Evaluation and Monitoring System on Urban Modern Agriculture in Beijing

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I. Introduction

1. Research Background

In the process of accelerated social and economic development and rapid urbanization in Beijing, the economic share of agriculture has been declining year by year; the fundamental role and important functions of agriculture has been gradually neglected. The present statistical system in agriculture is mainly based on its traditional “production” function, without including its functions regarding people’s leisure (named “life” function) and the ecological environment (named “ecology” function). For the government, the production data in agriculture under this system seems not scientific enough to reflect and evaluate agriculture comprehensively, objectively and fairly, and hence can not provide sufficient information for them to formulate relevant policies.

2. Significance of research

In 2006, Beijing Municipal Bureau of Statistics (BMBS) and NBS Survey Office in Beijing, in the second census of domestic agriculture, conducted the research of value of urban modern agriculture ecosystem services of Beijing. In 2008, BMBS and NBS Survey Office together with the Beijing Municipal Bureau of Landscape and Forestry realized six unifications, i.e. the unification of index system, name of index, statistical scope, statistical content, statistical methods and selection of parameters and improve the Evaluation and Monitoring System on Urban Modern Agriculture in Beijing. Since 2009, BMBS, NBS Survey Office in Beijing, Beijing Municipal Bureau of Landscape and Forestry and Beijing Water Authority associatively conducted the research on the calculation methods of value of agriculture ecosystem services of wetland and initially established the index monitoring system of value of agriculture ecosystem services of four ecosystems like farmland, grassland, forest and wetland.

Besides the traditional agriculture production, this system is to conduct the evaluation and statistics of agriculture life and ecological value, which is the need in fastening the development of modernization of urban agriculture. It is significant in theory and reality for comprehensively and objectively reflect the development status and trend of urban modern agriculture in Beijing. This system is the reference for objectively reflecting the key value of the ecological environment of Beijing and coordinating the ecological protection of ecological conservation development areas and social and economic development in Beijing and establishment of relevant ecological compensation system.

3. Innovation of this research

The agriculture in the value of agriculture ecosystem services covers four major ecosystems in Beijing, i.e. the forest, farmland, grassland and wetland ecosystem, which is different from the former researches on single ecosystem. Now, this research includes the gross production of agriculture, forestry, animal husbandry and fishery of current statistical

system into the system, combines the statistics of agri-tourism of agricultural statistics, institutionalizes, systemizes, and standardize the estimation method of value of ecosystem services and parameters and establishes the Evaluation and Monitoring System on Urban Modern Agriculture in Beijing in Beijing, which is the innovation in academic and statistical circles and has vital realistic significance and application value for re-comprehending the effect and value of agriculture and for comprehensively and objectively reflecting the development status of urban modern agriculture of Beijing.

II. Concept and monitoring index system of value of ecosystem service of urban modern agriculture in Beijing

The value of ecosystem services of urban modern agriculture in Beijing mentioned in this research refers to the products and service value for human surviving and living conditions and social and economic development by Beijing agriculture, including three parts of value, i.e. the direct economic value, indirect economic value and ecological and environmental value. The direct value includes two parts of value, i.e. the gross production of agriculture, forestry, animal husbandry and fishery and the value of water-supply. The indirect value refers to the economic performance brought by all the natural resources (or the ecological system) inside the agriculture for the special ecological advantage and realized in realistic economy. The value of ecology and environment refers to the performance brought by the natural resource (or the ecosystem) improving the human living conditions but not realized in the actual economic life

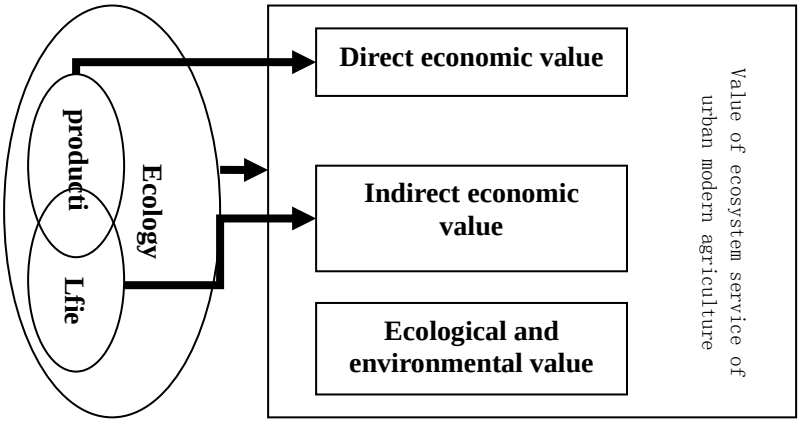

Figure 1 the relationship between the value of ecosystem service of urban modern griculture and modern agriculture function

