Gross Ecosystem Product (GEP) and Ecological Asset Accounting for Eco-Compensation

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Outline

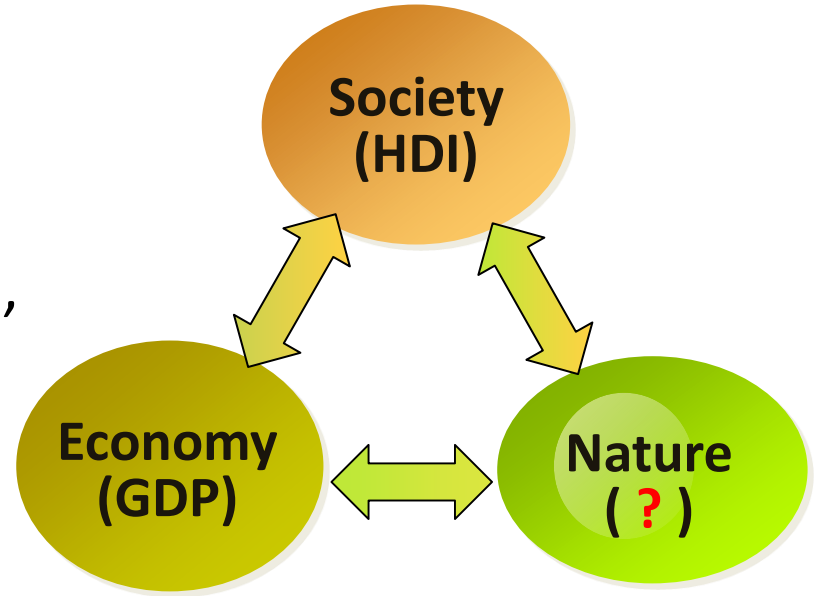
1. Background
2. GEP Concept and Purposes
3. Accounting Framework
4. GEP Experimental Accounting
5. Main Findings

Background

Background

Community 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.
- **Natural environment**: currently we do not have widely used index to measure its sustainability.



Background

- Nature (Ecosystem) is essential for human survival and development.
  - Creating and maintaining Earth's living supporting system: water cycling, soil formation and fertility, atmosphere chemistry stable.
  - Providing humans with food fiber, water, bio-energy.
- Natural (Ecosystem) services: the benefits humans obtained from the nature/ecosystems (MA, 2003).

Background

- Both developed and developing countries are attempting to find new accounting indicators or accounting system beyond GDP, to quantify the linkage between ecosystems and human well-being.
- The creation of a new system to account for ecosystem goods and services at national or regional scales has become a hot international topic for advancing the sustainable development agenda.

Background

Natural / Ecosystem service evaluation is the hot topic globally.

- UN: IPBES (Inter-government platform for Biodiversity and Ecosystem Services), 2012-
- UN: Millennium Ecosystem Assessment, 2003-2008
- UNSD: SEEA (Environmental and economic accounts), 2003, 2012
- UNSD: Land and ecosystem accounts, 2012
- World Bank: Wealth accounting and valuation of ecosystem services
- TEEB: The Economics of Ecosystems and Biodiversity, 2010
- EEA (European Environment Agency): Simplified ecosystem capital accounts
- UK: National ecosystem service assessment
- Australia: Ecosystem Accounting—Policy Applications, 2012
- SC (Statistics Canada): Measuring ecosystem goods and services
- People's Republic of China: Ecosystem survey assessment of China, 2012

Background

Chinese government initiated eco-civilization and related policies.

- Integrated **ecological benefits into economic and social development evaluation system**.
- Establish **eco-compensation policy, reflecting** the market demand and resource scarcity, as well as **ecological value** and inter-generational compensation.
- Improve **accountability system** of **ecological and environmental protection** and environmental damage compensation system.
- Establish **natural capital accounting system.**

Background

- Clean water and green mountain are golden and silver mountain.
  - Ecosystem and nature have huge values.
  - Ecological value can be transferred to economic benefits.
- In the 19th Congress of the CCP, our modernization, characterized with harmony between humans and nature, … and provides more high quality ecological products (and services).

GEP Concept

Concept of GEP

Gross Ecosystem Product, GEP

- Gross Ecosystem Product (GEP) is the total value of final ecosystem goods and services supplied to humans in a given region annually, like a county, province, or county.
- Ecological asset (EA) is the natural asset that provides ecosystem goods and services.
- Ecosystems:
  - **Natural ecosystems**: forests grasslands, wetland, desert, marine, etc.
  - **Managed ecosystems**: cropland, orchards, aquaculture farms, urban green-space, etc.
  - **Wildlife resources**

