Manufacturing industries spatial arrangement optimization in the framework of land-use efficiency in Shunyi, Beijing

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Abstract: With significant socioeconomic development and a growing population, promoting land-use efficiency is, and will remain, a crucial issue in land-use planning in China. Referring to the industrial development planning, this study employed the Logistic Stepwise Regression model to quantitatively analyze the relation between land-use efficiency and influence factors. Then, this study simulated three different manufacturing industries spatial arrangements scenarios based on the comparative advantage theory. The results showed that the arrangement for not only newly-increased but also exit-vacate might anticipate the highest land-use efficiency, output value and labor force employment with the lest area.

Introduction

It is well known that in order to secure a steady and fast economic development, the most important thing is to how to treat the relationship among economic restructuring, the transformation of development mode and inflation control. Switching off the mode of economic growth from the extensive to intensive mode is an important part of the goals and the focus of this year's macro policy. The Political Bureau of the Communist Party of China Central Committee issued a statement Monday which vowed that the government would accelerate economic restructuring and push forward substantive progress in changing the mode of economic development this year, while continuing the proactive fiscal policy and moderately loose monetary policy (Central People's Government of the People's Republic of China, 2010).

As one of the basic production factors, the promotion of land-use efficiency would be considered as the main way and the important symbol of the transformation of development mode. In the recent years, the promulgation and implementation of the Control Indicators for Industrial Project Land-Use and the Minimum Standards for Industrial Land Grant-Fee filled in the gaps in the fields of National Policy for industrial land-use efficiently. The former regulation selected the investment per area, land/building ratio, and nonproductive land ratio as the control indicators (Li

and Jiang; Meng et al., 2006). The latter regulation only select the grant-fee as the control standard, which can be regarded as a branch of investment. Yet, as a result the control effect is not satisfied that rapid economic growth and industrialization continued to result in massive land development across the country and agriculture land losses (George and Samuel, 2003; Jie, 2007). Therefore, the implemented regulations are necessary to be supplemented and perfected.

The purpose of this study is to find out an optimal industrial land-use planning method that could succeed in improving land-use efficiency accompanied with economic development. Based on theoretical researching on manufacturer behavior, this study analyzed the connotation and evaluation indicators of land use efficiency. On practical research stage, this study examined the case of the Shunyi District in Beijing ,where surrounded a large area of arable land and in a rapid industrialization progress (Meng et al., 2008), attempting to construct manufacturing industries spatial arrangement optimization system, including land-use efficiency evaluation, influence factors regression analysis, spatial arrangement simulation and comment.

Evaluation of land use efficiency

Theoretical analysis

According to factor market theory, labor, land and capital are considered as the three most important production factors (Mankiw, 2003). The iso-quant and iso-cost curves are used to express the correlation between cost and quant during enterprise organizing production. The iso-quant curves describe the combination modes of the production factors (Fig. 1). The iso-cost curves, which are parallel lines, link the equal cost points together (Fig. 2). While the iso-cost curve just tangential to the iso-quant curve, the point of tangency, which entrepreneurs expect, represents the lowest cost and the combination mode of the factors at this yield level. Then, if the government implemented policy for land-use efficiently which can keep up the present quantity (Q), the entrepreneurs possibly increase the labor or capital quantity instead of land. At the same time, the total cost increased while the entrepreneur behavior is represented as an increasing labor and capital input, for each area.

