

The Sustainable Development of Urban Agriculture under the Background of Rapid Urbanization

I . Introduction

Urban Agriculture is the product of region's industrialization and urbanization in a society or a country, and constantly is endowed with new connotations with the development of economy. Its theory and practice originate from Japan, Europe, the United States and other developed countries, which has been paid more and more attention with the economic globalization advancement by the developing nations that are doing industrialization and urbanization.

Urban agriculture involves wide complex issues. There is no unified definition between the domestic and the foreign scholars about urban agriculture. Mostly scholars define urban agriculture from its regional feature, its spatial form, its production and operation forms and its feature. For example, the definition of urban agriculture given by the United Nations food and agriculture organization is: "Urban agriculture means economic activities which exactly refers to planting and breeding industry within a big city or around a city circle, taking advantage of the gaps (including cultivated lands, mountainous lands, the surface of water) among cities, such as the activities of providing fresh agricultural produce, ecology, tourism and leisure products for cities ".

Urban agriculture sets multiple functions in one, and itself is a contradictory unity. On the one hand, developing countries need large scale of industrialization and urbanization constructions; on the other hand, it must pay more attention to the ecological environmental and social problems while making economic constructions. That is the main reason why

sustainable development of urban agriculture in developing countries is more and more difficult. Just like RAKODI, C (1988) points out, that urban agriculture is often ignored by local governments and land owners, although it can bring jobs and income and ensure its own national food security for low income groups (farmers, particularly low-income women).

Since the reform and opening in China, with the fast development of China's urbanization, agriculture is slowly driven out of the city, and with it comes the food safety problem and ecological environment deterioration, which let us to rethink deeply the seriousness of this problem, to seek the integration of urban and rural areas, to research the symbiosis of industry, agriculture and nature. Beijing, Shanghai, Wuhan, and other big cities have started the idea and practice of urban agriculture, and have issued relevant developmental planning to promote urban agriculture. Because China's city development level is uneven, and because the gap in economic and social development between the urban and rural areas or among different areas, the development of urban agriculture mode is not uniform. But, urban sustainable development of agriculture faces common opportunities and challenges:

First, due to its location which locates in the fringe between large or medium sized cities and general agricultural region, urban agriculture takes advantage of both the radiation and the pressure from city regions.

Second, in its function, urban agriculture both meets the various requirements of the side, and to a certain extent, limit the urban expansion.

Third, in the relationship between urban and rural areas, on the one hand, urban agriculture provides work for low-income people from urban and rural areas, so farmers have more opportunity to be engaged or partly engaged in non-agricultural industries, while citizens have

convenience participating in agriculture; on the other hand, in the process of rapid urbanization, urban agriculture faces the adjustment in structure and the upgration in function, the change of mode in life and production of residents, urban planning and management and a series of problems.

Fourth, the relationship between urban agriculture and industrialization is in that, on one side, industrialization provides urban agriculture a strong material base, the mechanical power advanced technology and management experience; on the other side, urban agriculture has got a great threat given by the industrial pollution.

In conclusion, this paper based on the background of the accelerate development on China's urbanization, explains the interaction among the industrialization, the urbanization and urban agriculture, to explore a sustainable development way for urban agriculture. The structure of the article is: the first part defines the basic connotation and the sustainable development in the challenges and opportunities of urban agriculture and puts forward the key point in this paper; the second part is the theoretical basis, which introduces related economic basic theories of urban agriculture; Based on the introduction and the theoretical basis in the second part, the third part sets the main index and sample data for sustainable development of urban agriculture; The fourth part is the empirical analysis, which selects panel data sample of 16 cities in China in the year of 2000-2008, using the fixed effect models to make regression analysis; The final part of this article is the conclusion, putting forward relevant policy suggestions.

II . The summary of economics theory of urban agriculture

In the 19th century, British social activist E.Howard designed a new city mode utilizing broad farmlands to surround the beautiful living environment, putting all what is good offered by the positive city life together with all the beauty and welfare provided by countryside in order to deal with the traffic jams, environmental degradation and city disease caused by farmers' influx into the big city. This should be the earliest urban agriculture theory.