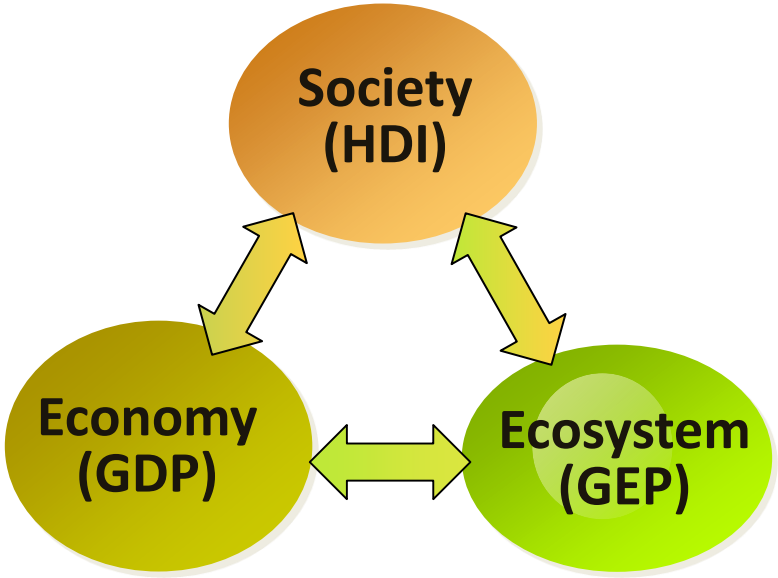
Concept of GEP

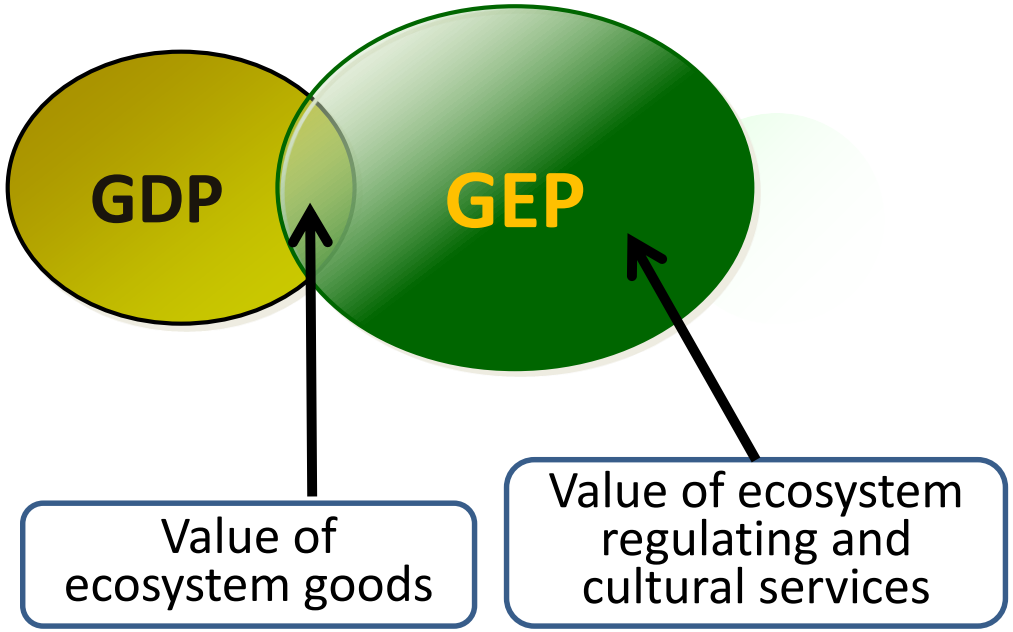
Purposes of GEP accounting

- Assessment/description of ecosystem status
- Measurement of community sustainability
- Evaluation of the contribution of ecosystems to human welfare and socio-economic development
- Evaluation of effects of conservation efforts
- Reveal the ecological linkages among regions
  - Ecological dependency
  - Ecological supporting