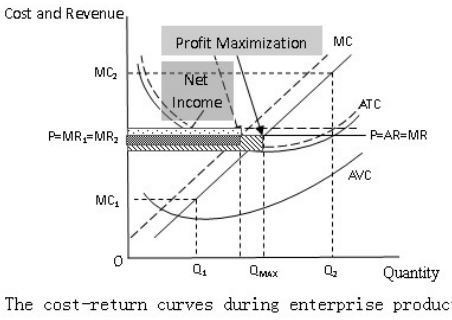


Fig. 1 The iso-quant curve during enterprise production

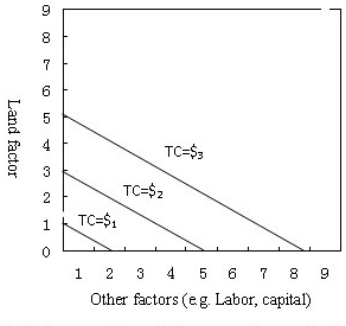


Fig. 2 The iso-cost lines during enterprise production

However, once industrial factory was built-up, the area for industrial production is hard to be changed for the lack of elasticity and fixity of the land factor. Namely, if it is impossible for the entrepreneurs to shrink the land area, instead, they will make an attempt at other methods to achieve a new equilibrium state. According to enterprise profit maximization theory, when the marginal-revenue (MR) is equal to the marginal-cost (MC), the enterprise profit reaches maximization and this quantity is named as equilibrium quantity (EQ) (Mankiw, 2003). For the analysis above, whenever the entrepreneurs shrink the land area or not, the new combination modes of the production factors would bring the marginal-cost curve and average-total-cost (ATC) curve move upward (from real-line to broken-line), which inevitably leads the income and quantity to reduce (Fig. 3). At this time, if the entrepreneurs blindly boost quantity in order to achieve more income, the marginal-cost will be higher than marginal-revenue even more and the net-income will reduce. Therefore, the rational entrepreneurs will emphasize on improving the product price to achieve more net-income, through the instrumentality of enhancing quality, increasing research and development, and increasing science and technology level. At the same time, the entrepreneur behavior manifested as total-revenue elevation, and this phenomenon is the same as the entrepreneur seek fortune behavior.

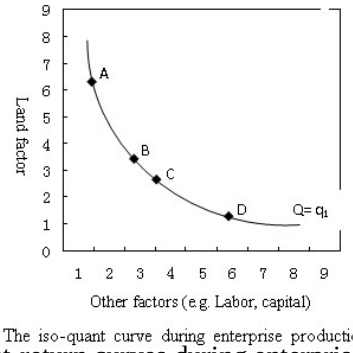


Fig. 3 The cost-return curves during enterprise production

To conclude, under land-use efficiently police constraint, the characteristics of entrepreneur behavior could be concluded to the increases of income and revenue per area, labor per area, and capital per area.

Factor analysis in Shunyi district

After selection of nine indicators, related to aspects of income and revenue, labor, capital and so no, we made use of the Factor Analysis module in SPSS13.0 software to reduce data and delete the overlapping of these indicators (Guo, 2007). From the analysis result for 1158 group samples in Shunyi district, there is obviously overlapping of these indicators. Based on the rotated component matrix, the first three components cumulatively explained 91.93% of variance, which would be considered as the principal components (Table 1).

Table 1 The rotated component matrix and component score coefficient matrix

		component matrix			component score coefficient matrix		
		Component 1	Component 2	Component 3	Component 1	Component 2	Component 3
Indicators	expenses of taxation per area	0.992	0.055	0.039	0.205	-0.007	-0.018
	revenue of production per area	0.990	0.012	0.043	0.206	-0.027	-0.008
	gross output value per area	0.988	0.032	0.045	0.205	-0.018	-0.009
	net income per area	0.980	-0.035	0.025	0.206	-0.045	-0.020
	added value per area	0.974	0.175	0.068	0.197	0.043	-0.005
	local employed persons per area	0.087	0.953	-0.067	-0.004	0.436	-0.207
	total employed persons per area	0.081	0.953	0.043	-0.011	0.420	-0.095
	exports per area	-0.037	0.696	0.324	-0.043	0.268	0.234
	total assets per area	0.098	0.132	0.960	-0.032	-0.079	0.955
% of variance		55.119	26.270	10.545			
Cumulative % of variance		55.119	81.389	91.934			

The first component determined by five indicators related to income and revenue, including expenses of taxation per area, revenue of production per area, gross output value per area, net income per area and added value per area, so that denominated in Income Component. The second component determined by three indicators mainly related to labor, including local employed persons per area, total employed persons per area, and exports per area. The higher correlation with number of employed persons than that of income component showed that, the key export oriented enterprises remain in labor-intensive industries and the high export is not necessarily to bring about high income. So, the second component was named as Labor Component, which as symbol of the employment capability. The third component determined by total assets per area so that denominated as Capital Component.

Brief summary

As the results of theoretical research and factor analysis, the characteristics of entrepreneur behavior could be concluded to three aspects, including income component, labor component, and capital component. Therefore, this study used score coefficient matrix to reduce these nine indicators into three components, which would be used as evaluation indicators of land use efficiency in the follow-up research.

