



AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search

<http://ageconsearch.umn.edu>

aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Urban Agricultural Development from the Perspective of Circular Economy—An Analysis of Sino-Singapore Eco-city Model in Tianjin

ZHANG Tian-yi^{*}, JIN Yan-ping

School of Economics and Management, Beijing Forestry University, Beijing 100083, China

Abstract The connotation and development of circular economy and circular agriculture are illustrated from the perspective of circular economy. Take the duplicable Sino-Singapore Eco-City in Tianjin as a case to analyze the background, significance and features of building Sino-Singapore Tianjin Eco-City and point out the sustainable developmental orientation of the "three harmony and three capabilities" as well as its inspiration on the development of Tianjin urban agriculture from the aspects of water-saving, land-saving and energy-saving. Under the direction of circular economy theory, the enhancement of economical utilization of agricultural resources and resource utilization of agricultural wastes has positive effects on improving urban environment: decentralize organic solid wastes from sewage cycle system; further study the physiological and biochemical mechanism of increasing yield and income of ecological agriculture; bring urban agriculture into city land utilization planning and city development planning.

Key words Circular economy, Urban agriculture, Sino-Singapore Tianjin Eco-City, China

Urbanization trend in China is irresistible. At present, the urbanization rate is 46.6% and is planned to reach 65% in 2030. Since developing countries are experiencing the climax stage of urbanization, the high-speed urbanization process of absorbing rural population is quicker than the improvement of infrastructure^[1]. Agriculture is the foundation of national economy. And developing agriculture circular economy is the basic section of developing circular economy in the whole society as well as building a harmonious society. China is a country with a big population but limited cultivated land. How to make a new and sustainable road for urban agricultural development in the planning and constructing of urbanization is a crucial subject. Integrating into urban system is the key to the steady development of urban agriculture. The writer illustrated the connotation and development of circular economy as well as circular agriculture and further analyzed the mode of Sino-Singapore Tianjin Eco-City, aiming to provide reference for urban agricultural development from the perspective of circular economy.

1 Connotation and development of circular economy and circular agriculture

1.1 Presenting and connotation of circular economy Belonging to the resource-conserving and environment-friendly economic form, circular economy is a mode of economic development in accordance with the concept of sustainable development with the core of high-efficient and recycling utilization of resources, the principle of reducing, reusing and recycling and the feature of low investment, low consumption, low emission and high efficiency. The "Spaceship Theory" presented in 1962 by Boulding, an American economist, is regarded as the germination of circular economy thought. In 1990, British environmental economists Perse and Tener formally used "Circular E-

conomy" in the book *Natural Resources and Environmental Economics* for the first time. Understood from its connotation, circular economy is not only a new idea of the coordinated development of social economy and resources, but also a new specific developmental as well as practical pattern. With the ideal of clean production and economical consumption of circular economy, traditional method of economic growth is transformed from the exploiting pattern of "resources-product-emission" to the closed-loop mode of "resources-product-renewable resources"^[2]. With the imitation of natural ecosystem, circular economy, as an economic system, is established according to the circulation of substances and energy flow scale in natural ecosystem. It is a substance circulation process which integrates economic system into natural ecosystem harmoniously. Circular economy is a reflection of the harmony between man and nature with clean production as the breakthrough point of development, the reduction of material resources as the developmental expression and the coordinated development of economy and ecology as the ultimate goal.

1.2 Exploration of agricultural circular economy Ministry of agriculture issued *Advice on the Notice of Implementing Recent Key Work of Building Conservation-oriented Society by the State Council* in 2005, stressed the importance of saving land, water, fertilizer, chemical, seeds and energy as well as the comprehensive and cyclic utilization of resources and greatly spread the adaption of "top ten economical technologies". Over utilization of agricultural resources increasingly deteriorates the eco-environment, which has become a severe obstacle in the sustainable development of agriculture. Ecological functions of agriculture can be effectively exerted through the innovation of agricultural technology. For example, the consumption of water resources can be reduced and the utilization efficiency can be improved through water-saving technology and dry land farming technology; deterioration of the quality of cultivated land can be reduced and phenomenon like desertification can be improved by studying and adopting technologies