Concept of GEP

- GDP, HDI, and GEP

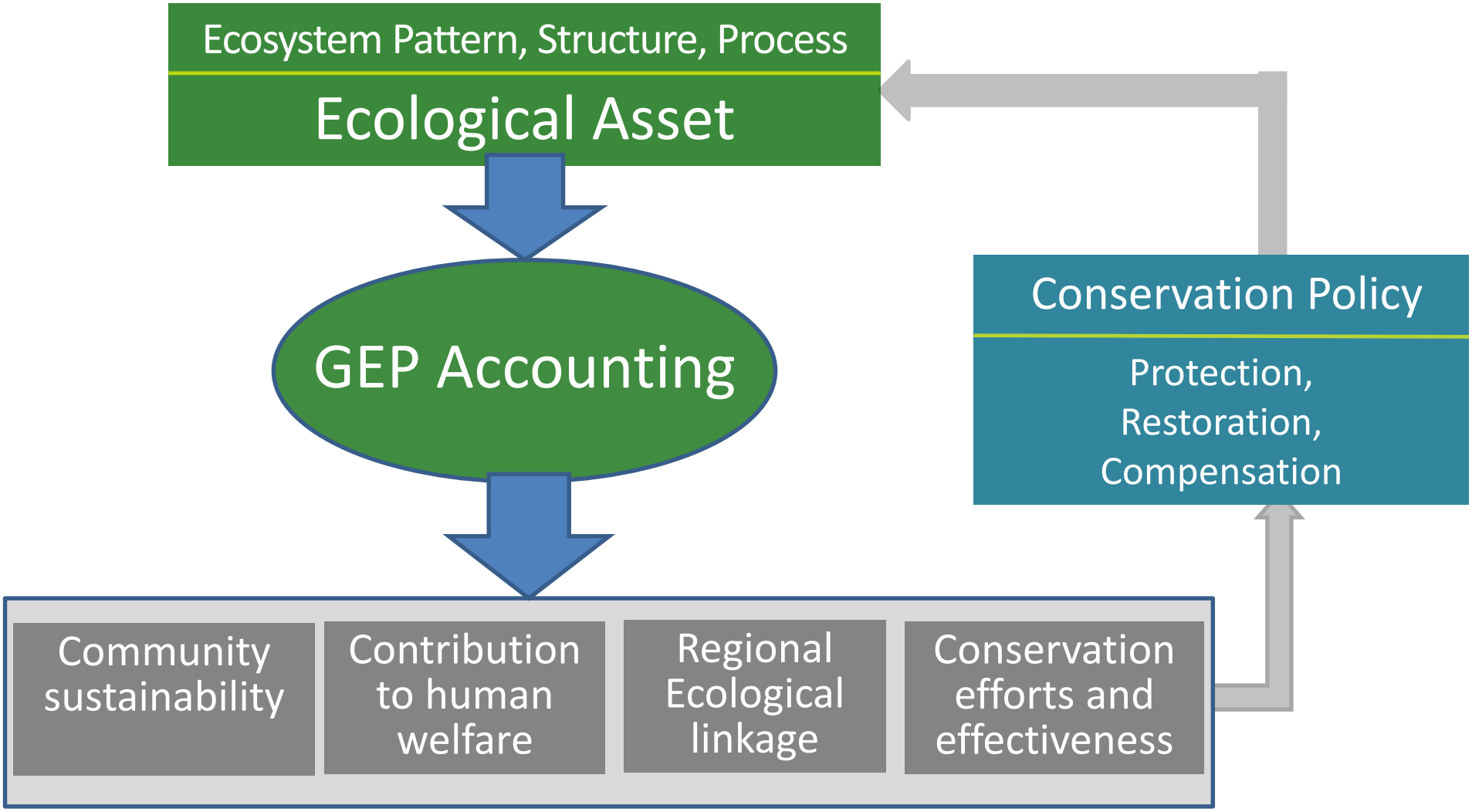




- GEP, GDP and Green GDP
  - **GEP**: the goods and services provided by ecosystems.
  - **GDP**: the goods and services provided by economic systems.
  - **Green GDP**: the GDP minus natural and environmental costs.

Concept of GEP

GEP accounting and policy implementation



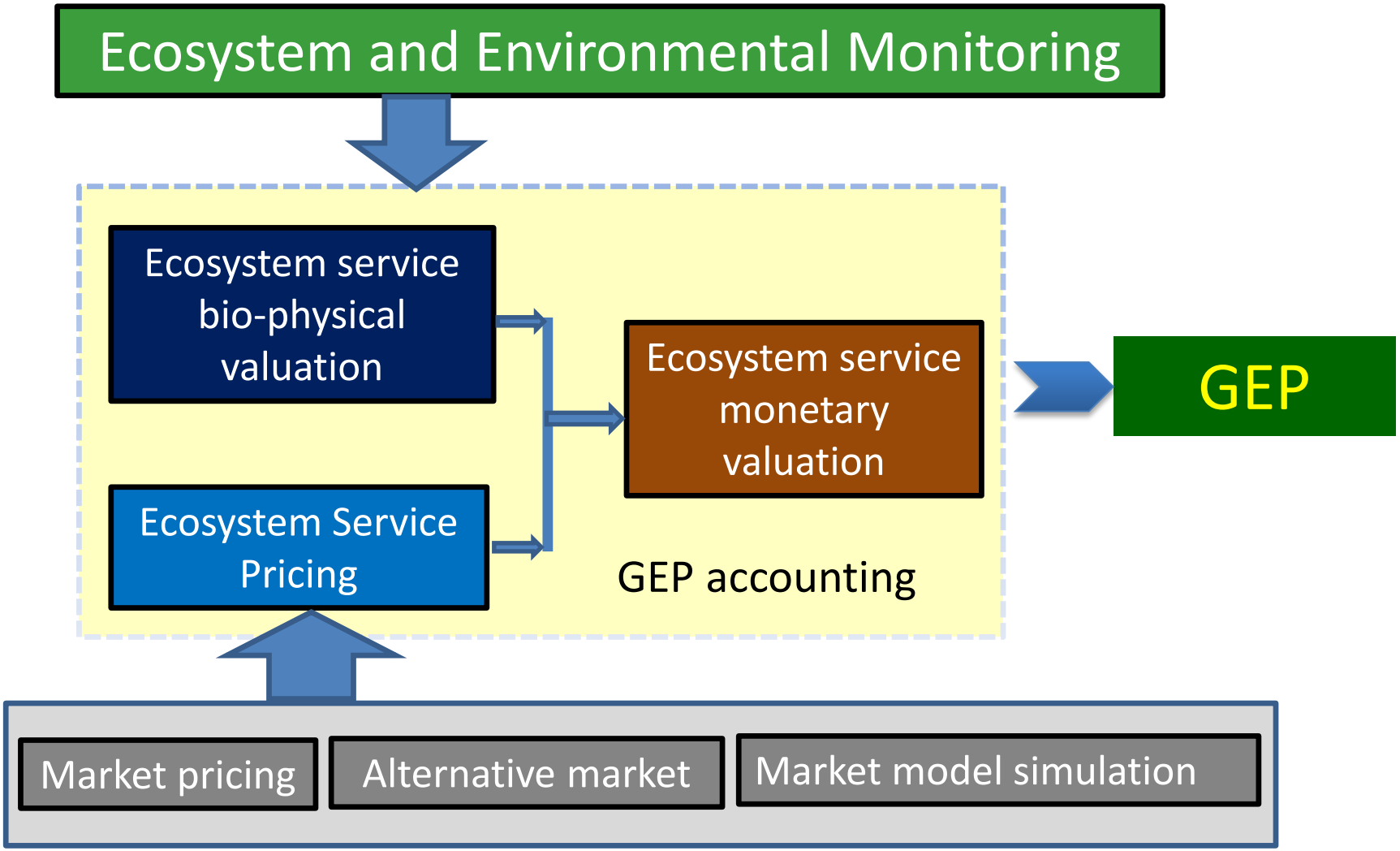
Accounting Method of GEP

GEP Accounting Methods

The principle of GEP accounting

- 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



GEP Accounting Methods

- **Accounting of bio-physical values of ecosystem goods and services**
  - **Ecosystem goods**: grain, fruit, meat, eggs, vegetables, water, medicinal materials, biological materials, fiber, biomass, etc.
  - **Regulation and culture services**: water conservation, soil conservation, contaminants purification, carbon sequestration, oxygen production, aesthetics, recreation, culture identity, knowledge, education, inspiration for art, etc.
- **Pricing of ecosystem goods or services**
  - timber price, water price, soil conservation price, pollutant purification price, etc.
  - alternative market, market model simulation methods