As shown in Figure 1, for the function of agriculture, the subject of labor is theanimals, plants and ecosystem constituted by them. Thus the ecological feature is the fundamental feature of the agriculture, while the agricultural functions are derived from the ecological features. For example, cropping follows the physiological rule of plants and is around the product of root and fruit of plants, which shows the living functions of agriculture. Thus, all functions of agriculture is oriented from its own ecological essence. The production and living functions of the modern agriculture not only associate to each other, but also are included in the ecological functions.

1. Installation of index system

The value of ecosystem service of urban modern agriculture in Beijing includes the direct economy value, indirect economy value and ecological and environmental value, i.e. the first class index, 12 second indexes and 36 third indexes. The followings are the specific index system:

Chart 1Evaluation and monitoring system of urban modern agriculture in Beijing

First index	Second index	Third index

Direct economic value	Gross production of agriculture, forestry, animal husbandry and fishery	agriculture production
		forestry production
		production of animal husbandry
		production of fishery
		gross production of agriculture service.
	value of water-supply	value of water-supply
Indirect economic value	Value of cultural and tourism services	urban tourism value
		suburb tourism vaule
		Value of culture and leisure
		Value of science and education
	Value for energy storage of hydraulic power	Value for energy storage of hydraulic power
	Value of appreciation of landscape	Value of appreciation of landscape
Value of ecology and environment	Value of climate regulation	Value of regulation of atmosphere composition
		Value of humidity regulation
		Value of temperature regulation
	Value of water source conservation	Value for regulating surface water
		Value for supplementing the groundwater
		Value for holding up the precipitation
		Value for conserving the precipitation
	Value for purifying environment	Value for reducing the quantity of bug dust
		Value for releasing negative oxygen ion
		Value for purifying water quality
		Absorption of harmful gas
		Value for reduction of noise
		Value for releasing the alexin of plant
		Dissolving the solid waste
	Value of biodiversity	Value for nursing the plant
		Value of rare animal
	Value for disaster prevention and reduction	Value for regulating and storing the flood
		Value for protection of farmland
		Value for windbreak and sand-conservation
	Value for soil conservation	Value for avoiding the waste land
		Value for reduction of nutrient loss
		Value for reduction of sediment accumulation and detention
	Value for soil formation	Value for accumulation of plant nutrient
		Value for resolving the dead and litter fauna

2. Explanation of index

i. Direct economic value

Include the two part values, i.e. the gross production of agriculture, forestry, animal husbandry and fishery in current agriculture statistical system and value of water-supply.

a. Gross production of agriculture, forestry, animal husbandry and fishery is the gross production of agriculture, forestry, animal husbandry and fishery, shown by the monetary, and the value generated by the supporting services activities of agriculture, forestry, animal husbandry and fishery.
b. Value of water-supply is the value of water sources of wetland for maintaining the regular social production and residential life, shown by monetary.

ii. Indirect economic value includes the value of cultural and tourism services, value for energy storage of hydraulic power and value of appreciation of landscape.

a. Value of cultural and tourism services refer to the tourism, leisure, science and educational environment and value generated by the culture with the assistance of unique resource advantage of agriculture.
b. Value for energy storage of hydraulic power refers to the value generated from the transformation from the potential energy of current of river and lake to the kinetic energy of hydroturbine then to the electric power of electric generator.
c. Value of appreciation of landscape: in city, the value of landscape is comprehensively decided by the position of land, traffic condition and surrounding conditions, in which the appreciation directly generated by agricultural resources like forest and wetland is

the value of appreciation of landscape.