Influence factors of land-use efficiency

Method

Present research on relationship between land-use efficiency and influence factors rest on qualitative analysis. This study made use of the Regression Analysis module in SPSS13.0 software, in order to get the relationships between the Dependent Variable (land-use efficiency) and Independent Variable (influence factors). The Linear Regression is the most usual method, under the condition that the independent variable should be a continuous series (Li et al., 2005). however, in this study, as independent, the land-use efficiency is composed of three components and it is impossible to synthesize them into a continuous series. Consequently, this study made use of the Binary Logistic Regression method, under the condition that independent variable should be a discrete series (like 0 or 1) (Pereira and Itami, 1991; Verburg et al., 1999).

Dependent variable

Referring to the industrial development planning, there are three kinds of sectors to be encouraged in the future, including dominant sectors, assistant sectors and emphasized sectors (Meng et al., 2008.). Considering the different functions of these sectors in economic development and the land-use intensities at local and similar regions (Jiang, 2006; Gu et al., 2006; Li et al., 2008),

we endowed every sector with a standard value for evaluation land-use was efficiency or not. If the land-use intensity is higher than the standard value, the dependent variable was assigned as 1, or else 0 (Table 2).

Table 2 The land-use efficiency standards in Shunyi

Sector types	Sector names	Income Component	Labor Component	Capital Component
Dominant sectors	Manufacture of electrical machinery	200	——	200
	Manufacture of transport equipment	150	——	——
	Manufacture of food and beverages	100	8	50
Assistant sectors	Manufacture of paper, stationery and sporting goods	——	——	70
	Manufacture of chemicals	——	——	200
	Manufacture of metal products and general purpose machinery	——	——	80
Emphasized sectors	Manufacture of textiles and apparel	——	20	——

Independent variable

According to interrelated research achievements, this study selected 16 influence factors as independent variable spreading from economic structure, person and labor, transports, and agglomeration effects.

As one of the most important influence factors for land-use efficiency, economic structure serves as promoting land-use intensity (Gerrit and Wim, 2002; Yichuan et al., 2005). Generally speaking, the land-use efficiency of the primary industry is far less than the secondary and the tertiary which is usually higher than the secondary. In the later period of industrialization, under the challenge from the tertiary industry, every industrial enterpriser must take efforts to promote land-use intensity, otherwise they will be replaced by tertiary industry with high land-use intensity. In this study, we selected output value structure and land use structure (including arable to agricultural land ratio, built-up land ratio, urban and rural to built-up land ratio, and industrial to urban and rural built-up land ratio) as the indicators of economic structure.

In the aspect of person and labor, enterprisers pay more attention to the quantity, quality and price of labor (Dennis, 1997). Only the quantity of regional labor reached the doorsill, the sector and enterprisers just settled down. The quality of labor is also a vital factor for factory location selection. for example, the labor-intensive industry requires 4~5% technical personnel ratio and then the capital-intensive industry needs 15~20 technical personnel ratio (Liu, 2006). In this study, we selected mobile population ratio, rural population ratio and agricultural labor ratio as the indicators of person and labor.

According to Agricultural Location Theory and Industrial Location Theory, the condition of transport determines the location selections (Pellegram, 2001). With socioeconomic development, not only the distance of transport but also quality of roads, productions and labor forces, will influence transport (Shahab, 2001). Thus, in this study we selected distance to high-speed road, distance to airport, distance to first-grade road and distance to road as the indicators of transport.

Industrial aggregation refers to the phenomenon that the neighboring factories will achieve more income on the strength of location advantage (Chen, 2000), which could be decomposed into scale economy and scope economy (Wang, 2001). The scale economy is produced by factories of the same sector aggregated for closed and frequently relationships and the scope economy is produced by factories of the related sector aggregated for upper and lower class productions. It is generally considered that the enterprises inside development zones would produce more benefit than decentralized ones, because of the better infrastructure, the convenience communion and the preferential policy. In addition, the enterprises should achieve additional benefits, which is produced in the currency field, especially in the tertiary industry developing field. Thus, in this

study we selected grade of development zone (the national development zone is named as 1) and relevancy with the tertiary industry (including distance to district center, distance to town center, and distance to village center) as the symbol indicators of agglomeration effects.

