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An Analysis on Present Situation of Land Use Based on GIS in Caocun Town

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Abstract Taking Caocun Town for example, we use GIS technology to systematically analyze the present situation of land use in Caocun Town on the basis of land reclamation rate model and land use degree model from quantitative structure, spatial distribution and degree of land use, in order to provide a basis for adjustment and optimization of land use structure, comprehensive land consolidation and full tapping of land use potential in Caocun Town, and provide a reference for rational land use and land protection policy formulation.

Key words Present situation of land use, GIS, Caocun Town

1 Introduction

In this paper, under the support of GIS technology, based on the present land use data in Caocun Town (Yongqiao District, Suzhou City, Anhui Province) in 2015, we analyze the quantitative structure, spatial distribution and degree of land use in Caocun Town, provide a basis for adjustment and optimization of land use structure, comprehensive land consolidation and full tapping of land use potential in Caocun Town, and provide a reference for rational land use and land protection policy formulation.

2 Study area and data sources

2.1 Study area Caocun Town is at the junction of three counties in Jiangsu and Anhui provinces, known as the First Town in northern Anhui, with a landform type dominated by plain. In terms of overall terrain, it is high in northwest while low in southeast. It features a warm temperate semi-humid monsoon climate, with the annual average temperature of 14.5°C and average annual rainfall of 881.6 mm. The spatial and temporal distribution of rainfall is quite different. It has an area of 133.3 km², administers 15 villages, and has population of 68000. This town is 20 km north to the center of Xuzhou City, and 40 north to Suzhou City. The unique geographical advantage makes Caocun Town become a focus of Suzhou's Eastward Development Strategy, and it was approved as the comprehensive reform and development pilot town at the provincial level by Anhui Provincial Development and Reform Commission in 2005.

2.2 Data sources In this paper, the data are mainly from the topographic map in the study area and land use change survey data in 2013. *Caocun Town Land Use Plan* (2006–2020) provides the auxiliary information, and Gauss-Kruger projection and 1980 Xi'an coordinate system are used.

3 Research methods

3.1 GIS technical support Firstly, we use the ArcGIS10.2 conversion tool to convert the topographic map of the study area into the shp file format and load it into the software; secondly, we use georeferencing tool for coordinate matching of current land use map in Caocun Town; finally, we display all the superimposed data, classify the change data according to the latest national land use classification standards, and use ArcGIS10.2 spatial statistical tool to calculate the current land use structure in the study area.

3.2 Land reclamation rate model Land reclamation rate reflects the intensity of use of land resources in the region^[1], and it is calculated as follows:

$$\text{Land reclamation rate} = \text{arable land area (ha)} / \text{total land area (ha)} \times 100\%.$$

3.3 Land use degree model Land use degree reflects the degree of human impact in the land system, and it can be used to reflect the intensive level of regional land use. The higher the comprehensive index of land use degree, the higher the intensive level of regional land use. The expression is as follows:

$$L_j = 100 \times \sum_{i=1}^n A_i \times C_i$$

where L_j is the comprehensive index of land use degree; A_i is the grading index of type i land use degree; C_i is the grading area percentage of type i land use degree; n is the grading number of land use degree.

According to the comprehensive analysis method advanced by Liu Jiuyan *et al.* for land use degree, we classify the land use type and determine the extent of use (Table 1), and establish the comprehensive index model for land use degree^[2].

4 Results and discussions

4.1 Land use structure After classifying the change data according to the latest national land use classification standards, we get the present land use map of Caocun Town (Fig. 1). Table 2 shows that the total land area of Caocun Town is 13319.63 ha. In all administrative villages, the three villages with the largest land