GEP Accounting Methods

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

$$\mathrm{GEP} = EPV + ERV + ECV$$

$$\mathbf{GEP} = \sum_{i=1}^{n} EP_i \times P_i + \sum_{j=1}^{m} ER_j \times P_j + \sum_{k=1}^{l} EC_k \times P_k$$

GEP Accounting Methods

Ecosystem goods and services

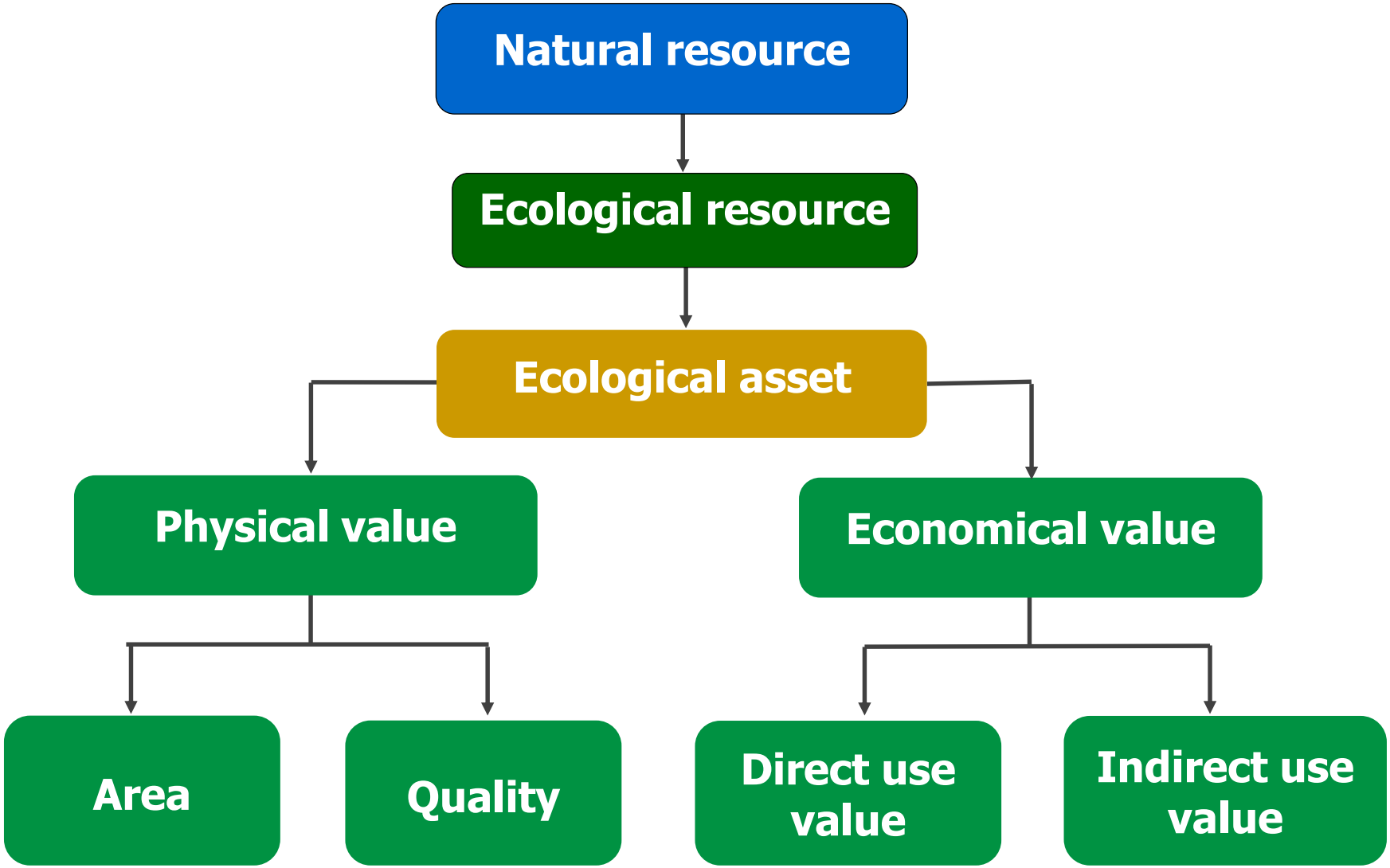
Categories	Goods and Services (Examples)
Ecosystem goods	**Food**: grain, vegetable, fruits, meat, milk, egg, fish
	Materials: wood, fiber, water, genes
	Energy: bio-energy (fuel wood), hydropower, wind energy
	Others: medicine, seedling, ornament
Regulating services	**Regulation services**: water conservation, soil conservation, carbon sequestration, climate regulating, pollutant purification, pollination
	Protecting services: sand storm prevention, flooding mitigation, pest control
Cultural service	**Aesthetic services**: recreation and ecotourism
	Cultural value: knowledge, education, arts, spirit