Results

Table 3 The model summary on influence factors of the food and beverages manufacture

Factors	Coefficients	Std. Error	Wald	df	Sig.	Exp(B)
Distance to high-speed road	0.426	0.219	3.795	1	0.049	1.532
Grade of development zone	2.250	1.167	3.719	1	0.050	9.492
Distance to town center	1.104	0.447	5.364	1	0.021	3.015
Distance to first-grade road	-1.317	0.505	6.792	1	0.009	0.268
Output value structure	0.756	0.304	6.183	1	0.013	2.129
Agricultural labor ratio	-1.840	0.848	4.711	1	0.030	0.159
Constant	-17.304	7.405	5.461	1	0.019	0.000

Predicted probability of ROC Curve is 0.885; Overall Percentage: 75.6

Table 4 The model summary on influence factors of the transport equipment manufacture

Factors	Coefficients	Std. Error	Wald	df	Sig.	Exp(B)
Grade of development zone	-1.839	0.784	5.505	1	0.019	0.159
Distance to village center	0.554	0.211	6.889	1	0.009	1.740
Urban and rural to built-up land ratio	2.397	1.158	4.282	1	0.039	10.991
Agricultural labor ratio	-0.854	0.375	5.187	1	0.023	0.426
Constant	-19.123	10.987	3.029	1	0.082	0.000

Predicted probability of ROC Curve is 0.883; Overall Percentage: 82.0

Table 5 The model summary on influence factors of the electrical machinery manufacture

Factors	Coefficients	Std. Error	Wald	df	Sig.	Exp(B)
Grade of development zone	-0.805	0.364	4.896	1	0.027	0.447
Distance to high-speed road	-1.586	0.704	5.069	1	0.024	0.205
Constant	4.551	1.694	7.217	1	0.007	94.748

Predicted probability of ROC Curve is 0.873; Overall Percentage: 81.3

Table 6 The model summary on influence factors of the paper, stationery and sporting goods manufacture

Factors	Coefficients	Std. Error	Wald	df	Sig.	Exp(B)
Industrial to urban and rural built-up land ratio	0.770	0.270	8.161	1	0.004	2.160
Agricultural labor ratio	0.489	0.232	4.459	1	0.035	1.631
Constant	-5.432	1.588	11.698	1	0.001	0.004

Predicted probability of ROC Curve is 0.804; Overall Percentage: 78.2

Table 7 The model summary on influence factors of the chemicals manufacture

Factors	Coefficients	Std. Error	Wald	df	Sig.	Exp(B)
Grade of development zone	-1.000	0.456	4.799	1	0.028	0.369
Distance to village center	0.303	0.134	5.079	1	0.024	1.354
Distance to town center	0.370	0.191	3.745	1	0.043	1.447
Rural population ratio	-0.341	0.177	3.732	1	0.043	0.711
Constant	0.250	1.875	0.018	1	0.894	1.284

Predicted probability of ROC Curve is 0.814; Overall Percentage: 81.8

Table 8 The model summary on influence factors of the metal products and general purpose machinery manufacture

Factors	Coefficients	Std. Error	Wald	df	Sig.	Exp(B)
Distance to town center	-0.391	0.196	3.991	1	0.046	0.676
Distance to first-grade road	0.242	0.114	4.537	1	0.033	1.274
Rural population ratio	-0.587	0.145	16.457	1	0.000	0.556
Constant	0.661	1.139	0.337	1	0.562	1.936

Predicted probability of ROC Curve is 0.931; Overall Percentage: 94.5

Table 9 The model summary on influence factors of the textiles and apparel manufacture

Factors	Coefficients	Std. Error	Wald	df	Sig.	Exp(B)
Distance to high-speed road	0.141	0.063	4.999	1	0.025	1.151
Distance to town center	-0.214	0.095	5.090	1	0.024	0.807
Arable to agricultural land ratio	0.384	0.154	6.252	1	0.012	1.468
Mobile population ratio	0.358	0.187	3.687	1	0.045	1.431
Rural population ratio	-0.350	0.153	5.252	1	0.022	0.705
Constant	-1.974	1.195	2.731	1	0.098	0.139

Predicted probability of ROC Curve is 0.826; Overall Percentage: 79.7

The results showed that the factors, effect modes and influence degree for land-use efficiency are different in sectors (Table 3 to Table 9).

