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Evaluation Method for Industrial Concentration District in The Area

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ABSTRACT

In areal scope, certain concentration of industry brings positive effects that raise the effectiveness of regional economic development, but it also results in various negative aftereffects such as ecological environmental destruction in the area when it is over certain limit. Furthermore, it loses dominance of the economic geographical location of the area and causes serious loss from the state viewpoint by resulting the problem of industrial relocation in the economic geographical space. In this paper, we solved methodological problem of evaluating industrial concentration district in the area in order to protect negative effects due to high concentration of industry that causes acute issues with environment and resources recently. In order to solve this problem, we established evaluation index system for evaluation of the industrial concentration district in the area, studied the methodology to search industrial concentreation district with the use of the analytic function of influence scope and aggregate district etc. in GIS and then searched indusrial concentraion district in 00 industrial area by applying this method. We should no longer arrange new industry in such industrial concentration district in the future and have to rationally control the industrial structure by realizing the industrial relocation

Keywords: industrial concentration, economic geographical, ecological

1. Introduction

Industrial scale is being extended increasingly with the development of economy. When we consider a process of industrial extension in geographical space, it is expressed with the process that the enterprises are concentrated on certain area that is favorable for industrial production and development, the area that natural and economic geographical conditions are advantageous and resources are rich. This shows that industrial development process resulted in industrial concentration.

- First of all, the principle, theoretical basis and concept on industrial concentration have been studied in many literatures.

The concentration of industry is the concept defined with the meaning of concentration of ecology [1]. The etymology of the concentration is cluster in English, the ecological concept. The concentration of organism in the study of ecology mentions that different biotic groups interact with certain law according to species and units in area or environment. Therefore, the concentration of indsutry has some characters as regioal property, penetrability, creativity, network property, specialization and flexibility. The industrial concentration is the basis of formation of industrial area and it is of no significance without the industrial concentration and there isn't a scientific accuracy and viability without concentration area.

The regional economic concentration is the regional industrial cluster that the greater part is enterprise [2]. The industrial clusters are connected with definite geographical resources. The independent enterprise displays competition superiority about public resources but enterprise concentration may collaborate and produce on the basis of public resources between enterprises. In fact, the regional economic concentration is just areal indusrial concentration but industrial cluster mentions the group of relative structure interconnected to the geographical location through collaborative activities and interaction in certain area. Such group of enterprises may overcome joint opportunity and threat together.

Juan D., 2010 has developed SLEUTH model for simulation of areal spatial change and simulated the process of spatial change on the basis of the model [3]. The factors of areal spatial change include diffusion factor, multiplication coefficient, exhalation coefficient, gradient, road condition and so on.

The industrial concentration means the company and relative structures that are geographically near and connected closely [4]. Such industrial elements exist in specific industrial domain together or are related each other. The areal spatial control by concentration of tourist industry not only concentrates three layers of factors such as core layer of concentration, layer of offered factor, layer of correlation in the areal space but also develops correlation between every layer and every factor and establishes perfect synthetic system of tourist industry. The concentration of tourist industry is achieved on side of rasing areal competitive power and economic effectiveness and this concentration instigates areal development powerfully.

In the area, economic concentration is achieved from the central force for pursuit of benefit and economic dispersion is achieved from the centrifugal force for fall of cost [5]. Also, the larger the difference between areas is, the more the concentration degree of economic activity is and economic activity is dispersed again with the equality of both areas.

Industrial concentration is the same as industrial enterprise or enterprises of industry connected with core industry are concentrated in geographical location and as connected industries are concentrated highly in specific area and are grown up [6].

In order to evaluate the market concentration in economic relation, the concept of concentration rate is applied [7].

$$CR_n = \sum_{i=1}^{n} X_i \Big/ \sum_{i=1}^{N} X_i$$

Here, CR_n-concentration rate in n superior enterprises, X_i- sale data of i-th enterprise, n- n superior enterprises, N – total number of enterprise in industry

If CR is large, monopolistic strength is larger in indsutry.

