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Benefit Evaluation on Land Comprehensive Consolidation in the Small Towns

—A Case of Daxing District, Beijing, China

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Abstract Taking Daxing District, Beijing, China as an example, benefit evaluation index system of small-town land comprehensive consolidation is established from four aspects of resource benefit, economic benefit, social benefit and ecological benefit. Weight of evaluation index is determined by analytic hierarchy process. After the standardized treatment on the original value index, comprehensive index method is adopted to evaluate the land comprehensive consolidation benefits in 14 towns of Daxing District in the year 2005, combining with the index weight determined by analytic hierarchy process. Evaluation result shows that areas having significant effects are Yizhuang Town, Xihongmen Town, Yinghai Town, and Jiugong Town, which are concentrated in rural-urban continuum with significant location advantages and good economic and infrastructure status. Areas having good effects are Changziying Town, Huangcun Town, Panggezhuang Town, Beizangcun Town, and Yufa Town, which are located along Yongding River, with abundant farmland resources and good ecological environment. Areas having general effects are Weishan Town, Qingyundian Town, and Anding Town, with insignificant location advantages. Areas with no significant effects are Lixian Town and Caiyu Town, with relatively poor location, resource, and economic development status.

Key words Small town, Land comprehensive consolidation, Benefit evaluation, Index system, China

With the rapid development of urbanization and the increase of population, ecological environment is becoming worsening, which seriously hinders the sustainable development of small towns. In view of the status, problem and role of small towns in social development in China, land comprehensive consolidation is of great significance to promote the construction of small towns, to strengthen the sustainable development capability of small towns, and to realize the urban and rural harmonious development. Land comprehensive consolidation of small towns is to improve the ecological environment and living environment of small towns, to protect natural landscape, and to enhance the integrated production capacity of agriculture and the sustainable use ability of resources by optimizing the allocation of land resources, the consolidation benefit of which is a comprehensive benefit. Taking Daxing District, Beijing, China as an example, resource, economy, society and ecological benefit are selected as the breakthrough points to construct index system, based on the existing evaluation theory and method. Land comprehensive consolidation benefits in 14 towns of Daxing District in the year 2005 are evaluated, so as to provide references for the evaluation of land consolidation benefit in the rural-urban continuum.

1 Status of research area

Daxing District (39°26' – 39°50' N, 116°13' – 16°43' E), having an overall land area of 1 036.32 square kilometers, connects Fengtai and Chaoyang Districts in the north, Langfang

City, Guan County and Zhuozhou City in the south, and Tongzhou District in the east. Daxing District and Fangshan District face each other across the Yongding River in the west. Daxing District is located in the middle latitude area and is affected by westerlies, with cold north wind and little rain and snow in spring and winter, hot and rainy climate in summer, and clear and crisp days in autumn. In general, Daxing District has four distinct seasons and moderate precipitation, belonging to warm temperate semi-humid climate zone. The land tilts from northwest to southeast with 15 – 45 meters of ground elevation and 0.5% – 1% gradient. Daxing District has jurisdiction over 14 towns and 2 state-owned farms, which are plain areas. Evaluation range of this research only includes the 14 towns.

2 Data source, index construction and research method

2.1 Data source Data are mainly from 1995 and 2005 land use data, social and economic data and remote sensing image of towns in Daxing District, Beijing.

2.2 Index construction Based on the theoretical research on land comprehensive consolidation benefit evaluation of small towns, multi-index evaluation method is used to construct a three-layer comprehensive evaluation index system, which is target layer, criterion layer and index layer, according to the scientific and practicable, comprehensive and representative, dynamic and static, systematic and multi-level, comparable and reliable, and operable principles^[1-2]. Table 1 reports the evaluation on land comprehensive consolidation benefit. And the evaluation on land comprehensive consolidation benefit of small towns in Daxing District is carried out from four aspects of resource bene-

fit, economic benefit, social benefit and ecological benefit.