Since the 20th century, along with the wide spread of urban agriculture in many developed countries, research in its theory has been furthering. This article explains the theoretical bases of urban agriculture mainly from the view of point of economics.

Urbanization regarded as a complicated process in a country or regional space system, mainly shows, in the form, a spatial agglomeration process of population and non-agricultural activities. Urbanization contains an enormous development potential. A rapid urbanization period is often a fast economic growth period. The emergence and development of urban agriculture is the outcome induced by urbanization development. Urban agriculture development and urbanization process performance a mutual promotional and interdependent and interactional relationship.

On the one hand, in the progress of urbanization, the land resource is particularly scarce. Urban agriculture's economic competitiveness, compared to the other dominant industrial, commercial and residential land, usually appears its weakness, which makes urban agriculture present a kind of unstable trend in spatial distribution, which is often occupied by other economic activities. At the same time, urban environmental pollution and waste directly destroy crops growth, and make urban agriculture productivity decline.

On the other hand, the purpose of urbanization is not to devour agriculture and rural, but to guide constant change and development of agriculture from concept to its operation way. Its functional mechanism is in that urbanization can produce a huge agricultural products consuming market, stimulate the demand for agricultural products, and improve agricultural production ability continuously; Urbanization induces the agricultural department transform its function from providing a single production function to providing multiple compound integration of production, life and ecology; Urbanization induces agricultural structure to upgrade and transform from low level to high level, promoting urban sustainable development in agriculture. Therefore, in the induction of urbanization, the department of agriculture will increasingly be an open cycling industry system with multiple compound functions, and the end result is the realization of the integration of urban and rural areas.

From the point of view of the space, urbanization is a process in which the key elements agglomerate to the urban, generating centralizing economics; During this process, the cities become cluster of "centre", while the rural and agriculture evolve into "periphery". In 19th century, Johann Heinrich von Thünen's theory illuminates how the market distance influence land use (agricultural) type and agricultural production intensive degree and establishes location regularity of land use and comparativeness advantage of location, the two important basic concepts; the theory holds that a city is a center outside which there exists an agricultural distribution zone expanding in the shape of concentric circles. At the end of 20th century, new economic geography, focusing on regional development and industrial concentration problems in the background of globalization, further deepens the space location theory, so that spatial agglomeration of agriculture and industrial scale get further

development.

From the view of Agriculture itself, urban agriculture obviously reflects the versatility of agriculture. The multi-functional agriculture means not only providing more and better human specific products to meet the basic needs of society growing, but also taking other growing and expanding social, economic and ecological functions. The traditional agriculture mainly offers agricultural production to meet the human needs by using the performance of animals and plants; and urban agriculture production, circulation and operation, agricultural form and space layout, must obey all the needs of big cities, and provide services for people's lives and production, and gain economic profits for its service. Various needs of the people and the city decide the diversity of urban agriculture, the shape of the production and the form of business operation and function. The first beneficiary of multi-function agriculture is society as a whole, and then the agricultural operator, which means that urban agriculture, is increasingly becoming a social sector, and its attributes as an industry economic department is weakening. In this sense, the non-commercial feature of urban agriculture owns comparatively strong positive externality, and urban agriculture itself has the characteristics of quasi-public products, therefore, the sustainable development of urban agriculture deserves supports from government departments at all levels and society rather than being completely operated according to the principle of market economy.

As China gradually establishes and perfects its modern market economic system, especially under the new situation of the urban and rural development and the construction of new countryside strategy, the mode of agricultural production and operation, and decision-making in agricultural management have been changing greatly. At the same time,

the developments in the biological technology, computer and information technology which are taken as representatives of the rapid developments of modern technology bring new opportunities for the transformation from traditional agriculture to modern agriculture. The developing of urban agriculture presents a tendency of integration between agriculture and other industries. The amalgamation of agriculture and other industries enriches the multi-function connotation of agriculture. The emergence of new industry form drives the upgrading of the original industry, optimize agricultural resources' allocation, and prompt the adjustments and upgrations in agricultural production scale, production mode, and agricultural structure, thus greatly promote comprehensive benefit of urban agriculture and harmonious development between urban and rural areas.