Four parts such as deduction for factor, enlargement system of benefit, course dependence and closure consists of analytical structure of change of industrial cluster (Fan Xin-sheng, 2009) [8]. Deduction for factor like specific governmental policy, local factor and market condition etc. may disperse the specialization production of area and the industrial cluster in a germinal stage. Course dependence caused by benefit enlargement becomes economic and technical factor of formation of the indsutrial group and joint procedure of development of the industrial cluster. But in this procedure, local factor (for example, management of government, labor, penetration about market) does an important action and has local peculiarity. Because of the force of habit of benefit enlargement, course dependence and business tradition, changing group may run into low-efficient closure state.

- Next, some literatures have analyzed about dangerousness of indsutrial concentration.

Industrial cluster by industrial concentration contains certain dangerousness [6]. It may take 10 years or even more for concentration to deveop and support the stable competition superiority. With the development and fall of new companies and new industry and the development and change of local institutes and organizations concentration is being changed constantly. They also may lose the competitive geographical location and result in dangerousness of the industrial concentration in three sides of discontinuance of technical force, conversion of consumer's demand and tension of internal organization because of the

external world or internal forces. In addition, the important problem is the malignity competition between concentrated internal enterprises due to low price. At the same time, senility and destruction of industrial concentration may result in large dangerousness to the regional economy because of the existence of life period of industrial concentration.

- Next, some literatures have studied on the problem of realizing insutrial relocation in order to protect the environmental destruction due to the high economic growth [9].

A number of resource-based cities draw up the industrial planning for green transformation considering three factors: including industrial scale, industrial structure, and efficiency [10]. The industrial planning is same as the heart of economic development and if industrial planning neglects environmental problem, it can interfere with economic continuous development [11].

The purpose of the process of the industrial planning is to promote economic improved development [12].

Shengjun, 2014 has described that some areas, where pollution centralized due to high growth, went green by industrial restructuring in the aim of mitigation of environmental pollution [13]. They classified the restructured enterprises as following: going green in situ, relocating to industrial parks, relocating to ‘‘pollution havens’’, outsourcing to ‘‘pollution havens’’, relying on large firms.

Synthetically, the result is as following: the industrial concentration is the lawful course that is achieved with regional economic development course but contrariwise, the excessive concentration loses economic effectiveness because of various dangerousness including environmental problem and so we should relocate high concentrated industry in order to go green forward [14].

Here, the important problem is just to find the district where industry is concentrated locally and readjust industrial arrangement structure in the area.

Evaluation index system of the industrial concentration district in the area

Industrial concentration on the certain area is formed from positional inclination and inner connection of industrial production and increment of economic effectiveness.

Industrial concentration means that the enterprises cluster around certain district that is advantageous for industrial arrangement in areal scope.

Industrial concentration produces the economic effectiveness within certain limit because it forms the core leading the development of the area economy and increases the economic efficiency by joint utilization of technical facilities. But excessive concentration tenses the supply conditions of the area such as raw material, fuel, power, water, labor, traffic and so on and for this reason, it may decreases the economic effectiveness.

Hence, in order to increase the economic efficiency in industrial arrangement of given area, we must calculate the degree of industrial concentration within the area and find high concentrated district and consider a reasonable counterplan.

Industrial concentration in the area may be formed by the concentration of land utilization, labor, power demand, traffic demand, water utilization and so on. If such factors are concentrated in certain district excessively, that district might produce negative phenomenon due to industrial concentration. Thus, when industrial local concentration exceeds the certain limit, that district falls the economic effectiveness and produces the ecoenvironmental problem [15].

We can classify the evaluation conditions as the condition of land concentration, the condition of areal resources concentration and the condition of environmental pollution concentration to evaluate the industrial concentration district in the area.

The condition of land concentration

The most general form of industrial concentration is just the concentration in geographical space.

The evaluation index according to the condition of land concentration is the domain scope by enterprises.

The domain scope by enterprises contains the domain scope involving that of the given enterprise and isolation distance according to the standard of land planning.