iii. Value of ecology and environment: the forest, farmland, grassland and wetland ecosystem included in agriculture is vital for the living conditions of human beings and bring the objective value that does not enter the economic life, which is the agricultural ecology and environment. Considering the complication of ecology and environment and heterogeneity of calculation methods, we introduce several values that are quoted frequently and the calculations are mature and identical for evaluation. These values are value of atmosphere regulation,value of water source conservation,value for purifying environment,value of biodiversity, value for disaster prevention and reduction,value for soil conservation and value for soil formation.

a. Value of climate regulation: the green plant in ecosystem regulates the oxygen, fixes the carbon dioxide in the biological production, relieves the green-house effect of the earth, guarantees the fundamental condition for living activity and has the function to improve the climate like windbreak, increasing the humidity and regulating the climate. Here, it mainly involves the carbon dioxide fixation and oxygen release of ecosystem, regulating the temperature and humidity.
b. Value of water source conservation: the existence of ecosystem could vigorously increase the soil absorption ability for water, reduce the surface runoff, especially the water-storage and supplementary to the groundwater for the wetland ecosystem, and maintain regional water-balance. The value generated by the function of ecosystem for human beings is equivalent to the water source conservation. Value of water source conservation includes the value for regulating surface water,value for supplementing the groundwater,value for holding up the precipitation and value for conserving the precipitation.
c. Value for purifying environment: the plant in the ecosystem could purify the pollution of atmosphere, soil and water. The green plant could reduce the content of sulfide, nitride, halogen and bug dust in the atmosphere through absorption; meanwhile, the green plant could also absorb some pollution elements in the soil and sewage. The value generated by this function of ecosystem for human beings is equivalent to the value for purifying environment. The value for purifying environment includes the values involving seven aspects, i.e. the value for reducing the quantity of bug dust,value for releasing negative oxygen ion,value for purifying water quality, absorption of harmful gas, value for reduction of noise,value for releasing the alexin of plant and dissolving the solid waste.
d. Value of biodiversity: value of biodiversity includes the diversity of ecological systems, species and inheritance. The diversity of biology is the material basis for the surviving and development of human beings. Complicated terrain, climate and soil, especially the enormous forestry resources provide the diversified environment for growth of plant and thriving and living of wild animals. The value generated by the service of ecosystem is the value of biodiversity. The value of biodiversity includes the value of rare animal and value for nursing the plant.
e. Value for disaster prevention and reduction refers to the effect of the existence of ecosystem on reducing the erosion of wind and soil, regulating the flood, improving the ecological environment of farmland and increasing the production and quality of crops. The value for disaster prevention and reduction includes value for regulating and storing the flood, value for protection of farmland and value for windbreak and sand-conservation.
f. Value for soil conservation: due to the existence of ecosystem, the coverage of plant and litter layer could reduce the direct impact of the rainwater to the soil, protect the soil from erosion, and maintain the productivity of land; it can also protect the coast

and riverside and prevent the lake, river and reservoir from sediment accumulation. The value generated from this function of ecosystem is equivalent to the value for soil conservation. Value for soil conservation includes the value for avoiding the waste land, value for reduction of nutrient loss and value for reduction of sediment accumulation and detention.

g. Value for soil formation: the new biological production is synthesized by the nutrient absorbed from soil by the root of plant in the ecosystem, and the nutrient conserved in the plant could avoid the direct loss led by the erosion of rainwater, while the organism, as the litter, would be transferred to the soil and re-used by the ecosystem, which shows the effect of forestry plant in forestry ecosystem on the cycle and accumulation of nutrient. The value generated from the function of ecosystem is equivalent to the value for soil formation. The value for soil formation includes the value for accumulation of plant nutrient and value for resolving the dead and litter fauna.

III. Methods for monitoring and evaluating the value of ecosystem service of urban modern agriculture

This system combines the current statistical system and professional research, and conducts the statistics and calculation of the three parts of value of ecosystem service of urban modern agriculture.

1. Direct economic value

The gross production of agriculture, forestry, animal husbandry and fishery adopts the calculation chart of gross production of agriculture, forestry, animal husbandry and fishery in the statistical system of Beijing suburb. The value of water-supply adopts the water-supply of surface water issued by the master department of water resources and the measurable water production of surface water combining the general water price and the price of resurgent water issued by the price management department.

