

# Monitoring Agroecology Values in Peri-urban Landscapes in Beijing

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**China's many initiatives promoting urban-rural development, such as "The new countryside construction" and "New urbanisation" programme, are grounded in five development concepts: innovation, coordination, green development, opening up and sharing, and eco-civilisation. The concept of eco-civilisation refers to a comprehensive and harmonious system which builds on multi-stakeholder participation in the creation of a high-amenity environment and landscape with natural biodiversity and cultural richness. In other words, the question for Beijing is how its peri-urban landscapes can be maintained, while providing natural ecosystem services and cultural context.**

This evokes the question of how to measure ecological values or ecosystem services in a quantitative way to help raise public awareness and support. Beijing municipal government, jointly with academia, has been exploring new methodologies to quantify the value of agroecology in peri-urban landscapes in Beijing during the past decade. This article presents some achievements to date and poses some critical questions to be considered in future use.

## **Assessment of agroecology values, Version 1.0 (2006-2009)**

Given the complexity of the ecosystem, there is no ready-to-use methodology to assess the value of agroecology.

However, this value can be roughly divided into three parts: the direct agro-output value, the indirect agroecology economic value, and the agroecology service value. The first refers to the traditional production value of agriculture, including farming, forestry, animal husbandry, secondary production and fisheries. The second refers to the extra economic benefits generated by utilising the agro-resources. The third, agroecology service value, refers to the invisible ecological benefits brought by the natural agroecological system, including farmland, forest, and grassland.

Following this logic, an assessment and monitoring index system for evaluating the value of agroecology was initially established jointly by Beijing Bureau of Statistics, Beijing Municipal Bureau of Landscape and Forestry, and National Bureau of Statistics in 2007 (See Table 1 below).

## **Assessment of agroecology values, Version 2.0 (2010-2015)**

Based on application of Version 1.0 of the index, a special research project on further improvements of the monitoring system was conducted jointly by Beijing municipal government departments and various research institutes such as the Chinese Academy of Sciences, Chinese Academy of Forestry, Beijing Normal University and others. A new consensus on the concept of agroecology value was reached, in which the multiple functions of (peri)urban agriculture with their respective values were clearly identified. The direct agro-output value was mainly related to its production function, the indirect agroecology economic value was mainly related to its social service function, while the agroecology service value was linked to all, but mainly the eco-environmental functions.

The improved monitoring system further stressed the importance of agroecology values in landscape improvement, climate adjustment, water conservation and disaster mitigation, as well as agro-cultural service functions. In addition, a new sub-system of wetland was included in the system, along with additional indicators for the other three sub-systems as shown in Table 3.

Based on this index, the economic value of agroecology in Beijing was calculated as value in current year (VCY) and present discounted value (PDV). Specifically, VCY refers to the economic value per category in the measured year, while PDV refers to the value of accumulated value-added products, minus an annual discounted value of 5% assumed lost. Table 2 presents the PDV of agroecology using the new index system in Beijing from 2010 to 2016. It should be noted that the total PDV of agroecology in 2009 was much higher than originally calculated based on the initial index system. The main differences were induced by the indirect agroecology economic value (9.5 vs 93.5) and the agroecology service value (608.6 vs 732.7).

It can be seen from Table 2 that the total PDV of agroecology experienced a rapid increase during this period with an annual growth rate of 3.5%, compared to that of 2.7% during the period 2007 to 2009. Of all the categories, the indirect agroecology economic value gained the highest annual growth rate of 5.2%, resulting from the fast development of urban agriculture in its social service function, including the boom of agrotourism, rural heritage and cultural experiences. The value increase in agro-ecological value came from farmers' preferences for trees and agroecology practices and municipal government support.

### Assessment of agroecology values, Version 3.0 (2016-present)

Based on five years' application of the updated index system, again some minor adjustments were applied in 2016. The adjustments mainly focused on changes of some parameters and monitoring methodologies in calculating the index values, particularly the landscape improvement, environmental cleaning and purification. Following the

Table 1. The improved index system for evaluating the value of agroecology in Beijing (2010). Additions are indicated in bold. The other categories correspond to the original 2007 index.

Index	Indicators	
The direct agro-output value	Farming	Value-added products from traditional agriculture production
	Forestry	
	Animal husbandry	
	Fishery	
	Secondary production	
	<b>Water supply</b>	<b>Value-added conservation of water resources</b>
The indirect agroecology economic value	Sightseeing and leisure	Tourism revenue
		Sightseeing parks revenue
		Revenue from eco-parks, resorts, nursing homes, education and training centres/bases, etc.
		Revenue from forest park, natural reserve, etc.
	Crafts and souvenirs	Revenue from various kinds of self-processed crafts and souvenirs by local materials
	<b>Cultural tourism service</b>	<b>Revenue from agro-cultural tourism</b>
<b>Hydroelectric storage</b>	<b>Potential value from enhancing capacity of hydro-power</b>	
<b>Landscape improvement</b>	<b>Revenue from improvement of land use, transportation, and green environment</b>	
The agroecology service value	<b>Climate adjustment</b>	<b>Oxygen/CO<sub>2</sub> balance, mitigate greenhouse effect, wind prevention, humidity, temperature improvements</b>
	Water conservation	Rain-water harvesting
		Water purification
		Flood prevention
	Soil conservation	Reduction of land loss
		Prevention of decrease in soil fertility
		Mitigation of sediment accumulation
	Environment cleaning and purification	Absorption of SO <sub>2</sub>
		Absorption of fluoride
		Absorption of oxynitride
		Dust fall prevention
		Noise reduction
		Recycling of solid waste
Carbon sink and oxygen supply	Absorption of CH <sub>4</sub>	
	CO <sub>2</sub> fixation	
	Oxygen supply	
Bio-diversity	Diversity of animals and plants	
<b>Disaster mitigation</b>	<b>Flood water storage</b>	
	<b>Farmland protection</b>	
	<b>Wind break and sand fixation</b>	