The condition of areal resources concentration

The general form of industrial concentration is the concentration related to the utilization of the given areal resources for the arrangement of productivity such as labor, power, traffic, water and so on.

Hence, the condition of areal resources concentration involves the evaluation indices such as the coefficients of labor concentration, power concentration, traffic concentration and water concentration by enterprises.

- The coefficient of labor concentration

The coefficient of labor concentration is the contrasted concentration coefficient that the enterprises indicate in the use of labor of the given area.

$$C_{labor} = \frac{L_{enterprise}/L_{branch}}{L_{industry}/L_{area}} \quad \text{Eq. (1)}$$

Here, C_{labor} – the coefficient of labor concentration of the given enterprise, L_{area} – population of the area, $L_{industry}$ – the number of labor that devotes to industry in the area, L_{branch} - the number of labor that devotes to the given industrial branch in the area, $L_{enterprise}$ – the number of labor of the given enterprise

- The coefficient of power concentration

The coefficient of power concentration is the contrasted concentration coefficient that the enterprises indicate in the use of power of the given area.

$$C_{power} = \frac{P_{enterprise}/P_{branch}}{P_{industry}/P_{area}} \quad \text{Eq. (2)}$$

Here, C_{power} – the coefficient of power concentration of the given enterprise, P_{area} – the total quantity of power demand in the area, $P_{industry}$ – the total quantity of power demand that industry demands in the area, P_{branch} - the quantity of power demand that the given industrial branch demands in the area, $P_{enterprise}$ – the quantity of power demand of the given enterprise

- The coefficient of traffic concentration

The coefficient of traffic concentration is the contrasted concentration coefficient that the enterprises indicate in the use of traffic of the given area.

$$C_{traffic} = \frac{T_{enterprise}/T_{branch}}{T_{industry}/T_{area}} \quad \text{Eq. (3)}$$

Here, $C_{traffic}$ – the coefficient of traffic concentration of the given enterprise, T_{area} – the total volume of traffic of the area, $T_{industry}$ – the total volume of traffic for industry in the area, T_{branch} - the volume of carrying in and out for the given industrial branch in the area, $T_{enterprise}$ – the volume of carrying in and out for the given enterprise

- The coefficient of water concentration

The coefficient of water concentration is the contrasted concentration coefficient that the enterprises indicate in the use of water resources of the given area.

$$C_{water} = \frac{W_{enterprise}/W_{branch}}{W_{industry}/W_{area}} \quad \text{Eq. (4)}$$

Here, C_{water} – the coefficient of water concentration of the given enterprise, W_{area} – the total capacity of water resources of the area, $W_{industry}$ – the total capacity of water for industrial use in the area, W_{branch} - the capacity of water for use of the given industrial branch in the area, $W_{enterprise}$ – the capacity of water for use of the given enterprise

The condition of environmental pollution concentration

The condition of environmental pollution concentration evaluates the industrial concentration district as the fundamental indices such as the volume of air pollution, the volume of water pollution and the quantity of discharge of solid waste.

Fig. 1 is to synthesize the evaluation indices for evaluation of industrial concentration district.