(1) The agglomeration effects on sectors are different absolutely. The closer relevancy within labor, technology and messages, the more significant effects on promoting land-use efficiency will be caused by agglomeration, such as transport equipment manufacture and electrical machinery manufacture sectors. The advanced grade development zones are more advantageous to enhance the land-use efficiencies; so actually, the output-value per area of electrical machinery manufacture enterprises within the national development zone is the highest in Shunyi district. However, the agglomeration is difficult to produce added income for the food and beverages manufacture enterprises, even more outside development zones, where could achieve production raw material conveniently, achieved higher land-use efficiency than agglomeration. Besides, the enterprises, belonging to textiles and apparel manufacture or metal products and general purpose machinery manufacture, near to regional center (with developed market economy, frequently exchanged of products, and perfect service trades) had higher land-use intensity, because of their higher relevancies with the tertiary industry.

(2) Likewise, the transport conditions effects are different among sectors. With the gradual perfection of traffic infrastructure, the roads, especially high-speed roads, not only be used to resolve the goods transport problem, but also to resolve the daily commuting traffic problem for labors with high technology. For example, a number of the persons employed by the electrical machinery manufacture transport by high-speed road between factory and home almost every day. That is why this kind of enterprises nearby high-speed road would have higher land-use efficiency. Yet, the prices of labor and land of these regions are so high that the food and beverages manufacture and the textiles and apparel manufacture should locate far away from high-speed roads in order to employ cheaper labors. In order to resolve massive raw material and products transport problem, some sectors with low requirements to speed and quality of roads should just located nearby the first-grade road to save the cost, such as the food and beverages manufacture and the metal products and general purpose machinery manufacture. In addition, because of the influence intensification of other factors and the holistic perfection of traffic infrastructure, the influence of

transport condition was no longer significant.

(3) Labor and population structure is in tight connection with land-use efficiency of most sectors. Agricultural labor ratio determined by employment fields, but the rural population ratio determined by not only employment fields but also household system due to Urban-rural dual structure in China. Only employed by state owned enterprise, the surplus farm labors identities could convert from rural into urban. Therefore, because of large investment and high technology content, the enterprise belongs to the chemicals manufacture and the textiles and apparel manufacture usually owned by state, and their land-use efficiencies had significant positively connection with the rural population ratio. In contrary, the land-use efficiencies of the food and beverages manufacture had significant negatively connection with the agricultural labor ratio, in that these small-scale enterprises are usually owned by private and have incapability to convert the labors' identities. Furthermore, the mostly labors employed by individual workshop (such as the paper, stationery and sporting goods manufacture) remain part-time peasantry and assign to agricultural labor, so the land-use efficiencies of this kind had significant positively connection with the agricultural labor ratio.

(4) Unexpectedly, economic structure was insignificantly correlated with land-use efficiency in three sectors. In the other sectors, while the upgrading of economic structure and the improvement of technology resulted in improvement of product-addition value, income and revenue per area continuously improved and the land-use efficiency promoted as well, such as the food and beverages manufacture. The significant positively connection between the land-use efficiencies, of the transport equipment manufacture and the metal products and general purpose machinery manufacture, and urban and rural ratio and industrial land ratio, showed that, the fast promotion of land-use efficiency could not effectively control the urban sprawl and industrial nibble arable land. Besides, the labor-intensive enterprises (e.g. the textiles and apparel manufacture) need so massive labors that there are few labors go in for agricultural production and the agricultural management fall back to extensive mode with fewer fruit grower, where the ratio of arable to agricultural land is high.

Consequently, there exists significant connection with land-use efficiency and selected influence factors. In order to achieve the purpose of land-use efficiency improvement, the next stage is the industrial enterprise re-arrangement based on the relations with the influence factors.

Spatial arrangement optimizations

According to comparative advantage theory and the quantitative analysis on influence factors, this study simulated three different industrial-land spatial arrangements by the method of spatial analysis and attributes evaluation functions in ArcGIS 9.3, and then analyzed these projects by the area of industrial-land, land-use efficiencies, and forecasting scales of output value and labor force employment contrastively.