of breaking wind and stabilizing sand as well as soil; damage of natural disasters to agricultural production can be lessened by developing technologies of weather prediction and microclimate control. The relation between agro-ecological system and natural as well as social ecological system is shown in Fig. 1. Agricultural production and managing activities can not be done without agro-ecological system and social economic system. Flow of substances and energy, environmental effect and value realization all fully reflect the thought of circular economy. At present, many regions in China have taken various measures to study the developmental modes of agricultural circular economy. There are many specific methods. Firstly, the production form of reduction which reduces the quantities of used agricultural materials, such as fertilizer, agricultural chemical and film, to achieve the purpose of lessening pollution mainly through scientifically using those agricultural materials or replacing conventional production means and technology with the new ones. Secondly, the operational form of re-use which mainly makes wastes into energy, fertilizer and forage. Thirdly, the interlinking form of recycling which consists of two types. One is to change the usage of agricultural products through classification if their qualities change while storing and transporting and can not be sold as its original usage, which can not only reduce wastes issued to the outside of the system by agriculture through final goods, but also increase the source of available substances and energy. The other is to process agricultural products into pro-environmental agricultural production means from the perspective of protecting eco-environment, such as biologics like disposable field plastic film, nutrition pot and biodiesel and so on.

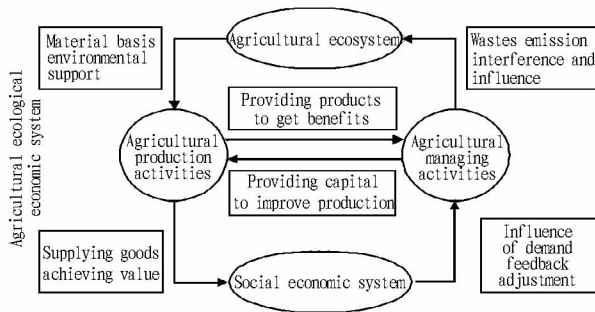


Fig. 1 Relationship between agro-ecosystem and natural, social-ecological system

1.3 Developmental mode of urban agriculture Since national conditions, social economy and natural conditions of each country and region in the world are not the same, developmental modes of urban agriculture are different from each other. In general, there are mainly three modes stressing economic functions, ecological functions and economic, social and ecological functions respectively^[3]. Highly intensive agriculture in Israel and the giant urban agricultural belt in America on both sides of the Atlantic Ocean belong to the first mode. However, some European developed countries emphasize ecological functions, such as citizen plantations in Germany and forest cities in Britain^[4]. These developed countries pay more attention to the improvement of natural environment and the enhance-

ment of living qualities for reasons like relatively advanced economy and cultural traditions. Japan and Singapore are the most typical ones in eastern Asia in considering economic, social and ecological functions. Large cities in China have two basic tasks, namely ensuring self-sufficient provisions for suburban peasants and providing subsidiary foodstuff for cities. Suburban countryside of cities in our country has a wide range which can be divided into suburban, outskirts and the far outskirts. So the development of urban agriculture in our country has different levels and aspects. Therefore, in the long run, the third mode which considers economic, social and ecological functions should be selected to develop urban agriculture^[5].

1.4 Urban agricultural development in Tianjin City economic and social advancement in Tianjin has higher requirement on agriculture in providing green protective shield to adjust the ecological balance between the urban and rural areas. Urban and suburban agricultural developmental mode in the past has difficulties in meeting the demand of economic development and citizens' demand on living environment. The best method of tackling the above contradiction is to optimize the distribution of resources. Highly contemporary urban agriculture which harmonizes the functions of production, ecology and social economy together can be developed within limited space to achieve a second leap in agriculture^[6]. From the latter half of 2008 till 2011, Tianjin will invest 7.7 billion yuan to establish 6 modern agricultural science parks in the coastal new area, namely Binhai Saline-Resistant Plant Science Park, Binhai Dongli Agricultural Science Park, Binhai Marine Cultivation Science Park, Binhai Eco-agricultural Science Park, Binhai Chadian Grape Science Park and Binhai Jinnan Recycling Agricultural Science Park. The building of the 6 major parks stresses regional distinctions, mixes functions of production, living, ecology, culture and education together and vigorously fosters unique and distinctive agricultural products with Binhai famous brands, and then raises the "gold content" of agriculture in Tianjin. And the coastal new area, as the country-level agricultural base for technological innovation and achievement transformation, will become the crucial engine of leading the development of modern agriculture in Tianjin.