2. Indirect economic value

According to the tourism and leisure agriculture report-form of suburb statistical system of Beijing, the overall income index is selected as the folk-custom income and sight-seeing garden income. Meanwhile, the suburb tourism value is summarized through the combination of income data of hotel and sight spot in suburb of the database of the institute in service industry. Urban tourism value, culture leisure value and scientific and educational value are calculated by the urban tourism income and the number of tourist of free park and place of historical interest combining the parameters like landscape influence factor according to the research results. According to the hydraulic power and the energy storage of hydroelectricity of the price of electricity; the appreciation in the value of landscape is calculated by the combination of standard land price of Beijing and the influent scope of agriculture ecosystem.

3. Value of ecology and environment

The value of ecology and environment reflects the ecological effect that was not materialized by the economic value on the forestry ecosystem, farmland ecosystem, grassland ecosystem and wetland ecosystem. This research transfers the invisible and value of ecosystem service of agriculture without any market value into the material and computable value by the combination with research results of ecology and economics in calculating the ecological and environmental value, referring the statistical data of agriculture and forestry and adopting the remote sensing technique to acquire the resource of grassland and wetland for physical quantity data and utilization of market pricing, replacement project, shadow project and the methods of opportunity cost and willingness to pay. We will not provide the detailed information since the estimation of ecological and environment value involves in many professional methods of ecology.

IV. Results of the Evaluation and Monitoring System on Urban Modern Agriculture in Beijing

Since 2006 when the subject team began to conduct the research of value of ecosystem services of urban modern agriculture in Beijing, the Evaluation and Monitoring System on Urban Modern Agriculture in Beijing is gradually formed in 6 years through the continuous improvement on the monitoring scope, index system and calculation method under the support of colleges and scientific research institutions

According to the monitoring result of 2011, the annual production of value of ecosystem service of urban modern agriculture in Beijing is 324.158billion yuan, increasing by 5.7% against last year; the discounted value is 896.815billion yuan, increasing by 2.5% against last year.

In the constitutions of the annual production of value of ecosystem service of urban modern agriculture of Beijing, the direct economy value is 38.876 billion yuan, taking 12% of the total production and increasing by 11.4% against the last year; the indirect economy value is 107.341 billion yuan, taking 33.1% of the total production and 7% large than that of last year; the value of ecology and environment is 177.942 billion yuan, occupying 54.9% of the total production and 3.8% larger than that of last year. As shown in figure 2, the indirect economy value and value of ecology and environment take 88% of the total value, much larger than 12% of the direct economy value of the agriculture statistical system. Thus, the most part of the value generated by modern agriculture has not been counted into the current agriculture statistical system, the rural life and ecological function have been ignored and the fundamental value of agriculture has been underestimated greatly.

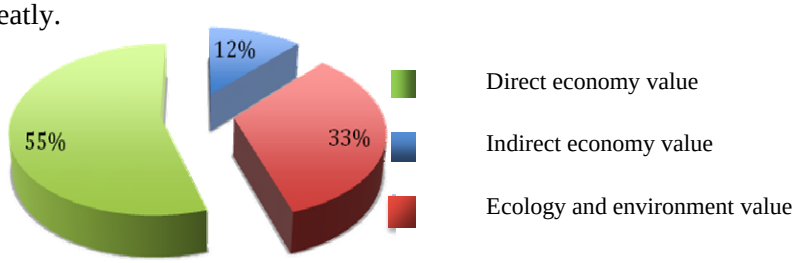

Figure 2 the constitutions of value of ecosystem service of urban modern agriculture of Beijing

Through years of exploration and practice of the Evaluation and Monitoring System on Urban Modern Agriculture in Beijing, the concept, connotation, index system, estimation method and the method acquiring the parameter and data have been continuously improved. From the macro perspective, the monitoring system have reflected the value and development status of Beijing agriculture in a scientific way; however, limited by the recognition and development of scientific research and data sources, the selection of some estimation methods and parameters need to be improved and the correctness of fundamental data needs to be enhanced. We will positively follow the scientific development and technical innovation and gradually update and improve the monitoring system of value of ecosystem service of urban modern agriculture of Beijing.

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