GEP Accounting Methods

Services	Indicators	Quantity indicators	Quantitative valuation methods	Value indicators	Value valuation methods
Provisioning services	Agricultural products	Production of agricultural products	Statistical data	Value of agricultural products	Market price method
	Forestry products	Production of forestry products		Value of forestry products	
	Animal products	Production of animal products		Value of animal products	
	Fishery products	Production of fishery products		Value of fishery products	
	Water resources	Water consumption		Value of water resources	
	Ecological energy	Amount of ecological energy		Value of ecological energy	
	Others	e.g., production of ornamental resources		Value of ornamental resources	
Regulating services	Water retention	Amount of water retention	Water Balance Equation	Value of water retention	Surrogate market method
	Soil retention	Amount of soil retention	RUSLE	Value of sediment reduction	
				Value of diffused pollution reduction	
	Flood mitigation	Lake: adjustable storage capacity	Hydrologic data	Value of flood mitigation	
		Reservoir: flood control storage	Monitoring data		
		Swamp: stagnant water			
	Sandstorm prevention	Amount of sand-fixation	REWQ	Value of desertification reduction	
	Carbon sequestration -oxygen release	Amount of carbon sequestration	Mass balance method	Value of carbon dioxide sequestration	
		Amount of oxygen release		Value of oxygen release	
	Air quality maintenance	Amount of SO_2 absorption	Model of plants purification	Value of SO_2 treatment	
		Amount of NO_X absorption		Value of NO_X treatment	
		Amount of dust reduction		Value of dust treatment	
	Water purification	Amount of COD reduction	Model of water purification	Value of COD treatment	
		Amount of total nitrogen reduction		Value of total nitrogen treatment	
		Amount of total phosphorus reduction		Value of total phosphorus treatment	
	Climate regulation	Energy consumption of plant transpiration	Model of transpiration and evaporation	Value of plant transpiration	
		Energy consumption of water surface evaporation		Value of water surface evaporation	
	Biological control	Area of pest and disease occurrence	Analogy method	Value of biological control	
Cultural services	Natural landscape	Number of tourists	Travel cost method	Value of landscape recreation	Travel cost method

Methods of Ecological Asset Assessment

Methods of Ecological Asset Assessment



Methods of Ecological Asset Assessment

Ecosystem and ecological asset

Categories	Ecosystems
Natural ecosystem	Forest ecosystem
	Grassland ecosystem
	Wetland ecosystem
	Desert ecosystem
	Marine ecosystem
Managed ecosystem	Agricultural ecosystem
	Urban green space
Wildlife	Plants
	Animals

Methods of Ecological Asset Assessment

- **Ecological assets**: **the ecosystems which provide ecosystem goods and services**
  - **Natural ecosystems**: forests, grasslands, wetland, desert, marine, etc.
  - **Managed ecosystems**: cropland, orchard, aquatic farm
  - **Wildlife resources**

- **Ecological assets physical quantity accounting**
  - **Areas and qualities of different ecosystems**: forests, grassland, wetland, farmland, etc.
  - **Number of wildlife and protected species**

Methods of Ecological Asset Assessment

Physical value of ecological assets

Ecological Assets	Ecological Assets Item	Quality Grade (km^2)						Accounting Indicators
		Total	I	II	III	IV	V	
Natural ecosystem	Forest							Relative biomass density
	Shrub							
	Grassland							Fractional vegetation coverage
	Lake							Water quality
	River							Water quality
	Swamp							Water quality
	Desert							--
Artificial ecosystem based on natural ecological processes	Cropland							Quality of cropland
	Urban green							Area
Wildlife	Wild plants							Quantity
	Wild animals							

Methods of Ecological Asset Assessment

Physical value of ecological assets

Ecological Assets	Quality Level（km^2）										
Categories	Total	Excellent		Good		Medium		Poor		Very Poor	
		Area	Ratio（%）	Area	Ratio（%）	Area	Ratio（%）	Area	Ratio（%）	Area	Ratio（%）
Forest											
Shrub											
Grassland											
Lake											
River											
Swamp											
Urban green											
Wild plants											
Wild animals											
Important protected animals											
Important protected plants											

Methods of Ecological Asset Assessment

Ecological assets index

- **Composite index of ecological assets**: accounting forests, shrubland, grasslands, lakes, rivers, and swamps natural ecosystem assets such as converting and quality comprehensive index.

- **EQ**: the comprehensive index of ecological assets

  Eq_i = the ith class ecological assets index;
  i = the ecological asset class;
  j = the ecological assets quality index (1-5);
  EA_{ij} = the area of the jth level of the ith class ecological asset;
  EA_i = the area of class i ecological assets

$$EQ = \frac{\sum_{i=1}^{6}\sum_{j=1}^{5}\left(EA_{ij} \times j\right)}{\left(\sum_{i=1}^{6} EA_i \times 5\right)} \times \frac{\sum_{i=1}^{6} EA_i}{9600000} \times 10^4$$

$$EQ_i = \frac{\sum_{j=1}^{5}\left(EA_{ij} \times j\right)}{\left(EA_i \times 5\right)} \times \frac{EA_i}{9600000} \times 10^4$$

GEP and GEP Accounting

in

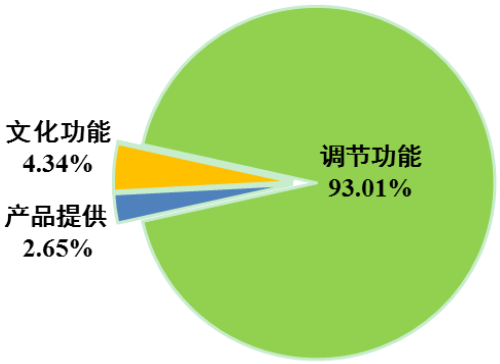
Qinghai Province; **Qiandongnan** Miao and Dong Autonomous Prefecture; and the autonomous counties of **Eshan** Yi and **Pingbian** Miao