Table 1 Land use type and land use degree grading

Land use type level	Land use type	Land use degree grading index
Unused land level	Unused land or the land hard to use	1
Woodland, grassland and waters level	Woodland, grassland and waters	2
Agricultural land level	Cultivated land, garden plot, artificial grassland	3
Urban settlement land level	Land for cities and towns, residential area, industry and mining, and transportation	4

area are Qianwang Village (1347.13 ha), Minci Village (1270.05 ha) and Shangqiao Village (1209.14 ha), accounting for 10.11%, 9.54% and 9.08% of total land area of Caocun Town, respectively; the three villages with the smallest land area are Sanhuan Village (431.36 ha), Hebei Village (568.50 ha) and Caocun Village (603.76 ha), accounting for 3.24%, 4.27% and 4.53% of total land area of Caocun Town, respectively. In terms of the land type, arable land has the largest area, reaching 8035.46 ha, accounting for 60.33% of total land area of Caocun Town; garden plot has the smallest area, reaching 329.97 ha, accounting for 2.48% of total land area of Caocun Town. The arable land of Caocun Town is distributed to varying degrees in administrative villages. Shangqiao Village has the largest arable land area (782.15 ha), followed by Zhangzhuang Village (701.24 ha), and Sanhuan Village has the smallest arable land area, only accounting for 2.87% of total arable land area of Caocun Town. Garden plot is unevenly distributed in administrative villages, and it is mainly in Qianwang Village (37.06%), Minci Village (26.01%), Minxian Village (12.93%) and Caocun Village (11.33%), accounting for 87.32% of total garden plot area of Caocun Town; the garden plot area of Zhangzhuang Village, Taoshan Village, Zuowa Village and Hebei Village only accounts for 0.72% of total garden plot area of Caocun Town. The woodland area of Caocun Town is 1419.64 ha, accounting for 10.66% of total land area of Caocun Town. The woodland area of Minci Village and Qianwang Village is 289.02 ha and 259.95 ha, respectively, accounting for 20.36% and 18.31% of total woodland area of Caocun Town, 9.7% and 7.65% higher than the town's forest coverage rate, respectively. The grassland area of Caocun Town is 587.09 ha, accounting for 4.41% of total land area of Caocun Town, and it is unevenly distributed. Chentong Village has the largest area, reaching 120.15 ha, accounting for 20.47% of total grassland area of Caocun Town, 19.93% higher than the proportion of total grassland in Sanhuan Village, Zuowa Village, Sihou Village and Taoshan Village. The transportation land area of Caocun Town is 347.16 ha, accounting for 2.61% of total land area of Caocun Town, and Huzhuang Village and Sanhuan Village have the most transportation land. The waters and water conservancy facility area of Caocun Town is 759.84 ha, Shangqiao Village has the largest waters and water conservancy facility land area while Hebei Village has the smallest area, only 18.87 ha. The area of land for cities, towns and villages, industry and mining in Caocun Town is 1474.77 ha, accounting for 11.07% of total land area of Caocun Town, and there is a small difference in the area. Huzhuang Village has the largest area (130.73 ha) of land for cities, towns and villages, industry and mining while Hebei Village has the smallest area (66.52 ha). The area of other land use types in Caocun Town is 365.71 ha, accounting for 2.75% of total

land area of Caocun Town, mainly concentrating in Qianwang Village, Shangqiao Village, Mawan Village and Caocun Village. The statistical tool is used to calculate, and we get the present land use structure of different villages in Caocun Town (Table 2).