The project for Neither Newly-Increased Nor Exit-Vacate

The aims of this project were to protect the existing arable area and avoid repeated investment. Firstly this project extracted all the existing manufacturing industrial land, which area is about 5500 ha, from the database for the current situation of land utilization in Shunyi 2008. Secondly, based on the Binary Logistic Regression equations achieved in Section 3.4, this project calculate every land parcels scores (form 0 to 1) on land-use intensity of the eight sectors respectively. Thirdly, this project regarded the ratio of the score to the average as the comparative advantage degree for every parcel of each sector. Finally, basing on the comparative advantage degrees for every parcel, this project distributed each parcel one sector to develop in the future, which comparative advantage

degree is the highest. Thus, this spatial arrangement was only based on the existing industrial-land, and neither cause newly-increased industrial-land nor need to exit-vacate existing industrial-land, but just as space exchange among sectors within existing industrial-land (Fig. 4).

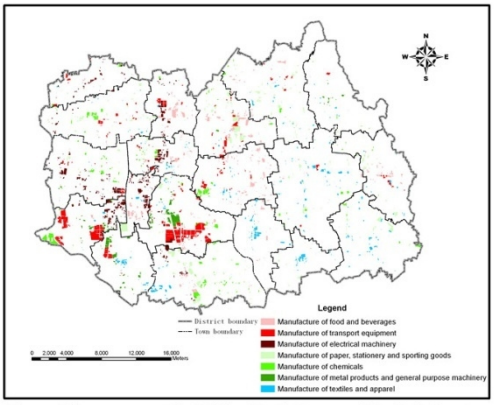


Fig. 4 The spatial arrangement for Neither Newly-Increased Nor Exit-Vacate

The project for No Newly-Increased but Exit-Vacate

The aim of this project was to improve the land-use efficiencies on foundation of project 1. The methods and processes of this project were basically the same as the project 1 (Section 4.1) without the process to exit and vacate the factories with lower land-use intensity. After calculating scores on land-use intensity, this project regarded the factories which scores on each sector all below 0.5 as eliminations first. According to this project, there are 1720 ha, which is nearly one third industrial-land should be eliminated. Thus, this spatial arrangement was also based on the existing industrial-land, and couldn't cause newly-increased industrial-land to protect arable area; meanwhile several factories should be exited and be vacated to improve land-use efficiency (Fig. 5).

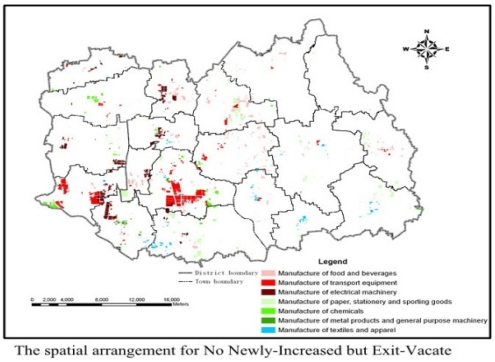
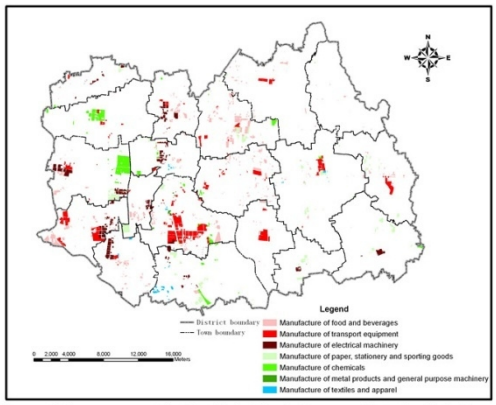


Fig. 5 The spatial arrangement for No Newly-Increased but Exit-Vacate

The project for Not Only Newly-Increased but also Exit-Vacate

The aim of this project was to consider the influences of urban planning and infrastructure amelioration. In this project, not only the existing but also the planning industrial land (about 2060 ha) were considering together, and the influences caused by planning roads and planning development zones. Then, the other methods and processes of this project were absolutely the same as the project 2 (Section 4.2). According to this project, there are 1553 ha area should be exit and vacated, and 560 ha planning area were forbidden to develop industry, because of their lower scores on land-use efficiencies. Thus, this spatial arrangement was considered as completely-new layout of industrial land on the scope of urban planning (Fig. 6).