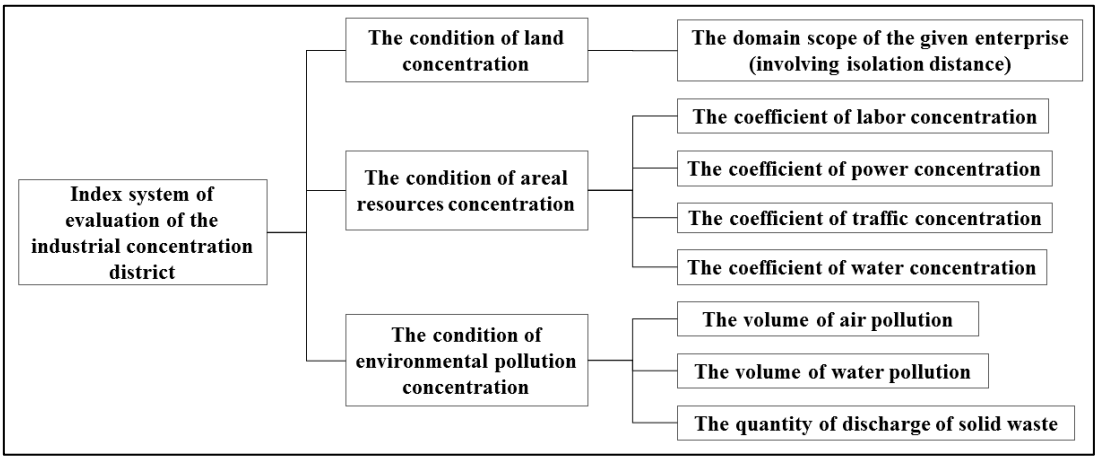

Figure 1. Evaluation index system of the industrial concentration district in the area

2. Method

2.1. Decide the value of evaluation indices by enterprises for evaluation of industrial concentration district.

First of all, classify the existing enterprises in the research area according to the industrial branch.

Secondly, decide the value of evaluation indices of the industrial concentration district according to the enterprise.

In the condition of land concentration, decide the isolation distance of the enterprises according to the standard of land planning.

In the condition of areal resources concentration, decide the value of the coefficient of labor concentration, power concentration, traffic concentration and water concentration by enterprises.

In the condition of environmental pollution concentration, decide the volume of air pollution, the volume of water pollution and the quantity of discharge of solid waste according to the enterprise.

2.2. Search the districts that the enterprises are concentrated locally according to the evaluation indices using the analytic function of influence scope and aggregate district in GIS.

First of all, link the attribute table of the enterprises.Shp with the table of the evaluation index value of the industrial concentration for the analysis of GIS.

Secondly, decide the influence scope of the enterprises according to the evaluation indices .

The condition of land concentration: Fix the buffer section according to the isolation distance according the enterprises.

The condition of areal resources concentration: Fix the buffer section according to the coefficient of concentration(C_{labor}, C_{power}, $C_{traffic}$, C_{water}) by enterprises.

The condition of environmental pollution concentration: Evaluate the influence district of environmental pollution according to the amount of pollution discharge of the enterprises by Kriging interpolation in GIS.

Thirdly, on the basis of decision of influence scope of the enterprises according to the evaluation indices , search the industrial concentration district according to the evaluation indices by using the analytic function of aggregate district in GIS (ArcToolbox/Cartography Tools/Generalization/Aggregate Polygons) (Fig. 2.).

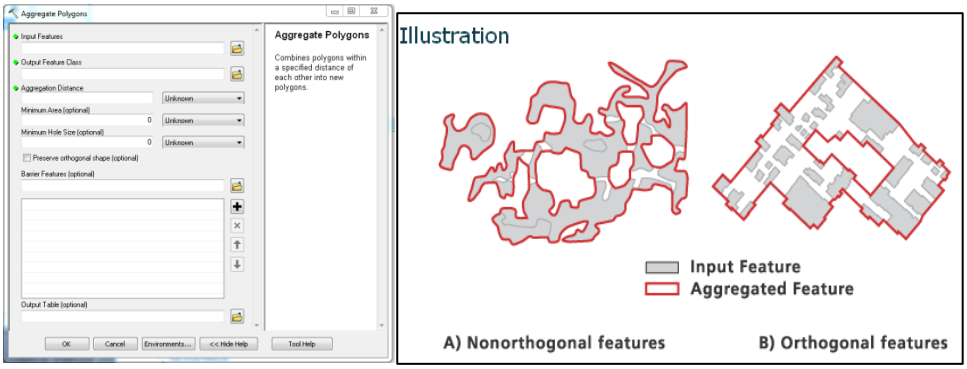

Figure 2. The analytic tool of aggregate district in GIS and the example picture of the analysis

As shown in Fig. 2, "Aggregate Polygons" is the analytical tool that groups the closed polygons each other and creates new polygons, the concentration districts newly.