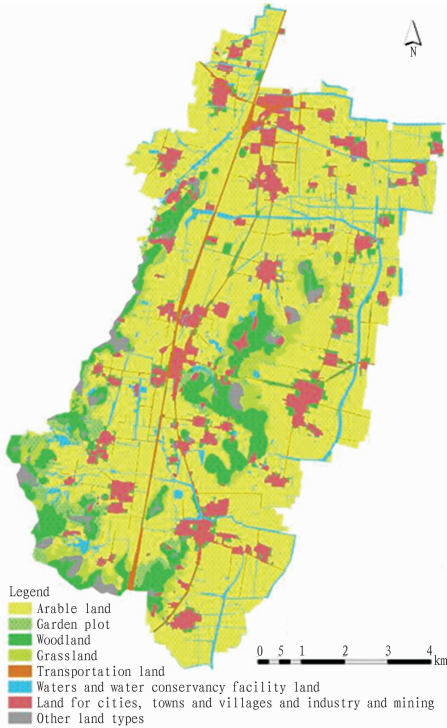


Fig. 1 Present land use map of Caocun Town

4.2 Spatial layout of land use Using ArcGIS10.2 symbolic function, we take the land use structure data of different villages in Caocun Town as symbolized field for calculation, and get the pie chart that can reflect the land use structure comparison effect of different villages (Fig. 2). The proportion structure of the pie chart reflects the proportion of area of a land use type to total land area in one village. With various land use types of Caocun Town as symbolized field, it is divided into four levels using natural breaks classification method, and by calculation, we get the spatial distribution map that can reflect the land use types in Caocun Town (Fig. 3). Fig. 3 shows that there is an obvious difference in land use types between the villages in Caocun Town, reflecting certain spatial distribution characteristics. The northwest and central part of Caocun Town are dominated by garden plot, woodland, grassland and other land use types; the east, southeast and north of Caocun Town are dominated by arable land, and the land for cities and towns, villages, industry and mining, and water conservancy facility; the west-central part of Caocun has the largest proportion of transportation land.

Table 2 Present land use structure of different villages in Caocun Town

Unit: ha

Administrative village	Total area of administrative village	Arable land	Garden plot	Woodland	Grassland	Transportation land	Waters and water conservancy facility land	Land for cities, towns and villages and industry and mining	Other land types
Sihou Village	666.29	476.80	2.62	23.12	0.17	25.24	56.16	82.19	0.00
	A	71.56%	0.39%	3.47%	0.03%	3.79%	8.43%	12.34%	0.00%
	B	5.93%	0.79%	1.63%	0.03%	7.27%	7.39%	5.57%	0.00%
Xiaoshankou Village	804.06	513.75	11.10	94.58	19.96	8.63	46.14	88.15	21.76
	A	63.89%	1.38%	11.76%	2.48%	1.07%	5.74%	10.96%	2.71%
	B	6.39%	3.36%	6.66%	3.40%	2.48%	6.07%	5.98%	5.95%
Mawan Village	1080.56	676.59	5.84	115.44	44.78	30.55	74.52	94.92	37.93
	A	62.61%	0.54%	10.68%	4.14%	2.83%	6.90%	8.78%	3.51%
	B	8.42%	1.77%	8.13%	7.63%	8.80%	9.81%	6.44%	10.37%