The spatial arrangement for Not Only Newly-Increased but also Exit-Vacate

Fig. 6 The spatial arrangement for Not Only Newly-Increased but also Exit-Vacate

Contrast analysis

In this study, we used several evaluation indicators (including, the area of industrial-land, land-use efficiencies, and forecasting scales of output value and labor force employment) to analyzed of these plans contrast (Table 10 and Table 11). The results showed that, the arrangement for neither newly-increased nor exit-vacate might anticipate the lowest land-use efficiency and output value but the most area, because there are several extensive land-use factories remains; the arrangement for no newly-increased but exit-vacate might anticipate the higher land-use efficiency and output value with less area; the arrangement for not only newly-increased but also exit-vacate might anticipate the highest land-use efficiency and output value and labor force employment but the lest area. Consequently, the forecasting scales of output value and labor force employment were far exceeding the present levels, so the improvement of industrial land-use efficiencies should be realized by the way of spatial arrangement.

Table 10 The comparative analysis on area and scores on land-use intensity

Unit: hm^2

Sector types	Sector names	Project 1		Project 2		Project 3	
		Area	Scores	Area	Scores	Area	Scores
Dominant sectors	Manufacture of food and beverages	900	0.75	687	0.85	1360	0.89
	Manufacture of transport equipment	1420	0.84	1153	0.91	1613	0.84
	Manufacture of electrical machinery	760	0.55	780	0.72	887	0.72
Assistant sectors	Manufacture of paper, stationery and sporting goods	913	0.60	580	0.77	700	0.72
	Manufacture of chemicals	620	0.53	320	0.73	767	0.80
	Manufacture of metal products and general purpose machinery	367	0.32	80	0.49	20	0.32
Emphasized sectors	Manufacture of textiles and apparel	520	0.46	187	0.65	93	0.70
All sectors		5570	0.64	3787	0.80	5440	0.81

Table 11 The comparative analysis on output value and labor force employment

Units: output value is 100,100,100 yuan; labor force is 10,000 persons

Sector types	Sector names	Project 1		Project 2		Project 3	
		Output value	Labor force	Output value	Labor force	Output value	Labor force
Dominant sectors	Manufacture of food and beverages	40.73	10.18	35.05	8.76	73.16	18.29
	Manufacture of transport equipment	107.65	10.76	94.28	9.43	122.12	12.21
	Manufacture of electrical machinery	252.60	6.31	337.26	8.43	384.56	9.61
Assistant sectors	Manufacture of paper, stationery and sporting goods	11.48	6.56	9.42	5.38	10.62	6.07
	Manufacture of chemicals	19.60	1.96	13.94	1.39	36.91	3.69
	Manufacture of metal products and general purpose machinery	7.02	1.40	2.41	0.48	0.37	0.07
Emphasized sectors	Manufacture of textiles and apparel	10.67	4.98	5.44	2.54	2.92	1.36
All sectors			42.16	497.79	36.42	630.65	51.31

Conclusions

With the implementation of macro policy such as “tightening up land use” and “ regulating land supply gate”, the enterprises’ land-use cost was increasing so continuously that enterprisers began to input more labor force or capital instead of land or raise product price to keep up profits. And there was a similar result achieved by factor analysis in Shunyi District, which showed that the characteristics of enterprisers behavior could be concluded to three aspects, including income component, labor component, and capital component. These results were benefit to land-use efficiency evaluation and National Policy settings for improving land-use efficiency.

To reveal the relationship between land-use efficiencies and its influences factors, method of Binary Logistic Regression was employed to make a quantitative analysis instead of qualitative analysis which was mainly rested on in China. As a result, there are great differences in the influence factors, effect modes and influence degree for land-use efficiency in different sectors. Consequently, it is necessary to optimize the industrial-land spatial arrangement using the results of regression analysis while the optimization method and technology may be different or even contrary. Then, to practice and verify former conclusions, this study stimulated three industrial-land spatial arrangements scenarios, which all realized the aim of improving land-use efficiencies.

Although spatial arrangement optimization played an important role in improving land-use efficiencies, other supporting measures were necessary. For example, assistant policy can be made to spatial exchange among the enterprises. Also the economic growth mode conversion should be further encouraged.

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