>
<th>Benefited Counties</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>6.0</td>
<td>221</td>
</tr>
<tr>
<td>2010</td>
<td>24.9</td>
<td>437</td>
</tr>
<tr>
<td>2014</td>
<td>48.3</td>
<td>512</td>
</tr>
<tr>
<td>2017</td>
<td>62.7</td>
<td>715</td>
</tr>
</tbody>
</table>
Linking ecosystem services to policy making

National park system planning

The national parks were located based on distribution of represented ecosystems, natural landscape, wildlife and ecosystem services.
Applications in local governments

- All provinces in China have mapped ecosystem services, and identified local ecosystem function conservation areas.
- Ecosystem service spatial patterns were the basis for urban master planning and regional land use planning in many cities, as Beijing, Guangzhou.
Investment of natural capital
China has made great efforts in ecosystem conservation and restoration

✧ Sloping Lands Conversion Program targeting forest /Grassland restoration (SLCP-F)(1999-)
✧ National Forest Conservation Program (NFCP) (1998-)
✧ Three-North Shelter Forest Program (TNSFP)(1978-)
✧ Public ecological forest conservation program (2004-)
✧ Ecological financial transfer program (2008-)
✧ Regional ecological restoration program(2002-)
Investment of natural capital in China

National Forest Conservation Program (NFCP)
- 901 counties in 18 provinces
- Protected forests: 0.12 billion hectares
- Budgets: 360 billion RMB

Sloping Lands Conversion Program
- 2279 counties in 25 provinces
- Investment: > 400 billion RMB
- Returned cropland: 9.0 million hectares
- Benefited household: 32 million.
Investment of natural capital in China

Three north green belt project

- 13 provinces, 551 counties
- Investment: > 45 billion RMB
- Reforestation: 29.19 million hectares

Karst region ecosystem restoration project

- 300 counties in 5 provinces
- Protected forests: 0.12 billion hectares
- Budgets: 11.9 billion RMB
- Benefited people: 51.96 million people
Gross Ecosystem Product (GEP)
Region is a coupled nature-economic-social system

✧ Economy: GDP is widely used to measure economic system performance.
✧ Society: HDI (Human development index) is used to measure social development status based on health, education and living-standard since 1991.
✧ Nature: currently we do not have widely used index to measure its contribution to human welfare.
Concept of GEP

Gross Ecosystem Product, GEP

- Gross Ecosystem Product (GEP) is the total value of final ecosystem goods and services supplied to human well-being in given region annually, like a county, or a province, a county.

- Ecosystem asset (EA) is the natural asset that provides ecosystem goods and services.

- Ecosystems:
  - Natural ecosystem: forests, grasslands, wetland, desert, marine, ...
  - Managed ecosystem: cropland, orchards, aquaculture farms, urban green-space, ...
  - Wildlife,
Concept of GEP

**Purposes of GEP accounting**

- Assessment/description of ecosystem status
- Evaluation of the contribution of ecosystems to human welfare
- Assessment of effectiveness of conservation efforts
- Evaluation of performance of local governments or communities in natural conservation, particularly in China
- Reveal the ecological linkages among regions
  - Ecological dependency
  - Ecological supporting
GDP, HDI, and GEP

- **GDP** refers to the goods and services provided by economic systems.
- **HDI** (Human Development Index) is a measure of human development.
- **GEP** (Genuine Economic Performance) is the GDP minus natural and environmental costs.

**Concept of GEP**

- **Value of ecosystem goods**
- **Value of ecosystem regulating and cultural services**

**GEP, GDP and Green GDP**

- **GEP**, the goods and services provided by ecosystems.
- **GDP**, the goods and services provided by economic systems.
- **Green GDP**, the GDP minus natural and environmental costs.
# GEP and SEEA-EEA