Sanhuan Village	431.36	230.70	2.75	1.93	0.00	36.69	32.65	126.57	0.08
	A	53.48%	0.64%	0.45%	0.00%	8.51%	7.57%	29.34%	0.02%
	B	2.87%	0.83%	0.14%	0.00%	10.57%	4.30%	8.58%	0.02%
Taoshan Village	677.15	506.96	0.07	14.08	3.00	28.06	35.40	89.59	0.00
	A	74.87%	0.01%	2.08%	0.44%	4.14%	5.23%	13.23%	0.00%
	B	6.31%	0.02%	0.99%	0.51%	8.08%	4.66%	6.07%	0.00%
Shangqiao Village	1209.14	782.15	5.39	72.98	62.33	18.82	89.53	125.87	52.07
	A	64.69%	0.45%	6.04%	5.16%	1.56%	7.40%	10.41%	4.31%
	B	9.73%	1.63%	5.14%	10.62%	5.42%	11.78%	8.53%	14.24%
Zuowa Village	900.84	680.62	0.69	30.32	0.00	6.63	75.12	100.17	7.28
	A	75.55%	0.08%	3.37%	0.00%	0.74%	8.34%	11.12%	0.81%
	B	8.47%	0.21%	2.14%	0.00%	1.91%	9.89%	6.79%	1.99%
Caocun Village	603.76	289.76	37.38	74.39	12.31	24.33	35.29	93.36	36.94
	A	47.99%	6.19%	12.32%	2.04%	4.03%	5.85%	15.46%	6.12%
	B	3.61%	11.33%	5.24%	2.10%	7.01%	4.64%	6.33%	10.10%
Huzhuang Village	993.91	593.99	7.85	103.67	59.36	44.93	28.04	130.73	25.33
	A	59.76%	0.79%	10.43%	5.97%	4.52%	2.82%	13.15%	2.55%
	B	7.39%	2.38%	7.30%	10.11%	12.94%	3.69%	8.86%	6.93%
Chentong Village	1087.07	643.80	3.92	127.00	120.15	16.04	40.05	106.81	29.29
	A	59.22%	0.36%	11.68%	11.05%	1.48%	3.68%	9.83%	2.69%
	B	8.01%	1.19%	8.95%	20.47%	4.62%	5.27%	7.24%	8.01%
Hebei Village	568.50	402.43	1.60	54.78	16.31	7.31	18.87	66.52	0.68
	A	70.79%	0.28%	9.64%	2.87%	1.29%	3.32%	11.70%	0.12%
	B	5.01%	0.49%	3.86%	2.78%	2.10%	2.48%	4.51%	0.19%
Minci Village	1270.05	572.03	85.82	289.02	88.81	30.38	70.76	105.37	27.86
	A	45.04%	6.76%	22.76%	6.99%	2.39%	5.57%	8.30%	2.19%
	B	7.12%	26.01%	20.36%	15.13%	8.75%	9.31%	7.14%	7.62%
Minxian Village	713.50	396.69	42.66	105.13	17.43	26.51	40.53	73.16	11.39
	A	55.60%	5.98%	14.73%	2.44%	3.72%	5.68%	10.25%	1.60%
	B	4.94%	12.93%	7.41%	2.97%	7.64%	5.33%	4.96%	3.11%
Qianwang Village	1347.13	567.96	122.28	259.95	114.64	26.52	56.17	89.81	109.80
	A	42.16%	9.08%	19.30%	8.51%	1.97%	4.17%	6.67%	8.15%
	B	7.07%	37.06%	18.31%	19.53%	7.64%	7.39%	6.09%	30.02%
Zhangzhuang Village	966.32	701.24	0.00	53.27	27.84	16.52	60.59	101.55	5.30
	A	72.57%	0.00%	5.51%	2.88%	1.71%	6.27%	10.51%	0.55%
	B	8.73%	0.00%	3.75%	4.74%	4.76%	7.97%	6.89%	1.45%
Caocun Town	13319.63	8035.46	329.97	1419.64	587.09	347.16	759.84	1474.77	365.71