III. The main index and sample data

To domestic and foreign scholars, the ways to evaluate and measure the development of urban agriculture are multifarious, because urban agriculture involves wide range and rich content. Most of the main index, however, is embodied in its economic, social and ecological function. This paper tries to use the regression analysis, to reflect the development process of urban agriculture, to reveal the development trend for urban agriculture, search the way for its sustainable development.

This paper defines the variable relevant to the sustainable development of urban agriculture as follows:

ea: the proportion which the effective irrigation area accounts cultivated land area, or known as the effective irrigation coverage on a unit area of cultivated land. The effective irrigation coverage on a unit area of cultivated land comprehensively embodies the investment level of

urban agriculture and the level of science and technology, the ecological environment situation and the level of government's management, etc. And it can also reflect the opportunities and challenges the urban agriculture faces under the background of rapid urbanization. This paper used it as the dependent variable, indirectly reflect the comprehensive level of sustainable development in urban agriculture.

rtp: the proportion that rural population accounts the total population. It reflects the flow condition for population between urban and rural areas in the process of urbanization. It reflects from the side many indicators of moderate scale operation and the recruit ability for urban and rural labor employment in the development of urban agriculture.

paa: per capita arable land which is used to measure the abundant degree of land resources a region has for urban agriculture production.

tpt: per capita agricultural machinery power, reflecting the investment in material basis for urban agricultural equipments and the level of urban agricultural mechanization.

er: rural electricity consumption per capita, which reflects the rural market economy development level and rural residents living standards, and which also reflects the social development level of urban agriculture.

ca: chemical fertilizer use quantity for each unit of cultivated land area. A certain amount of fertilizer can increase crop yield per unit area, but the excessive application of chemical fertilizer will definitely cause pollution to the soil, and groundwater resources.

tar: per capita agricultural output, an important index of the level of economic development, which reflects the output level of urban agriculture,

pi: the primary industry fixed assets investment accounts for the gross investment of fixed

assets of the whole society, the index reflects during the process of the industrialization and urbanization, the capital distributional proportion among three major industries, and also reflects how much the capital pays attention to urban agriculture.

The data uses in this paper mainly come from the statistical yearbook of 16 major cities, such as Beijing, Shanghai and Tianjin and so on. There are four municipalities that are governed directly under the central government (Beijing, Tianjin, Shanghai, Chongqing), municipalities separately listed in the state plan (Dalian, Qingdao, Xiamen, Ningbo) and 8 deputy provincial cities (Shenyang, Jinan, Nanjing, Chengdu, Guangzhou, Hangzhou, Wuhan, Xian), among them, 4 cities in the Midwest (Chongqing, Chengdu, Wuhan and Xian). Each variable descriptive statistics are shown as below:

Table 1 Descriptive statistics results

Variable	Obs	Mean	Std. Dev.	Min	Max
+-----					
ea	144	.7148288	.2160036	.2093102	1
rtp	144	.448884	.195334	.0974999	.9261362
paa	144	.04118	.022287	.0090361	.0993042
tpr	144	.3688468	.1957999	.0319976	.9157196
er	144	546.2288	531.9347	30.66141	2498.636
+-----					
ca	144	.6292182	.2230026	.2332074	1.388436
tar	144	.2597453	.1215588	.108138	.8920123
pi	144	.0148535	.0159311	.0001295	.0679999

The table is N = 16, T = 9 balance panel data. Table 1 simply lists the seven variables observation data, mean, standard deviation, the maximum and the minimum.