2 Mode analysis of Sino-Singapore Eco-City in Tianjin

2.1 The background and significance of building Sino-Singapore Tianjin Eco-City Tianjin Sino-Singapore Eco-City is located in the northeast of the coastal new area, and has a total area of 30 km² with the overall investment of 50 billion yuan. It was proposed by premiers of China and Singapore in April, 2007 and settled in the coastal new area in Tianjin on November 18, 2007. The population of the whole eco-city will reach 350 000. As a cooperation project of China and Singapore, Sino-Singapore Tianjin Eco-City will mirror advanced experience in Singapore and have wide cooperation in city planning, environmental protection, resources conversation, recycling economy, eco-construction, renewable energy utilization, middle water reuse, sustainable development and promoting

social harmony. The establishment of eco-city demonstrates the determination of governments in China and Singapore to settle global climate change, strengthen environmental protection and economize resources as well as energy. It also provides active discussion and a typical model in constructing a resource-conserving and environment-friendly society. Sino-Singapore Tianjin Eco-City is a large-scale environmental and urban developmental project on the conception of saving energy and improving cycle efficiency of resources. The eco-city has a green coverage ratio of 50% and the direct drinking water system in the city allows people to have direct drinking water the moment they open the tap. The construction of the eco-city began formally on September 28, 2009. Sino-Singapore Tianjin Eco-City has formed a complex ecosystem which consists of lakes, rivers, wetland, waters and green land. It is the first eco-city in the world developed and constructed through interstate cooperation, the largest ecologically livable modeling new city in today's world and the second cooperation construction project of China and Singapore after Suzhou Industrial Park.

2.2 Features of Sino-Singapore Eco-City Sino-Singapore Eco-City has the following characteristics. Firstly, it is the first eco-city developed and constructed with interstate cooperation. Secondly, it is an eco-city constructed under the condition of resources constraint. Thirdly, with an aim of restoring and protecting ecology, Sino-Singapore Eco-City is to build an ecosystem harmonizing natural environment and man-made environment so as to achieve the harmonious coexistence of man and nature. Fourthly, it has a compact city layout supported by green transportation. Fifthly, index system is taken to be the basis of city planning to guide urban exploration and construction. Sixthly, city basic framework consists of ecological valleys (ecological corridors) and ecological cells (ecological communities). Seventhly, marked by city direct drinking water, eco-recycling water system stressing middle water reuse, rainwater collection and river system repairing is to be built in water deficient area induced by water quality. Lastly, marked by the utilization of renewable energy, Sino-Singapore Eco-City strengthens the conservation of energy and the reduction of emission, develops recycle economy and builds a resource-conserving and environment-friendly society.

2.3 Orientation of "three harmony and three capabilities" of sustainable development The construction of eco-city is brand new. As the first eco-city with international cooperation in the world, the construction of Sino-Singapore Tianjin Eco-City is in accordance with the general trend of international society tackling climate change, developing low carbon economy and promoting sustainable development. The "model room" of world livable cities is being built. Leaders in China and Singapore have strong determination and proposed the conception of "three harmony and three capabilities" which means the harmonious coexistence of man and man, man and economic activities, man and nature and capabilities of implementing, duplicating and popularizing. The conception can be summarized as two sentences—to be ecological, environment-friendly and energy-conserving and to be natural, harmonious and livable.

2.4 Inspiration of the developmental mode of Sino-Singapore Eco-City on urban agriculture in Tianjin Key fields of developing circular economy in Sino-Singapore Tianjin Eco-City mainly focus on conserving water, land and energy and environment-friendly technological industries. Inspiration of this duplicable mode on urban agriculture in Tianjin is to be discussed from the aspects of conserving water, land and energy respectively.

2.4.1 Water-conserving field. Water is the basic natural resource in the economic development of human society. According to the idea of circular economy, the circulating ring of water resources is to be established to achieve the reduction, reuse and recycling of resources. Water demand is to be greatly reduced through increasing water in many ways and through adopting various water-saving strategies comprehensively. And correlation between circular economy and water recycling is to be formed gradually. Developing circular economy of water resources is a crucial strategy of transforming extensive economic growth mode into intensive economic growth mode, taking new industrial developmental road and building an all-round society with sustainable economic development.

