Introducing eco-compensation mechanisms in urban water resource areas to improve ecosystem services provision

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Introduction

Urban biodiversity & eco-services

1. What they are
2. Why to protect
3. How to protect
1.1 Urban biodiversity

Urban biodiversity is the variety and richness of living organism (including genetic variation) and habitat diversity found in and on the edge of human settlements (Müller et al., 2010).

Urban environment offer a range of opportunities for organisms, within, upon, and between individual built structures.

- urban green space
- vegetated area
- wetlands
- habitat
- urban flora
- urban fauna
1.2 Urban ecosystem service

- Ecosystem services incorporate both the goods and services provided by the functions of the system (Costanza et al., 1997).

- Urban ecosystems contribute key services for human physical, social and mental well-being.

<table>
<thead>
<tr>
<th>Urban ecosystem services in Stockholm (Bolund, 1999)</th>
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<tbody>
<tr>
<td>street trees</td>
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<tr>
<td>air quality regulation</td>
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<tr>
<td>climate regulation</td>
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<tr>
<td>noise reduction</td>
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<tr>
<td>rainwater drainage</td>
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<td>sewage treatment</td>
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<td>recreational &amp; cultural values</td>
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1. What they are
Biodiversity in urban areas provides a number of ecosystem service, which are important for maintaining urban sustainability.

1. What they are

Urban biodiversity & urban ecosystem service

- Urban biodiversity
- Supporting ecosystem service
- Providing, regulating, supporting, cultural
- Urban flora and fauna, within, upon urban greenspace, vegetated areas and water bodies

Urban ecosystem
2. Why to protect

Motivations

- eg. vegetation cover or NPP
- eg. flood prevention, production
- eg. benefits, income

Urban biodiversity

Urban Ecosystem services

Human well-being
The relationship between ecosystem services and human well-being (MA, 2003)
Countermeasures in China

3. How to protect

- new-type urbanization
- Eco-city planning
- Ecological civilization
- Green GDP
- Sponge city
- Eco-compensation
Countermeeasures in China

Environmental Protection Law of the People’s Republic of China (2014 Revision)

Artical 31: establish and improve the system of compensation for ecological protection.

- increase national financial transfers to the reserve
- guide regional governments in beneficial area and conservation area to conduct the ecological protection compensation: negotiation or market rules

Eco-compensation

balanced regional development
3. How to protect

Eco-compensation

5 major fields

Watershed:
- trans-boundary/trans-region watershed eco-compensation;
- drinking water source area

Forest:
- compensation fund

Grassland:
- compensation fund

National Ecological Function Zones:
- financial transfer

Mineral resources exploitation:
- security payment
Eco-compensation vs PES

A kind of institutional arrangement to protect environment by adjusting the stakeholders’ interests based on the ecosystem value, ecological protect cost and opportunity cost.

VS

A voluntary transaction where a well-defined ES (or a land-use likely to secure that service) is being bought by a (minimum one) ES buyer from a (minimum one) ES provider if and only if the ES provider secures ES provision. (Wunder, 2005)
Eco-compensation

- **purpose:** to improve the ecosystem service
- **theory basis:** ecosystem services are public goods
  - internalize the externality of ecosystem services
- **scope object:** actions affected ecosystem services
- **method:** adjust stakeholders’ economic behavior
  - destroyer pay compensation fee
  - beneficiaries pay compensation fee
  - protectors accept compensation fee
  - protectors provide the ecosystem services
Eco-compensation

- a policy or institution
- stated, in law and regulations
- eco-service internalization
- government-oriented
- in money or in kind
- applied widely, in 5 major fields’ ecological protection

PES

- a project
- voluntary, negotiated
- eco-service trade-off
- market-oriented
- in money (fee)
- mainly applied in watershed ecological protection
Fig. the ecological compensation framework based on ecosystem service
Beijing, Miyun Reservoir

Wuyishan City, drinking water source

Xiamen City, a reservoir project

Case 1

Case 2

Case 3
● Case 1: on Miyun reservoir protection in Beijing, China

- Miyun Reservoir located in the county north, where is 14km from Miyun county town and 90km from downtown of Beijing.
- It is an important drinking water source in Beijing, about 70% area of which is water source preserve.
- The preserve area is partitioned into three levels. Miyun Reservoir Wetland has been listed as the national important wetland and the biodiversity preserve.

Fig. the map of Miyun Reservoir Preserve
Chinese government has paid high attention to water resource protection and proposed “The strictest water resources management system” in 2012, in which strengthened protection of drinking water sources was re-emphasized.