Using this tool, we may evaluate the industrial concentration district as the method that groups the enterprises of which influence scope are closed each other.

Using such analytical method for the concentration district, we may search the industrial concentration district in the research area according to the evaluation indices .

2.3. Synthesize the analytical data of the concentration district obtained in 2.2. according to the evaluation indices and then evaluate the industrial concentration district synthetically.

Here, use the analytical function of the overlay (Weighted overlay) in GIS.

"Weighted overlay" is the analytical tool that overlays several rasters using a common measurement scale and weights each according to its importance.

The importance weight of the evaluation indices is calculated using the analytical method of hierarchic structure (AHP).

On the basis of the analytical data about the concentration district according to the evaluation indices, using the analytical method of the weighted overlay, we may evaluate the industrial concentration district in the research area synthetically.

The principle diagram of evaluation methodology for industrial concentration district and its evaluation flow chart is as following (Fig. 3, Fig. 4).

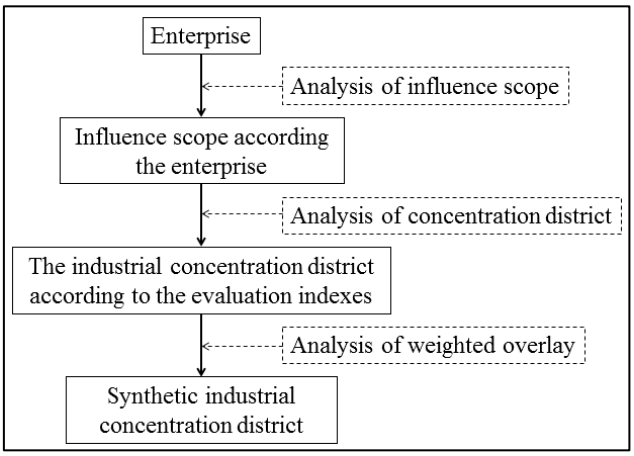

Figure 3. The principle diagram for search of the industrial concentration district

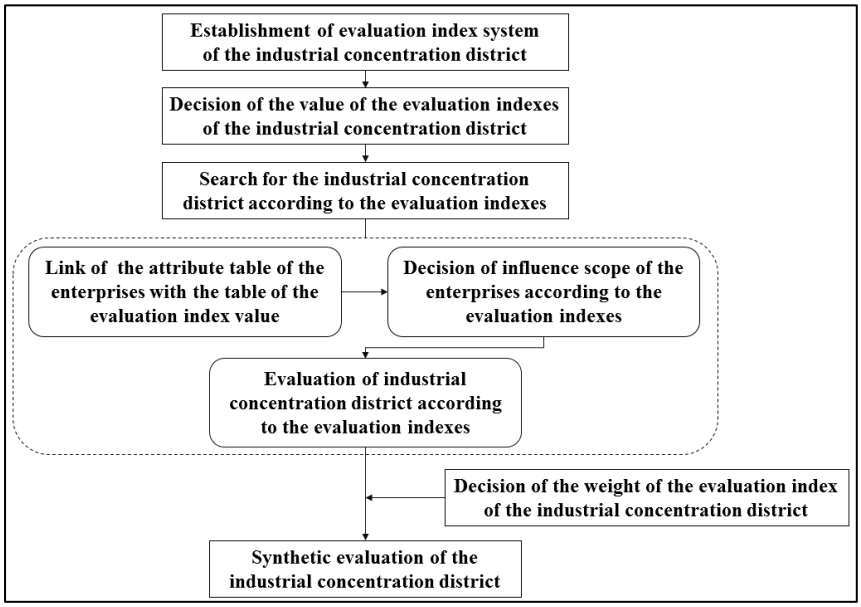

Figure 4. Evaluation flow chart of the industrial concentration district

3. Result and Discussion

3.1. In order to evaluate the industrial concentration district in 00 industrial area, decision on the value of the industrial cocncentration district according to the present enterprises of the area should be made.