2.4.1.1 Developmental strategies of circular economy of water recycling. Firstly, water must be introduced. Since the eco-city has quite limited water resources, water must be brought in from its surrounding areas. Secondly, industrial structure is to be rationally distributed. Industries with low water consumption and high output benefits should be developed with priority and those with low output benefits and high water consumption should be limited, which increases the economic benefits created by one-sided water. Thirdly, regenerated water is to be recycled. Regenerating and reusing waste water as the supplementary water resources in the city is the key measure of relieving the shortage of water resources and ensuring water supply in the city. The implement of recycling waste water is to transform the strategic goal of disposing waste water from "sewage disposal and standardized emission" in traditional sense to water recycling with the core of enhancing the comprehensive availability of water resources. Facilities and technologies of regenerating water resources and waste water vary due to specific purposes and different water qualities. Fourthly, rain water is to be recycled. Rain water collecting system and underground storage system are to be established to rationally distribute the equipment of collecting and storing rain water by using infrastructure in the city. Collection and utilization can be integrated to achieve an optimal effect. Overall arrangement, along with urban flood control can form a controlling system of rain and flood to achieve the transformation of rain water resources to water resources in other forms^[7].

2.4.1.2 Four links adopted to urban agriculture in Tianjin. Water-conserving technologies in Sino-Singapore Tianjin Eco-City are to be introduced to the agricultural technological park of urban agriculture in Tianjin and are mainly applied to four basic links. Firstly, evaporated quantity and seepage loss of water in the irrigation pipelines during the process of transportation are to be reduced to improve the utilization rate of irrigation water in

farmland. Secondly, water loss in deep layer and ground loss during the irrigation are to be reduced to improve the quality of irrigation water and to cut water demand of per unit area. Adopting information technology, accurate irrigation system is to be implemented to make "non-sufficient" water supply to farmland according to the actual water demand of crops. Thirdly, evaporation loss of water in the soil is to be reduced. Natural rainfall and irrigation water resources are to be effectively used and natural rainfall is to be fully and effectively collected. Utilization rate of rain water is to be advanced to the utmost through measures of irrigation, agronomy, management and so on. Fourthly, water production efficiency of crops is to be improved and water transpiration consumption is to be reduced to get higher output and water saving benefits. Micro-irrigation techniques include drip irrigation, micro sprinkler irrigation, infiltration irrigation, micro pipe irrigation and so on. Water is to be irrigated around the root of the crop through various pipes and irrigation implements after being pressurized and filtrated. Micro irrigation belongs to localized irrigation with only part of the soil being moistened, which is suitable for densely sown crops. Micro irrigation techniques have obvious benefits of conserving water. 80% – 85% of water can be saved compared with surface irrigation. At present, micro irrigation is adopted in plastic greenhouse cultivation and the cultivation of crops with high output and benefits. There are some relative water-conserving measures, such as strategies of replacing normal irrigation water, excavating precipitation resources and improving utilization of natural rainfall as well as using^[8], expanding and implementing industrial waste water and domestic sewage in agricultural irrigation after being processed.

2.4.2 Land-conserving field. Circular economy of land resources is mainly reflected in land intensive utilization to ensure the sustainable use of land. The structure of land utilization system within a certain region is to be adjusted and transformed and the same is true of the following functional benefits to achieve the sustainable growth and stability of land productivity, ensure the potential of land resources, prevent land degradation and pursue sound economic, social and ecological benefits at the mean time^[9].

2.4.2.1 Developmental strategies of circular economy of land resources utilization Water takes up a large area of land utilization in Sino-Singapore Tianjin Eco-City and chiefly consists of water channels, salt pools, ponds, shrimp ponds of sewage reservoirs, crab ponds and fishponds as well as some other land utilization forms, such as reed marshes, vineyards, graveyards, villages and land to be constructed and so on. Firstly, the holding capacities of buildings are to be properly improved so as to fully make use of land resources. Exploitation of conserving energy and land is advocated to effectively make use of land with intensive farming and management. Secondly, lowest investment of per unit land is limited to improve land output ratio. The output ratio of per unit land is advanced through limiting lowest investment of unit land in the eco-city. Thirdly, three-dimension utilization of land with multidimensional spatial development is to be conducted. Land utilization of the eco-city