Note: A represents the proportion of area of a land use type to total land area in one village; B represents the proportion of area of a land use type in one village to total area of this land use type.

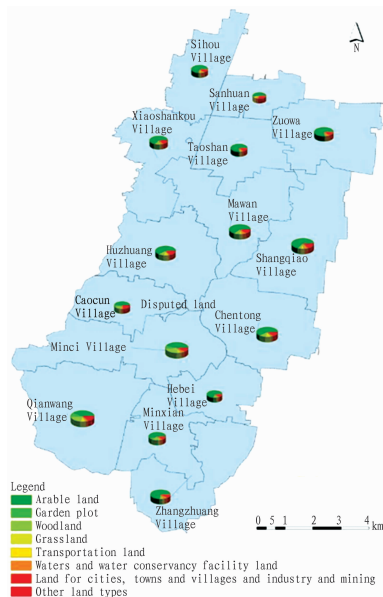


Fig. 2 Land use structure of different villages in Caocun Town

4.3 Land use degree Through land reclamation rate model and land use degree model, we calculate the reclamation rate and comprehensive index of land use degree for different villages in Caocun Town (Table 3). Land use degree mainly reflects the breadth and depth of land resource development, and we generally use land reclamation rate and comprehensive index of land use degree to reflect^[3]. As can be seen from Table 3, the average land reclamation rate is 60.33%. The land reclamation rate of Zuowa Village, Taoshan Village, Zhangzhuang Village, Sihou Village, Hebei Village, Shangqiao Village, Xiaoshankou Village and Mawan Village is higher than the average of Caocun Town. The reclamation rate is highest in Zuowa Village, reaching 75.55%, while the reclamation rate is lowest in Qianwang Village, reaching 42.16%. The land reclamation rate can reflect the extent of land resources development and use, but to fully reflect the comprehensive degree of land use and development in a region, the comprehensive index of land use degree is better than the reclamation rate. The average comprehensive index of land use degree is 287.42 in Caocun Town. The comprehensive index of land use degree of Sanhuan Village, Taoshan Village, Sihou Village, Zuowa Village, Hebei Village, Zhangzhuang Village, Huzhuang Village and Minxian Village is above the average. The highest comprehensive index of land use degree is 329.79 in Sanhuan Village, while the lowest comprehensive index is 260.35. Using ArcGIS10.2 symbolic function, by calculation, we get the comparison map of land reclamation rate and comprehensive index of land use degree in different villages of Caocun Town (Fig. 4). Fig. 4 shows that the present situation of land use in Caocun Town to be analyzed with comprehensive index of land use degree is in general consistent with the results of analysis with land reclamation rate. However, there are also obvious inconsistencies, for example, the land reclamation rate is low in Sanhuan Village, but its comprehensive index of land use degree is the highest, because the proportion of land for cities, towns and villages and industry and mining and transportation in Sanhuan Village is larger than in other villages.

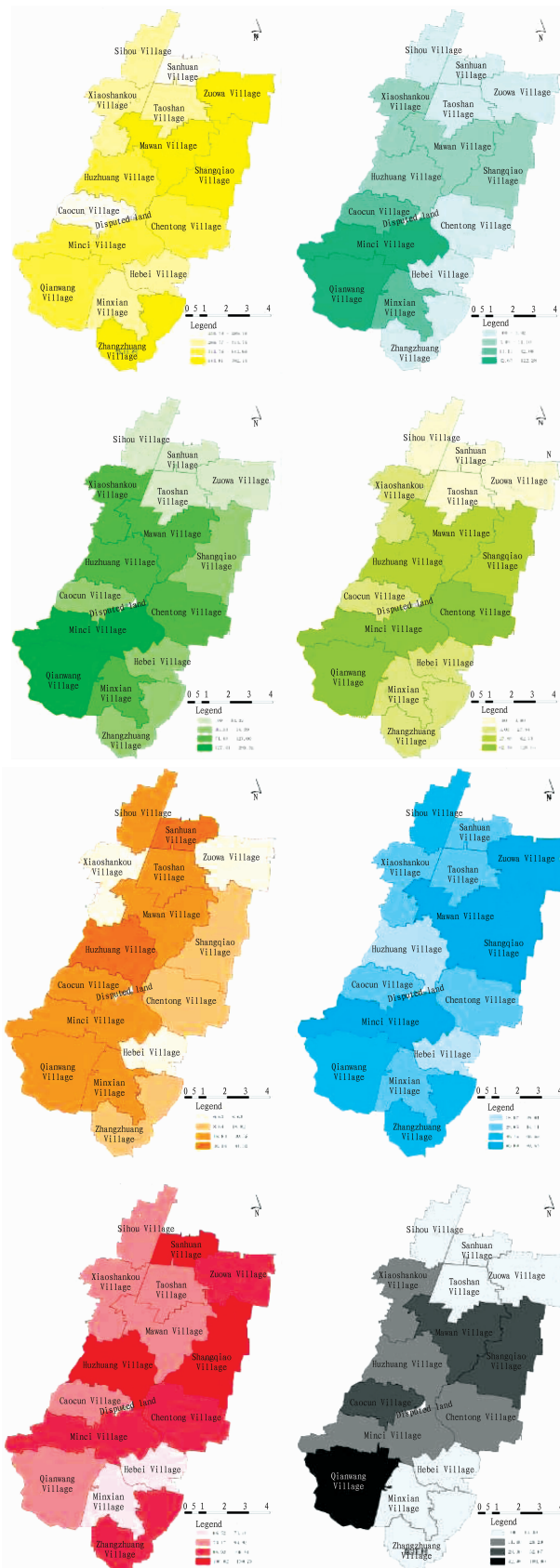
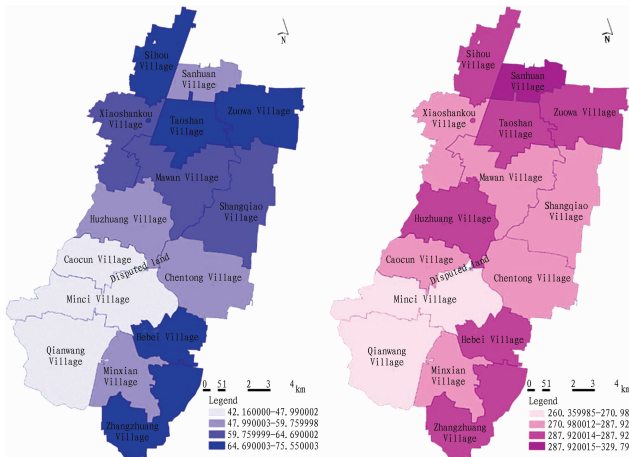