<table>
<thead>
<tr>
<th></th>
<th>GEP</th>
<th>SEEA-EEA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Similarity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basic ideas</td>
<td>Valuing the contribution of nature to human wellbeing</td>
<td></td>
</tr>
<tr>
<td>Accounting principles</td>
<td>Ecosystem products and services</td>
<td></td>
</tr>
<tr>
<td>Main contents</td>
<td>Flows of value (ecosystem material products, regulating services, and cultural services) and stocks (ecosystem asset)</td>
<td></td>
</tr>
<tr>
<td>Methods</td>
<td>Similar methods for regulating and cultural services</td>
<td></td>
</tr>
<tr>
<td><strong>Difference</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Definition</td>
<td>The aggregated value of ecosystem products and services in given region.</td>
<td>Comprehensive framework for valuing ecosystem services</td>
</tr>
<tr>
<td>Attributes</td>
<td>A comprehensive indicator to measure the contribution of nature to human wellbeing</td>
<td>Technical guideline for valuing ecosystem products and services</td>
</tr>
<tr>
<td>Index</td>
<td>Ecosystem products including the materials from both natural and managed ecosystems</td>
<td>Ecosystem products including the materials only from natural ecosystems</td>
</tr>
<tr>
<td>Policy implementation</td>
<td>An indicator to evaluate performance of conservation policies and efforts</td>
<td>A technical guideline to evaluate performance of conservation policies and efforts</td>
</tr>
<tr>
<td>Calculation methods</td>
<td>There are some different calculation methods for individual services, eg, ecosystem material products, water retention, EA.</td>
<td></td>
</tr>
</tbody>
</table>
**Use value of ecosystem services**
- Direct use value: food, bio-energy, water resource,
- Indirect use value: water retention, soil retention, pollutant purification, climate regulation

**The value of final eco-services**
- Ecosystem goods, regulating services, cultural services

**The bio-physical value accounting**
- Amount of food production, amount of water retention, amount of soil retention,

**The monetary value accounting**
- The economic value of ecosystem services
GEP accounting methods

Ecosystem and environmental monitoring

Ecosystem service bio-physical valuation

Ecosystem Service Pricing

Ecosystem service monetary valuation

GEP accounting

Market pricing  Alternative market  Market model simulation
GEP accounting methods

- Accounting of economic values of ecosystem services
  - GEP: the total economic value of ecosystem provision (EPV), Ecosystem regulating services (ERV) and cultural services (ECV) in the given area annually.

\[
GEP = EPV + ERV + ECV
\]

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

<table>
<thead>
<tr>
<th>Categories</th>
<th>Goods and services (examples)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecosystem goods</td>
<td>Food: grain, vegetable, fruits, meat, milk, egg, fish,</td>
</tr>
<tr>
<td></td>
<td>Materials: wood, fiber, water, genes,</td>
</tr>
<tr>
<td></td>
<td>Energy: bio-energy(fuelwood), hydro-power, wind energy,</td>
</tr>
<tr>
<td></td>
<td>Others: medicine, seedling, ornament</td>
</tr>
<tr>
<td>Regulating services</td>
<td>Regulation services: water conservation, soil conservation, carbon sequestration, climate regulating, pollutant purification, pollination,</td>
</tr>
<tr>
<td></td>
<td>Protecting services: sand storm prevention, flooding mitigation, pest control,</td>
</tr>
<tr>
<td>Cultural service</td>
<td>Aesthetic services: recreation and ecotourism</td>
</tr>
<tr>
<td></td>
<td>Cultural value: knowledge, education, arts, spirit</td>
</tr>
</tbody>
</table>
GEP experimental accounting in Qinghai province
The grassland assets index is the highest, indicating that grassland is main kind of ecological assets in Qinghai Province. Grassland assets index increased the most with 13.6%, because of grassland quality promotion; Increase rate of river assets index is 12.1%, because of river quality promotion.
### GEP and EA accounting of pilot areas