Source: Beijing Bureau of Statistics

**Table 2.** The PDV of agroecology by categories in Beijing (2010-2015)

Categories	2009 original	2009 new index	2010	2011	2012	2013	2014	2015
Direct agro-output value	31.5	33.5	34.9	38.9	41.9	44.3	46.1	38.5
Indirect agroecology economic value	9.5	93.5	100.3	107.3	114.9	119.7	123.8	129.1
Agroecology service value	608.6	732.7	740.2	750.6	761.4	779.1	815.1	873.9
Total value of agroecology	649.6	859.7	875.4	896.8	918.2	943.1	985.0	1041.4

Unit: billion yuan. Source: [www.bjstb.gov.cn/taiban/\\_719/\\_727/stgb/index.html](http://www.bjstb.gov.cn/taiban/_719/_727/stgb/index.html)



*Chestnut Agro-Park in Huairou District, North Beijing*

adjustment, the value of agroecology by categories in Beijing in 2016 was calculated as shown in Table 3.

The comparison of VCY and PDV in Table 3 indicates that the yearly agroecology service value is huge, while the PDV is even more significant. The agro-economic value results from accumulated yearly inputs and performance, while the agroecology service function mainly depends on a well-maintained plant stock. Thus, maintenance is needed

over an extended period.

### Discussion

Application of the methodology shows that the index system could serve as a powerful tool in convincing policy-makers to allocate more resources to agroecological services through improving peri-urban agriculture. Based on this new way of presenting data on agriculture value, Beijing has enlarged its budget for management of its peri-urban mountainous

**Table 3.** The value of agroecology by categories in Beijing (2016)

Categories	Value in current year (VCY)	Present discounted value (PDV)
Direct agro-output value	39.6	39.6
Indirect agroecology economic value	115.0	115.0
Agroecology service value	198.5	901.9
Total value of agroecology	353.1	1056.5

Unit: billion yuan. Source: [www.bjstb.gov.cn/taiban/\\_719/\\_727/stgb/index.html](http://www.bjstb.gov.cn/taiban/_719/_727/stgb/index.html)



*Mulberry Agro-Park in Daxing District, South Beijing*



*Eco-landscape in Peri-urban North part of Beijing*

areas to enhance their agroecological service function in soil and water conservation as well as acting as a carbon sink. In 2016 a large new programme was launched to increase the city's forestry land area percentage to one third of its region by 2020.

#### Editors notes

In China, agroecology is understood as sustainable and multifunctional land use and (agro)ecosystem services. This concept of ecosystem services is criticised by several groups for being anthropocentric (promoting an exploitative human-nature relationship). However, others argue that the concept may also be used to reconnect society to ecosystems, emphasising and reconceptualising humanity's relationship with nature. In the latter case, nature and ecosystems are appreciated because of their simple existence, and looked upon with awe and respect. Economic evaluation of agroecological values is also critiqued for being too narrowly economic in which value is mostly understood as gains/economic profit, whereas agroecological values also include values such as land stewardship, equality, justice, mutual learning, etc. Counterarguments claim that valuation of ecosystem services leads to more informed decision-making where "monetary valuation thus provides additional arguments for decision-making processes and does not replace ethical, ecological, or other nonmonetary arguments". Other forms of non-monetary evaluation, such as stakeholder perceptions, biophysical and human welfare assessment are complementary methods that can be used (Taken from: Schroter M, et al. 2014, Ecosystem Services as a Contested Concept: A Synthesis of Critique and Counter-Arguments. [onlinelibrary.wiley.com/doi/10.1111/conl.12091/full](http://onlinelibrary.wiley.com/doi/10.1111/conl.12091/full))

However, the current index system proposed by Beijing may not be readily applied by other cities due to the high cost of investigation, identification of detailed agricultural typologies, maintenance of databases, and costs of the participation of local agencies. There is a need to adapt and apply the method for wider practical use.

The system helps convince the larger society to recognise the importance of agroecology in enhancing the quality of life and city welfare as the whole. However, the extensive indicators are hard to communicate clearly to Chinese consumers. They may be more motivated by seeking zero risk to food safety, than showing concern for environmental protection or farmer livelihoods. Once consumer trust in the food system is improved, this may change over time.

Finally, the index system is based on quantitative—economic measurement. It needs to be complemented with recognition of non-monetary values. Such social values would include education of children, enjoying traditional food flavours or living in harmony with the planet for example. Care should also be taken that the index does not create a ground for justifying the economic exploitation of nature.

These challenges are relevant in discussing agroecology worldwide. This article serves therefore as a starting point to kick off this debate.

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