is going to be multidimensional to fully make use of spatial resources on, above and under the ground. Fourthly, regulation of sewage reservoirs is strengthened to fully play land potential. Since sewage reservoirs take up much land resources, some of the sewage reservoirs can be backfilled to be construction land after being regulated, which will fully exert the potential of land resources in that region^[10]. Fifthly, environmental management of ecological reservation is to be strengthened. Non-construction ecological reservation in the eco-city, such as rivers and costal beaches, is to be regulated to be integrated into natural landscape system to beautify the natural environment in the eco-city and achieve the harmony between man and nature.

2.4.2.2 Inspiration on urban modern agriculture in Tianjin Sino-Singapore Tianjin Eco-City is located in the area with relatively poor natural conditions, saline soil, sparse vegetation, degenerated environment, fragile ecology and water quality-induced water shortage. Meanwhile, the area relies on the metropolis and has low matching infrastructure investment with convenient transportation, which is beneficial to restoring exploitation of ecology. The eco-city belongs to water quality-induced water shortage region with typical features of new coastal area, such as salty land, saline wasteland, wetland and high salinization. From the perspective of conserving land, the construction of such an eco-city with an area of 35 km² has great significance in agriculture of Tianjin where there is sparse cultivated land since all the construction land of the eco-city is salty land and saline wasteland. Additionally, glass greenhouse cultivation in modern agricultural technological park is to be introduced into Sino-Singapore Tianjin Eco-City to plant fruits and vegetables with high output and excellent quality, which can meet the consumption demand of the whole eco-city and provide a new thought for the development of urban modern agriculture in Tianjin. Since the mode of Sino-Singapore Tianjin Eco-City is duplicable, a mini-sized environment-friendly livable city with sustainable development and energy-conservation can be built in saline beaches in large and medium-sized cities in China on the experience of Sino-Singapore Tianjin Eco-City, integrating urban agriculture and modern agriculture technological parks.

2.4.3 Energy-conserving field. As an economic developmental mode, circular economy takes the reduction of resources consumption as the precondition, including reduction of energy consumption, energy recycling and comprehensive utilization. The basic aim of modern circular economy is to prevent wastes emission and reduce environmental contamination from the source. Developing circular economy is the fundamental method of "reducing emission" and the most effective method of conserving energy and reducing emission from the source. Introduction of greenhouse equipment greatly improves the agricultural equipment in Tianjin. Geothermal energy is to be fully and effectively utilized to get high economic benefits through producing agricultural products with high added values. Since consumers in Sino-Singapore Tianjin Eco-City purchase green products which are not polluted or beneficial to public health,

(To page 16)

workers^[6] and realize disconnection between registered permanent residence and social welfare. Explore a registration system for migrant workers to freely live and migrate in practice step by step.

3.2.2 Deepen the reform of labor employment system in cities. First, form an unified labor market in the whole country, realize fair, open and just employment system of urban and rural labors and eliminate discriminatory urban employment policy. Second, express service function of public employment institutions, accurately and timely provide employment information in regions and clear the employment channel. Third, accelerate construction of labor marketing information system and provide overall and correct information for migrant workers all over the country. Fourth, strengthen free education and training of professionalism for rural migrant workers.

3.2.3 Establish social security system covering cities and villages. Establish social security system for migrant workers according to grading and gradual principle. It includes universal security system for injury suffered on the job, medical security system according to contribution, social relief system mainly for migrant workers and urban housing system with the principle of guaranteeing vulnerable groups.

3.2.4 Formulate laws and regulations guaranteeing related rights and interests of migrant workers. Because migrant workers belong to marginal groups and vulnerable groups in cities, government departments should confirm a minimum standard

(From page 12)

green organic vegetables, fruits and flowers are cultivated in glass greenhouse after the introduction of agricultural technological park into the eco-city. Environmental protection and resources and energy-conservation are emphasized to achieve sustainable consumption while pursuing a comfortable life. All in all, ecological construction of the service industry should strengthen cooperation among industries and build an economic chain of substance cycling, wastes utilization and gradient utilization of energy among industry, agriculture and other service departments, which will gradually form a recycling ring of three major industries. Thus, circular economy is to be achieved on microscopic level with the ecological construction of the industry being promoted at the same time^[11].