#### Bio-physical value & monetary value of GEP in Qinghai Province

<table>
<thead>
<tr>
<th>Types of service</th>
<th>Category of ecosystem services</th>
<th>Accounting items</th>
<th>2015</th>
<th>Bio-physical quantity</th>
<th>Monetary value (Billion Yuan)</th>
<th>% of total value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Material services</strong></td>
<td>Production of ecosystem goods</td>
<td>Agricultural crop production ($x10^2$ t)</td>
<td>3091.2</td>
<td>5.6</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Animal husbandry production ($x10^2$ t)</td>
<td>724</td>
<td>5.8</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fishery production ($x10^2$ t)</td>
<td>10.6</td>
<td>0.3</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Forestry production ($x10^3$ m$^3$)</td>
<td>825</td>
<td>0.7</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plant nursery production ($x10^9$)</td>
<td>11</td>
<td>0.7</td>
<td>0.1</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td></td>
<td>13.1</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water supply</td>
<td>Water use in downstream agricultural irrigation ($x10^9$ m$^3$)</td>
<td>15</td>
<td>1.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water use in households ($x10^9$ m$^3$)</td>
<td>13.8</td>
<td>1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Water use in industry ($x10^9$ m$^3$)</td>
<td>29.2</td>
<td>2.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hydropower production ($x10^9$ kwh)</td>
<td>92</td>
<td>48.8</td>
<td>4.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td></td>
<td>106.7</td>
<td>9.7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Flood mitigation</td>
<td>Flood mitigation ($x10^3$ m$^3$)</td>
<td>0.07</td>
<td>0.03</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Retained soil ($x10^9$ t)</td>
<td>0.4</td>
<td>7</td>
<td>0.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Soil retention and non-point pollution prevention</td>
<td>Retained N ($x10^3$ t)</td>
<td>10</td>
<td>0.02</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Retained P ($x10^3$ t)</td>
<td>0.7</td>
<td>0.002</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water purification (wetland)</td>
<td>COD purification ($x10^3$ t)</td>
<td>104.3</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>NH-N purification ($x10^3$ t)</td>
<td>10</td>
<td>0.02</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>TP purification ($x10^3$ t)</td>
<td>0.9</td>
<td>0.003</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>SO$_2$ purification ($x10^3$ t)</td>
<td>150.8</td>
<td>0.2</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Air purification</td>
<td>NO$_2$ purification ($x10^3$ t)</td>
<td>117.9</td>
<td>0.1</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dust purification ($x10^3$ t)</td>
<td>246</td>
<td>0.04</td>
<td>0.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sandstorm prevention</td>
<td>Sand retention ($x10^6$ t)</td>
<td>0.5</td>
<td>31.7</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Carbon sequestration</td>
<td>Carbon sequestration ($x10^3$ t)</td>
<td>0.02</td>
<td>4.7</td>
<td>0.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Climate regulation</td>
<td>By vegetation ($x10^9$ kwh)</td>
<td>653.5</td>
<td>346.3</td>
<td>31.4</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>By water surface ($x10^9$ kwh)</td>
<td>1078.3</td>
<td>571.5</td>
<td>51.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td></td>
<td>961.7</td>
<td>87.2</td>
<td></td>
</tr>
<tr>
<td><strong>Cultural services</strong></td>
<td>Eco-tourism</td>
<td>Tourists ($x10^6$ persons)</td>
<td>23.2</td>
<td>21.6</td>
<td>2.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grand Total</td>
<td></td>
<td>1103.115</td>
<td>100.0</td>
<td></td>
</tr>
</tbody>
</table>
GEP of Qinghai in 2015: 1103.1 Billion

<table>
<thead>
<tr>
<th>Items</th>
<th>Value (billion yuan)</th>
<th>Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Material services</td>
<td>119.8</td>
<td>10.9</td>
</tr>
<tr>
<td>Regulating services</td>
<td>961.7</td>
<td>87.1</td>
</tr>
<tr>
<td>Cultural service</td>
<td>21.6</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1103.1</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

GEP constitute of Qinghai Province in 2015
GEP and EA accounting of pilot areas

Ecosystem services produced within Qinghai Province

Material services
Ecosystem services produced within Qinghai Province

Regulating services

GEP and EA accounting of pilot areas
GEP and EA accounting of pilot areas

The location of beneficiaries in recipient provinces
## Changes of the GEP in Qinghai Province (2000–2015)

<table>
<thead>
<tr>
<th>Services</th>
<th>2015 (Billion Yuan)</th>
<th>2000 (Billion Yuan)</th>
<th>2000–2015 (constant price)</th>
<th>Rate of change (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Provisioning services</td>
<td>119.8</td>
<td>50.3</td>
<td>138.2</td>
<td>138.2</td>
</tr>
<tr>
<td>Regulating services</td>
<td>961.72</td>
<td>945.09</td>
<td>1.8</td>
<td>1.8</td>
</tr>
<tr>
<td>Culture services</td>
<td>21.6</td>
<td>3</td>
<td>620.0</td>
<td>620.0</td>
</tr>
<tr>
<td>GEP</td>
<td>1,103.12</td>
<td>998.39</td>
<td>10.5</td>
<td>10.5</td>
</tr>
</tbody>
</table>
China has made big efforts to apply ecosystem service evaluation and mapping in conservation policies.

Ecosystem service evaluation can be powerful and useful tools to support conservation policy making and innovation.

China is developing GEP accounting for evaluation of effectiveness of ecological compensation, conservation efforts.

Opportunity
- Urban ecological restoration: ecosystem service orientation
- Coastal management
- Marketing mechanism for ecosystem services.
Chinese Academy of Sciences (CAS)
Ministry of Environmental Protection of China
National Development and Reform Commission of China
Ministry of Science and Technology of China
National Natural Science Foundation of China
Natural Capital Project
Asian Development Bank
SEEA-EEA

... ...

Thanks!