Miyun County has devoted much effort and ample funds into water source protection for years. At the same time, local residents have encountered dilemmas because of restrictions on industrial development, forestry planting, and fisheries, among other economic activities.

There is an urgent need for an ecological compensation policy in the Miyun Reservoir conservation area to promote its social development.

Case 1: on Miyun reservoir protection in Beijing, China
Case 1: on Miyun reservoir protection in Beijing, China

Perspective: ecosystem service protection

Not all stakeholders are willing to protect ecosystem services

Eco-compensation to adjust stakeholders’ interests

 Residents in conservation area
 Water users
 Water company
 government

Eco-compensation

Intensify relationship

biodiversity
 Water supply
 Flood control
 Air quality regulation
 Water conservation

economic
 ecological
Case 1: on Miyun reservoir protection in Beijing, China

(WTA) Determine the amount of compensation

(WTP)

Eco-compensation mechanism

Water source’s residents

Protection

Pollution management
water saving
agriculture
“Green to Green” project
afforestation ...

Services’ beneficiaries

Water supply company

Water supply ecosystem service

eco-environmental impact

Fig. the relationship of stakeholders in drinking water source eco-compensation
The results showed that the average value of Miyun Reservoir residents’ WTA was 2142 RMB/family/yr. The income level, location and the perceiving of environmental protection were the key factors influenced the WTA value.

**Case 1: on Miyun reservoir protection in Beijing, China**

Ecological compensation for drinking water conservation → Stakeholders’ corrodination

Eco-compensation standard → Stakeholders’ willingness

Eco-compensation fee = (WTP, WTA)
Case 1: on Miyun reservoir protection in Beijing, China

The contribution that eco-compensation made to Miyun reservoir ecosystem service

Eco-service level

(1) Static baseline

Time

Start point

with eco-compensation

without eco-compensation

The contribution that eco-compensation made to Miyun reservoir ecosystem service
Case 2: on drinking water conservation in Wuyishan City, China

- Wuyishan City is located in the northwest of Fujian Province, China.
- It is famous of Mount Wuyi, the largest existing and best-preserved subtropical native forest ecosystem.
- Thus, the ecological construction is the most important in its eco-city planning.
Case 2: on drinking water conservation in Wuyishan City, China

Not all ecosystem services can be trade-off in market

Eco-compensation to internalize the externality

Perspective: ecosystem service trade-off

- Farming or grazing
- Forest protection
- Eco-compensation

land owners’ benefit
Water users’ benefit
Case 2: on drinking water conservation in Wuyishan City, China

Perspective: ecosystem service trade-off

Fig. The correlative chain in payment for ecosystem services in drinking water source reserve
The results showed that the opportunity cost of protectors was 8.977 million RMB in 2005; the extra water fee would be 0.07 yuan RMB/(t·a) in 15 compensatory years.

Case 2: on drinking water conservation in Wuyishan City, China

Eco-compensation fee = commercial forest income + cultivated land income
Case 2: on drinking water conservation in Wuyishan City, China

(2) Improving Baseline

The contribution that eco-compensation made to drinking water ecosystem service
Case 3: on reservoir project in Xiamen, China

- Lianhua Reservoir was built in Xiamen for guaranteeing the water resource for the surrounding residents.
- However, the reservoir has inundated 471.6 hm² land-use, including part of grassland and forest land. Thus it degraded the local ecosystem service level.
- In order to compensate the ecological loss in reservoir project and protect the new water conservation ecological service, an eco-compensation for a reservoir project in Xiamen was established.
Case 3: on reservoir project in Xiamen, China

Perspective: ecosystem service value

- Ecological protection
- Reservoir project
- Ecosystem services

Output

- Natural value: water conservation, biodiversity
- Social value: habitat, job
- Economic value: food production, tourism

Fig. Eco-compensation of reservoir project based on ecosystem service valuation
The total ecosystem services value was estimated 1.3 billion RMB. As the beneficiaries, the citizens enjoyed mainly from the service of water conservation, which could be the basis of the standard of extra water fee. The rest compensation may get from government tax.
Case 3: on reservoir project in Xiamen, China

The contribution that eco-compensation made to reservoir ecosystem service in Xiamen.
Summary

Eco-compensation on urban water resource area

- Identify ecosystem service value
- Coordinate the ecological and economic benefit
- Adjust human ecological protection behavior
- Improve ecosystem service

3. How to protect
Other related work

- Green GDP
  (for government’s policy)

- Ecological infrastructure
  (for Eco-city planning)
Some related papers


Some related papers


THANKS

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