3 Conclusion

The advantage of the mode of Sino-Singapore Tianjin Eco-City lies in its duplicability. Its success provides a new thought for the development of urban agriculture in large and medium sized coastal cities in China. Under the guidance of the theory of circular economy, strengthening the economizing utilization of agricultural resources and the resource utilization of agricultural wastes has positive effect on the improvement of city environment. Organic solid wastes are to be dispersed from the sewage recycling system, the physiological and biochemical mechanism of increasing output and income of ecological agriculture is to be further studied and urban agriculture is to be integrated into the planning of city land utilization as well as urban development.

for migrant workers on the aspects of wage level, worker's compensation, public welfare and so on to make their rights guarantee has a certain legal basis.

In a word, government should gradually eliminate dual institutional barrier in cities and countryside and dredge the institutional bottleneck of rural surplus labors transfer to achieve real transfer of rural surplus labors and clear up institutional barriers of Chinese urbanization and industrialization.

References

- [1] HOU DM, WANG DW, BAI NS, *et al.* From "migrant workers scarcity" to "rural workers rushing home": does China's Lewis turning point have come? [J]. Population Research, 2009(2): 32–47. (in Chinese).
- [2] ZHANG ZP. The falsification of China's Lewis turning point has come based on the false appearance analysis of "migrant workers scarcity" [J]. Shandong Economy, 2008(2):61–65. (in Chinese).
- [3] JIANG MX. Directory of tissue paper & disposable products (China) 2010 [M]. Beijing:China Petrochemical Press, 2010. (in Chinese).
- [4] LI QP, WANG Z. Reasonable thinking of "Shortage of Rural Workers" [J]. Times Finance, 2010(4):37–38. (in Chinese).
- [5] JIAN XH, ZHANG JW. From migrant workers boom to migrant workers scarcity institutional analysis on effective transfer of rural surplus labors [J]. Population Research, 2005(2):49–55. (in Chinese).
- [6] BIAN BQ. Prospects, causes and solutions of the transfer of rural surplus labors [J]. Agricultural Economy, 2010(2):82–83. (in Chinese).

References

- [1] LIANG ZL. The current situation, constrains and countermeasures in development of national modern agriculture [J]. Seed Industry Guide, 2008(6):8–9. (in Chinese).
- [2] CUI ZJ, SI W, MA XG. Study on the method of eco-agricultural mode design [J]. Science Technology and Engineering, 2006, 6(13):1854–1857. (in Chinese).
- [3] SHEN M, TANG JY. Improving rural ecological environment and promoting development of ecological agriculture [J]. Inquiry into Economic Issues, 2002(5):79–82. (in Chinese).
- [4] GU HY, ZHOU XW. Significance and implication of sustainable development of modern city agriculture [J]. Research of Agricultural Modernization, 2001, 22(1):20–23. (in Chinese).
- [5] ZHAO GJ, DU X, FENG LA. Research on development of eco-agriculture oriented to circular economy [J]. Ecological Economy, 2006(8):109–111. (in Chinese).
- [6] SCHULTZ TW. Transforming traditional agriculture [M]. Beijing: The Commercial Press, 1999. (in Chinese).
- [7] GU YK, HUANG CP. Strategies and thinking on developing efficient eco-agriculture in Zhejiang Province [J]. Journal of Zhejiang Agricultural Sciences, 2008(2):125–128. (in Chinese).
- [8] MOUGEOT LJA. Urban agriculture: concept and definition [J]. Urban Agriculture Magazine, 2000(1):5–7.
- [9] LIU HM, LI YQ, TAO Z, *et al.* Fundamental choice for the development of agriculture in China-eco-agricultural industrialization [J]. Chinese Journal of Eco-Agriculture, 2006, 14(3):217–219. (in Chinese).
- [10] YU JS. Exploration and recommendations for developing ecological agriculture in Shanghai [J]. Shanghai Rural Economics, 2007(7):8–10. (in Chinese).
- [11] YIN CB, ZHOU Y. Theories and models of the development of circular agriculture [M]. Beijing:China Agriculture Press, 2008. (in Chinese).