IV. The empirical analysis

1. Econometric model and method

Based on the above, this paper established the panel data model as follows:

$$Y_{it} = X'_{it}\beta + Z'_i\delta + u_i + \varepsilon_{it}$$

Subscript i represents the city, t stands for the year. Among them, $Z_{it} = Z_i, \forall t$ is the individual characteristics of time invariant; but X_{it} are time varying with individual. Perturbation terms consists of u_i and ε_{it} , of which the random variable u_i cannot be observed, representing the individual heterogeneous intercept; ε_{it} are perturbation terms changed with individual and time, presuming that they are independent identically distributed random variables, and not related with u_i . If an explanatory variable is related with u_i , it is called "fixed effects model"(FE). If all explanatory variables are not related with u_i , it is known as "random effects model" (RE).

In order to avoid spurious regression, this paper makes the inspection based on the same root unit root test LLC (Levin-Lin-Chu) and different root unit root test by Fisher-of all variables; the results refuse the null hypothesis of the unit root process, ensuring the smoothness of the panel data.

2. The regression results and analysis

This paper makes regression of the model above by using STATA11, and the measurement results are shown in table 2.

Table 2 The measurement results

	(1)	(2)	(3)	(4)
	fe	re	fe_scc	fe_iv
rtp	0.324*** (4.79)	0.319*** (4.93)	0.324*** (7.75)	0.294*** (3.61)
paa	-5.500*** (-5.91)	-5.929*** (-6.80)	-5.500*** (-23.28)	
tpt	0.278*** (3.23)	0.244*** (3.02)	0.278*** (4.63)	0.190* (1.78)
er	-0.000** (-2.11)	-0.000* (-1.86)	-0.000** (-2.40)	-0.000 (-0.32)
ca	0.095* (1.90)	0.087* (1.77)	0.095** (2.14)	
tar	0.043 (0.67)	0.038 (0.60)	0.043 (1.18)	-0.104 (-1.41)
pi	-0.947* (-1.95)	-0.970** (-2.02)	-0.947*** (-5.89)	-1.063* (-1.71)
lag_paa				-3.845*** (-3.40)
lag_ca				0.011 (0.18)

_cons	0.657*** (10.86)	0.694*** (9.91)	0.657*** (22.43)	0.715*** (9.39)

N	144	144	144	128
R-sq	0.467			
r2_w	0.467	0.464	0.467	0.281

NOTE: t statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01.

(1) and (2) were the estimate results of fixed effects model and random effects model. Considering the condition that the perturbation terms may have heteroscedasticity, an auxiliary regression is given as below (Wooldridge, 2002),

$$Y_{it} - \hat{\theta}\bar{Y}_i = (X_{it} - \hat{\theta}\bar{X}_i)' \beta + (1 - \hat{\theta})Z_i' \delta + (X_{it} - \bar{X}_i)' \gamma + [(1 - \hat{\theta})u_i + (\varepsilon_{it} - \hat{\theta}\bar{\varepsilon}_i)]$$

Then, using clustering robust standard deviation to examine the null hypothesis, the results refuse " $H_0: \gamma = 0$ ", while accept the fixed effects model. Next, Through the inspection of fixed effects model serial correlation and heteroscedasticity it finds that there is section heteroscedasticity; We revised serial correlation and heteroscedasticity using the method of Driscoll and Kraay(1998), and (3) are the results for correction. Further consideration to endogenous problem of the model let we use lagging a period of the two variables paa and ca as instrumental variables on regression, (4) are the results, Hausman test shows that the model has endogenous problems.