Fig. 3 Spatial distribution map of different land use types in Caocun Town

Table 3 Reclamation rate and comprehensive land use degree index of different villages in Caocun Town

Administrative village	Reclamation rate//%	Comprehensive index	Administrative village	Reclamation rate//%	Comprehensive index
Sihou Village	71.56	304.20	Huzhuang Village	59.76	293.35
Xiaoshankou Village	63.89	286.64	Chentong Village	59.22	279.49
Mawan Village	62.61	282.87	Hebei Village	70.79	296.92
Sanhuan Village	53.48	329.79	Minci Village	45.04	270.98
Taoshan Village	74.87	309.63	Minxian Village	55.60	287.92
Shangqiao Village	64.69	284.76	Qianwang Village	42.16	260.36
Zuowa Village	75.55	298.53	Zhangzhuang Village	72.57	296.46
Caocun Village	47.99	287.05	Caocun Town	60.33	287.42

**Fig. 4 Comparison map of land reclamation rate and comprehensive index of land use degree in different villages of Caocun Town**

5 Conclusions

(i) The total land area is 13319.63 ha in Caocun Town. In terms of the land type, arable land has the largest area, reaching 8035.46 ha, accounting for 60.33% of total land area of Caocun Town; garden plot has the smallest area, reaching 329.97 ha, accounting for 2.48% of total land area of Caocun Town. The proportion of woodland, grassland, transportation land, waters and water conservancy facility land, land for cities, towns and villages and industry and mining, and other land types, is 10.66%, 4.41%, 2.61%, 5.70%, 11.07%, and 2.75%, respectively. The land use structure of Caocun Town shows the characteristics of agriculture in general. (ii) There is obvious spatial structure difference

in land use between the villages in Caocun Town. The northwest and central part of Caocun Town are dominated by garden plot, woodland, grassland and other land use types; the east, southeast and north of Caocun Town are dominated by arable land, and the land for cities and towns, villages, industry and mining, and water conservancy facility; the west-central part of Caocun has the largest proportion of transportation land. (iii) There is a large difference in land use degree between the villages in Caocun Town, and the comprehensive degree of land use is high in the villages with high land reclamation rate. In general, the comprehensive degree of land use is not high in Caocun Town, and there is a need to improve the quality of cultivated land, strengthen agricultural infrastructure construction, optimize land use structure, improve the utilization rate and productivity of land, avoid deforestation, protect the ecological environment, and promote the sustainable use of land. (iv) This paper gives no consideration to dynamic changes in present situation of land use structure, and it is necessary to strengthen the dynamic analysis on land use and driving force in the future.

References

- [1] WANG WM. Land use planning[M]. Beijing: Science Press,2006. (in Chinese).
- [2] BAI LN, WANG DY, ZHANG YQ, *et al.* Analysis on land use spatial structure in Changchun City based on quantitative geography model[J]. Journal of Northeast Normal University(Natural Science Edition),2011,43(2):145–150. (in Chinese).
- [3] GAO ZQ, LIU JY, ZHAUNG DF. Study on the status quo of land utilization and land coverage based on remote sensing and GIS[J]. Journal of Remote Sensing,1999,3(2):135–138. (in Chinese).