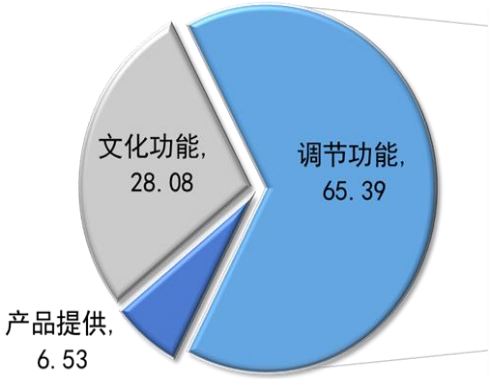
GEP and EA Accounting of Pilot Areas

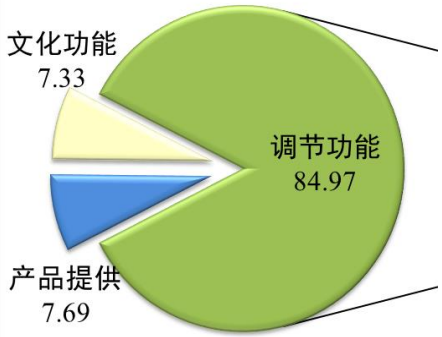
- **Purposes of ecological compensation**: Protection and restoration of the ecosystem (improvement of ecological asset) to ensure sustainable ecosystem service provision.
- **Ecological compensation effectiveness**: improvement of ecological asset, and production of ecosystem services.
- **Contents of GEP and EA accounting for eco-compensation**:
  - **Ecological asset accounting**: areas and quality of forests, grassland, wetland; population sizes of protected species
  - **GEP accounting**: just accounting ecosystem regulating services

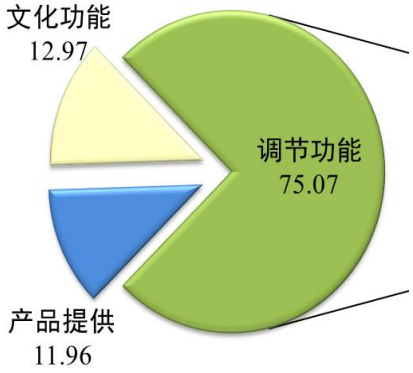
GEP and EA Accounting of Pilot Areas

Areas	GEP (CNY billion)	Provisioning services (CNY billion)	Regulating services (CNY billion)	Cultural services (CNY billion)	GEP / GDP	GEP density (CNY million/ km²)	Per capita GEP (CNY/person)
Qinghai Province	1,714.83	45.38	1,595.04	74.41	7.09	2.37	291,637.20
Qiandongnan Autonomous Prefecture	413.63	27.00	270.48	116.16	5.10	13.63	118,676.20
Pingbian County	18.08	1.39	15.36	1.33	7.02	9.49	115,891.00
Eshan County	15.78	1.89	11.84	2.05	2.53	8.00	103,848.70









GEP and EA Accounting of Pilot Areas

The value of regulating services accounted for 93.01% of the GEP in Qinghai Province in 2015.

Services	Indicators	Quantification		Value (CNY billion)	Total (CNY billion)
		Quantification	Unit		
Water conservation	Amount of water conservation	638.72	10^8 m^3	517.36	517.36
Soil retention	Amount of soil retention	3.91	10^8 m^3	6.99	28.38
	Reduction of nitrogen nonpoint source pollution	0.08	10^8 t	14.58	
	Reduction of phosphorus nonpoint source pollution	0.02	10^8 t	6.81	
Sand fixation	Amount of sand fixation	11.74	10^8 t	33.19	33.19
Flood mitigation	Amount of lakes flood mitigation	48.04	10^8 m^3	38.91	60.75
	Amount of reservoirs flood mitigation	11.60	10^8 m^3	9.40	
	Amount of swamps flood mitigation	15.36	10^8 m^3	12.45	
Air purification	Amount of sulfur dioxide absorption	93.63	10^4 t	1.18	1.25
	Amount of nitrogen oxide absorption	4.92	10^4 t	0.06	
	Reduce the amount of industrial dust	2.11	10^4 t	0.003	
Water purification	Reduction in the amount of COD emission	220.39	10^4 t	3.09	3.86
	Reduction in the amount of total nitrogen emission	17.08	10^4 t	0.3	
	Reduction in the amount of total phosphorus emission	17.08	10^4 t	0.48	
Carbon sequestration -oxygen release	Amounts of carbon sequestration	0.2567	10^8 t	9.91	23.57
	Amounts of oxygen release	0.1867	10^8 t	13.66	
Climate regulation	Energy consumption of plant transpiration	6,534.60	10^8 kwh	346.33	917.82
	Energy consumption of water surface evaporation	10,782.81	10^8 kwh	571.49	
Biological control	Area of pests and diseases occurrence	0.29	10^8 mu	8.85	8.85
Total				1,595.04	1,595.04

GEP and EA Accounting of Pilot Areas

The value of regulating services accounted for 65.39% of the GEP in Qiandongnan Prefecture.

Services	Indicators	Quantification		Value (CNY billion)	Total (CNY billion)
		Quantification	Unit		
Water conservation	Amount of water conservation	137.26	10^8 m^3	111.183	111.183
Soil retention	Amount of soil retention	24.84	10^8 m^3	9.043	32.642
	Reduction of nitrogen nonpoint source pollution	0.09	10^8 t	16.087	
	Reduction of phosphorus nonpoint source pollution	0.03	10^8 t	7.513	
Flood mitigation	Amount of lakes flood mitigation	0.02	10^8 m^3	0.014	13.409
	Amount of reservoirs flood mitigation	16.54	10^8 m^3	13.395	
Air purification	Amount of sulfur dioxide absorption	45.27	10^4 t	0.57	0.594
	Amount of nitrogen oxide absorption	1.71	10^4 t	0.021	
	Reduce the amount of industrial dust	1.17	10^4 t	0.002	
Water purification	Reduction in the amount of COD emission	1.98	10^4 t	0.028	0.035
	Reduction in the amount of total nitrogen emission	0.15	10^4 t	0.003	
	Reduction in the amount of total phosphorus emission	0.15	10^4 t	0.004	
Carbon sequestration -oxygen release	Amounts of carbon sequestration	0.15	10^8 t	5.817	13.84
	Amounts of oxygen release	0.11	10^8 t	8.023	
Climate regulation	Energy consumption of plant transpiration	1,689.63	10^8 kwh	89.391	94.972
	Energy consumption of water surface evaporation	105.29	10^8 kwh	5.581	
Biological control	Area of pests and diseases occurrence	0.12	10^8 mu	3.801	3.801
Total				270.475	270.475

GEP and EA Accounting of Pilot Areas

The value of regulating services accounted for 84.97% of the GEP in Pingbian County.