Table 1 Benefit evaluation index system of land comprehensive consolidation of small towns in Daxing District

Target layer	Criterion layer	Index layer
Benefit evaluation index system of land comprehensive consolidation of small towns in Daxing District	Resource benefit U_1	Land utilization rate V_1
		Water utilization rate V_2
		Unit GDP energy consumption V_3
	Economic benefit U_2	Per capita GDP V_4
		Growth rate of per capita GDP V_5
		Urbanization level V_6
		Industrial structure index V_7
	Social benefit U_3	Population density V_8
		Electricity consumption per capita V_9
		Employment proportion V_{10}
		Level of infrastructure construction V_{11}
	Ecological benefit U_4	Investment level of environmental protection V_{12}
		Air quality index V_{13}
		Greenland coverage rate V_{14}

2.3 Research method

2.3.1 Standardization of evaluation index. In order to strengthen the operability of benefit evaluation on land comprehensive consolidation in small towns, dimensionless treatment on index value should be firstly carried out, which is the basis for multiple index comprehensive evaluation. Its equation is

$$\text{Positive index: } D_i = B_i/M_i,$$

$$\text{Negative index: } D_i = M_i/B_i,$$

where D_i is the standardized value of the i th index factor, B_i is the actuality value of the i th index factor in the year 2005, and M_i is the actuality value of the i th index factor in the year 1995.

2.3.2 Determination of the evaluation index weight. Analytic hierarchy process is adopted to determine the weight of evaluation factor. Land comprehensive consolidation benefit system of small towns in Daxing District is broken down into indices at different layers. Judgment matrix is established based on the analyses of index relationship between layers and within a layer. Weight of criterion layer to target layer is calculated, as well as the weight of index layer to criterion layer, and the weight of index to overall target (Table 2).

2.3.3 Evaluation method. Based on the secondary index weight obtained by analytic hierarchy process and data standardized treatment, comprehensive index method is used to evaluate the land comprehensive consolidation benefit of 14

towns in Daxing District. Its equation is

$$F = \sum V_i \times W_i,$$

where F is the comprehensive evaluation index of small-town land comprehensive consolidation benefit, V_i is the i th index value at index layer, W_i is the weight of the i th index value at index layer.

3 Result and analysis

Evaluation equation of comprehensive index method is used to assess the land comprehensive consolidation benefits of towns in Daxing District in the year 2005. Table 3 reports the evaluation result.

Table 2 Index weight of benefit evaluation on land comprehensive consolidation of small towns in Daxing District

Index	Weight	Index	Weight
V_1	0.021 305	V_8	0.069 203
V_2	0.035 306	V_9	0.042 711
V_3	0.050 102	V_{10}	0.034 321
V_4	0.193 401	V_{11}	0.071 217
V_5	0.108 542	V_{12}	0.032 862
V_6	0.076 255	V_{13}	0.070 104
V_7	0.041 254	V_{14}	0.153 417

Table 3 Evaluation comprehensive index of land comprehensive consolidation benefits of small towns in Daxing District

Name of town	Comprehensive index	Sorting value	Name of town	Comprehensive index	Sorting value
Yizhuang Town	3.861	1	Beizangcun Town	1.957	8
Xihongmen Town	3.818	2	Yufa Town	1.691	9
Yinghai Town	3.728	3	Weishanzhuang Town	1.669	10
Jiugong Town	3.354	4	Qingyundian Town	1.549	11
Changziying Town	2.219	5	Anding Town	1.392	12
Huangcun Town	2.111	6	Lixian Town	1.387	13
Panggezhuang Town	1.993	7	Caiyu Town	1.325	14

As for the evaluation standards for land comprehensive consolidation benefit in small towns, there is still no national standard or local standard. Therefore, evaluation standard in

this research is determined based on questionnaire survey and expert consultation. For instance, comprehensive index greater than 3.350 shows that land comprehensive consolidation of