Observing the results, the coefficient of "rtp" variable is positive at 0.01 significant level, which indicates that in the process of urbanization, the labor force flow between urban and

rural elements is closely related to the development of urban agriculture. Under the trend of industry convergence, urban agriculture provides more employment opportunities for urban and rural laborers. The “tpt” variables was positive at 0.1 significant level, showing that agricultural mechanization has promoted the development of urban agriculture, and further reflects industrialization provides technical equipment for urban agriculture development, and brings the positive effects. The “pi” variable coefficient was negative at 0.1 significant level, which means the investments of urban agriculture are at relatively low level in the industrialization and urbanization process, but also suggests that capital is more willing to flow to the second industry and tertiary industry under the high risk and low income of agriculture. The “er” and “tar” two variables do not pass the statistical significance, which reflect the level of economic development of urban agriculture didn't improve its competitiveness effectively. In addition, RE model tried to add regional dummy variable and city level dummy variable, however, the results didn't pass the statistical significance.

V. The conclusion

By using the panel data of 16 china big cities from 2000 to 2008, this paper analyzes the basic condition of sustainable development of urban agriculture. Empirical analysis shows that urbanization, industrialization and sustainable development of urban agriculture are closely related with each other. Urbanization and industrialization provide a rare opportunity for urban agriculture, but a series of problems are coming in the sustainable development of urban agriculture, especially for the developing country-China, the dilemma of the performance is more prominent. Based on the conclusion, to realize the sustainable development of urban agriculture, accelerating the transformation of economic development mode, the harmonious development of urban rural and regional areas, improving the quality of the urbanization are becoming more and more important. In the process of rapid urbanization, the government ought to develop its own characteristic agriculture through adjusting measures to local conditions, according to objective location rules and relative layout, to speed up the structure adjustment and the transformation and upgration of urban agriculture, and to improve the level of economic development through the industrialization and informatization. Governments at all levels should intensify the urban agriculture investment and protection and reduce the logistics cost and taxation, to create conditions for its positive development; for the sustainable development of urban agriculture, the government should formulate the urban and rural unified planning, and strengthen the supervision, promote rural land use rights transfer and intensive space use.

References:

- [1] Gruber S, Soci A. Agglomeration, Agriculture, and the Perspective of the Periphery[J]. SPATIAL ECONOMIC ANALYSIS, 2010,5(1):43-72.
 - [2] Bryld E. Potentials, problems, and policy implications for urban agriculture in developing countries[J]. AGRICULTURE AND HUMAN VALUES, 2003,20(1):79-86.
 - [3] Page B. Across the great divide: Agriculture and industrial geography[J]. ECONOMIC GEOGRAPHY, 1996,72(4):376-397.
 - [4] RAKODI C. URBAN AGRICULTURE - RESEARCH QUESTIONS AND ZAMBIAN EVIDENCE[J]. JOURNAL OF MODERN AFRICAN STUDIES, 1988,26(3):495-515.
 - [5] Driscoll J C, Kraay A C. Consistent covariance matrix estimation with spatially dependent panel data[J]. REVIEW OF ECONOMICS AND STATISTICS, 1998,80(4):549-560.
 - [6] Smit J, Ratta A & Nasr J. 1996b. Urban agriculture: food, jobs and sustainable cities. Publication Series for Habitat II, Vol. I. New York: United Nations Development Programme (UNDP).
 - [7] Fang Zhiquan, Wu Fangwei, Urbanization and The Development of Urban Agriculture, Shanghai Financial University press, 2008, 1.
- (方志权, 吴方卫, 城市化进程与都市农业发展, 上海财经大学出版社, 2008, 1。)
- [8] YANG Dan-ni, YU Ju-sheng. The Theory and Policy of Japanese Urban Agriculture Enlighten Chinese Urban Agricultural Development, Acta Agriculturae Shanghai[J], 2008, 24(2): 87-90.
- (杨丹妮、俞菊生, 《日本都市农业的理论及政策对我国都市农业的启示》, 《上海农业学报》, 2008, 24(2): 87-90。)

* **

Xianghui Tian, dr in the Institute for the Development of Central China, Wuhan University, China.

Lei Wang, associate professor in the Institute for the Development of Central China, Wuhan University, China, E-mail: leiwang@whu.edu.cn.

Xiaojing Xu, Qingdao University of science&technology, China, E-mail: diana999044@163.com.