Services	Indicators	Quantification		Value (CNY billion)	Total (CNY billion)
		Quantification	Unit		
Water conservation	Amount of water conservation	9.99	10^8 m^3	8.099	8.099
Soil retention	Amount of soil retention	0.26	10^8 m^3	0.465	1.809
	Reduction of nitrogen nonpoint source pollution	0.0052	10^8 t	0.916	
	Reduction of phosphorus nonpoint source pollution	0.0015	10^8 t	0.428	
Flood mitigation	Amount of reservoirs flood mitigation	0.0153	10^8 m^3	0.012	0.012
Air purification	Amount of sulfur dioxide absorption	2.32	10^4 t	0.03	0.031
	Amount of nitrogen oxide absorption	0.09	10^4 t	0.001	
	Reduce the amount of industrial dust	0.06	10^4 t	0.0001	
Water purification	Reduction in the amount of COD emission	0.08	10^4 t	0.001	0.001
	Reduction in the amount of total nitrogen emission	0.01	10^4 t	0.0001	
	Reduction in the amount of total phosphorus emission	0.01	10^4 t	0.0002	
Carbon sequestration -oxygen release	Amounts of carbon sequestration	0.0070	10^8 t	0.269	0.64
	Amounts of oxygen release	0.0051	10^8 t	0.371	
Climate regulation	Energy consumption of plant transpiration	85.51	10^8 kwh	4.532	4.748
	Energy consumption of water surface evaporation	4.08	10^8 kwh	0.216	
Biological control	Area of pests and diseases occurrence	0.0007	10^8 mu	0.022	0.022
Total				15.362	15.362

GEP and EA Accounting of Pilot Areas

The value of regulating services accounted for 75.07% of the GEP in Eshan County.

Services	Indicators	Quantification		Value (CNY billion)	Total (CNY billion)
		Quantification	Unit		
Water conservation	Amount of water conservation	4.34	10^8 m^3	3.518	3.518
Soil retention	Amount of soil retention	0.21	10^8 m^3	0.384	1.469
	Reduction of nitrogen nonpoint source pollution	0.004	10^8 t	0.74	
	Reduction of phosphorus nonpoint source pollution	0.001	10^8 t	0.345	
Flood mitigation	Amount of reservoirs flood mitigation	0.26	10^8 m^3	0.214	0.214
Air purification	Amount of sulfur dioxide absorption	2.94	10^4 t	0.037	0.0381
	Amount of nitrogen oxide absorption	0.11	10^4 t	0.001	
	Reduce the amount of industrial dust	0.07	10^4 t	0.0001	
Water purification	Reduction in the amount of COD emission	0.18	10^4 t	0.002	0.0026
	Reduction in the amount of total nitrogen emission	0.01	10^4 t	0.0002	
	Reduction in the amount of total phosphorus emission	0.01	10^4 t	0.0004	
Carbon sequestration -oxygen release	Amounts of carbon sequestration	0.0055	10^8 t	0.212	0.505
	Amounts of oxygen release	0.004	10^8 t	0.293	
Climate regulation	Energy consumption of plant transpiration	105.45	10^8 kwh	5.589	6.092
	Energy consumption of water surface evaporation	9.49	10^8 kwh	0.503	
Biological control	Area of pests and diseases occurrence	0.0001	10^8 mu	0.003	0.003
Total				11.843	11.843

GEP Change of Pilot Areas

Areas	Services	2015	2010	2000	2000-2015 Change rate (%)
Qinghai Province	Provisioning services (CNY billion)	45.38	43.09	14.15	126.30
	Regulating services (CNY billion)	1,595.04	1,467.29	1,331.89	7.00
	Cultural services (CNY billion)	74.41	21.31	3.30	1,490.70
	GEP (CNY billion)	**1,714.83**	**1,531.69**	**1,349.34**	**13.10**
Qiandongnan Autonomous Prefecture	Provisioning services (CNY billion)	27.00	11.91	5.38	254.13
	Regulating services (CNY billion)	270.48	244.65	203.12	8.49
	Cultural services (CNY billion)	116.16	32.92	0.42	19,272.18
	GEP (CNY billion)	**413.63**	**289.48**	**208.93**	**60.62**
Pingbian County	Provisioning services (CNY billion)	1.39	0.97	0.42	133.23
	Regulating services (CNY billion)	15.36	13.77	11.23	6.47
	Cultural services (CNY billion)	1.33	0.45	0.08	1,668.00
	GEP (CNY billion)	**18.08**	**15.19**	**11.73**	**19.73**
Eshan County	Provisioning services (CNY billion)	1.89	1.19	0.72	84.10
	Regulating services (CNY billion)	11.84	10.92	10.37	-2.54
	Cultural services (CNY billion)	2.05	0.64	0.07	3,001.52
	GEP (CNY billion)	**15.78**	**12.74**	**11.16**	**19.13**

- 2000-2015, GEP of all study areas increased.
- Regulating services value increased: Qinghai, Qiandongnan and Pingbian
- Regulating services value decreased: Eshan

Physical Value of Ecological Assets in Pilot Areas

Unit : km^2

Pilots	Item	Total	Excellent		Good		Middle		Poor		Inferior	
			area	% total	area	% total	area	% total	area	% total	area	% total
Qinghai Province	Forest	2,943.5	1,280.2	43.5	94.7	3.2	150.3	5.1	461.7	15.7	956.6	32.5
	Shrubland	26,426.3	3,196.5	12.1	1,679.3	6.4	4,147.0	15.7	7,962.5	30.1	9441	35.7
	Grassland	377,374.3	24,267.3	6.4	75,359.5	20.0	78,927.9	20.9	120,562.4	31.9	78,257.2	20.7
	River	5,254.2	3,945.9	75.1	436.1	8.3	541.2	10.3	105.1	2	225.9	4.3
	Lake	14,313.8										-
	Swamp	28,142.1										-
	Urban green	16.9										-
Qiandongnan Autonomous Prefecture	Forest	18,417.0	112.4	0.61	1,725.3	9.37	8,093.9	43.95	5,243.8	28.47	3,241.5	17.60
	Shrubland	2,563.1	6.7	0.26	146.0	5.70	992.0	38.70	1,043.1	40.70	375.3	14.64
	Grassland	4,201.3	2,704.3	64.37	1,408.6	33.53	85.0	2.02	2.5	0.06	0.9	0.02
	River	116.7	0	0	94.07	80.61	0	0	0	0	22.63	19.39
	Lake	1.1										-
	Urban green	6.8										-
Pingbian County	Forest	1,239.5	49.7	4.0	303.9	24.5	505.9	40.8	299.9	24.2	80.3	6.5
	Shrubland	357.7	2.6	0.7	19.7	5.5	35.1	9.8	43.8	12.3	256.5	71.7
	Grassland	156.5	0.0	0.0	1.9	1.2	113.7	72.7	40.6	26.0	0.2	0.1
	River	3.8	0.0	0.0	0.0	0.0	3.8	100.0	0.0	0.0	0.0	0.0
	Urban green	0.05										-
Eshan County	Forest	1,116.0	184.8	16.6	367.8	33.0	434.2	38.9	108.4	9.7	20.8	1.9
	Shrubland	255.6	18.2	7.1	87.0	34.0	98.5	38.5	36.5	14.3	15.3	6.0
	Grassland	386.7	0.0	0.0	72.9	18.8	294.2	76.1	19.6	5.1	0.0	0.0
	River	4.0	0.0	0.0	1.3	33.7	2.0	50.7	0.6	14.3	0.1	1.3
	Lake	0.6	0.0	0.0	0.6	100.0	0.0	0.0	0.0	0.0	0.0	0.0
	Urban green	1.17										-

Changes of Ecological Asset Index

Pilot	Ecological asset index	2010	2000	Variation	Change rate (%)
Qinghai Province	Composite ecological assets index	223.35	198.15	25.2	12.7
	Forest ecological assets index	1.89	1.87	0.02	1.1
	Shrub ecological assets index	12.61	12.33	0.28	2.3
	Grassland ecological assets index	203.95	179.58	24.37	13.6
	River ecological assets index	4.9	4.37	0.53	12.1
Qiandongnan Autonomous Prefecture	Composite ecological assets index	14.86	13.56	1.3	9.6
	Forest ecological assets index	9.47	8.48	0.99	11.7
	Shrub ecological assets index	1.26	1.16	0.1	8.6
	Grassland ecological assets index	4.05	3.91	0.14	3.6
	River ecological assets index	0.08	-	-	-
Pingbian County	Composite ecological assets index	0.97	0.87	0.1	11.5
	Forest ecological assets index	0.76	0.68	0.08	11.8
	Shrub ecological assets index	0.11	0.11	0	0
	Grassland ecological assets index	0.09	0.08	0.01	12.5
	River ecological assets index	0.0024	0.0026	-0.0002	-7.7
Eshan County	Composite ecological assets index	1.25	1.1	0.15	13.6
	Forest ecological assets index	0.82	0.75	0.07	9.3
	Shrub ecological assets index	0.17	0.14	0.03	21.4
	Grassland ecological assets index	0.25	0.21	0.04	19.0
	River ecological assets index	0.0026	0.0028	-0.0002	-7.1

- 2000-2010, ecological asset index of all study areas increased.

Main Findings

Main Findings

- Indicators system of GEP accounting can reflect types of ecosystem products and services in different areas.
- Both GEP and ecological asset accounting indicated the effects of ecological protection efforts on ecosystem products and services of the four areas.
- Existing ecological and environmental monitoring and statistics can basically support GEP accounting in provincial, municipal, and county scales.

Main Findings

Problems

- Accounting methods of some indicators need further improvement, e.g., physical index accounting of air purification.
- Prices of some products and services are still controversial.
- Accounting method of ecological assets index and ecological assets balance sheet need further improvement.
- Historical data was incomplete, or monitoring methods were different.
- Data collection was hard work.

Main Findings

Recommendations

- Ecological benefit assessment method based on GEP and ecological asset accounting can be used for performance evaluation of eco-compensation.
- Improve GEP and the ecological asset accounting index system and methods; standardize valuation methods of ecological goods and services; and program GEP and ecological asset accounting technical guideline.
- Strengthen data sharing of environmental, hydrological, forest, meteorological and statistical information; improve the eco-environmental monitoring system; provide a database to support the establishment of a performance evaluation mechanism for eco-compensation with GEP assessment.

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