- The 15 present enterprises in 00 industrial area are classified into machine industry, building materials industry, foodstuff industry, daily necessities industry, clothing industry and pharmaceutical industry largely.

The actual condition of arrangement of the enterprises is as follows (Fig. 5).

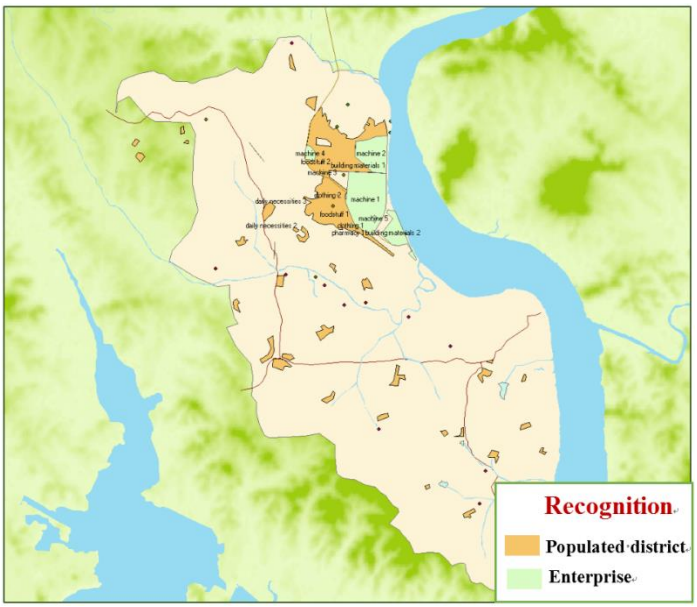

Figure 5. The arrangement plan of the enterprises in 00 industrial area

- The value of the evaluation indices of the industrial concentration district is decided according the enterprises (Table 1).

In Table 1, isolation distance, the index value for analysis of the condition of land concentration, is the value that the enterprises have according to the standard of land planning . And C_{labor}, C_{power}, $C_{traffic}$, and C_{water} are the values calculated by Eq. (1)~(4).

Table 1. The valueof the evaluation indices of the industrial concentration district according the enterprises

No.	Industrial branch	Enterprise	Isolation ditance (m)	C_{labor}	C_{power}	$C_{traffic}$	C_{water}	Volume of air pollution (m^3/year)
1	Machine Industry	machine 1	300	4.84	1.34	1.69	1516.3	30680
2		machine 2	200	1.00	0.96	0.07	218.4	680
3		machine 3	300	0.05	0.04	0	0.4	0
4		machine 4	100	0.54	0.11	0.01	5.5	50
5		machine 5	300	0.04	0.07	0.03	1.8	0
6	Building Materials Industry	building materials 1	100	0.66	0.25	0.05	311.1	0
7		building materials 2	100	5.83	2.29	1.81	1431.2	303400
8	Foodstuff Industry	foodstuff 1	100	4.50	1.35	1.70	1537.4	190
9		foodstuff 2	50	1.99	1.20	0.11	205	0
10	Daily Necessities Industry	daily necessities 1	100	2.29	0.83	0.31	580.7957	0
11		daily necessities 2	100	2.08	0.83	1.25	580.7957	0
12		daily necessities 3	100	2.11	0.88	0.24	580.7957	0
13	Clothing Industry	clothing 1	50	4.83	1.66	1.72	1452	0
14		clothing 2	50	1.66	0.88	0.08	290.4	0
15	Pharmaceutical Industry	pharmacy 1	50	6.4988	2.5506	1.8148	1742.4	0

3.2. On the basis of Table 1, search the districts where the enterprises are concentrated locally in 00 industrial area according to the evaluation indices using the analytic function of influence scope and aggregate district in GIS.

For the GIS analysis, the value of influence scope according the enterprises is decided by linking the attribute table of the enterprises. Shp of Fig. 5 with Table 1. According to the evaluation indices, the influence scope of the presesnt enterprises in 00 industrial area is decided by using the analytic function of influence scope in GIS (Fig. 6).

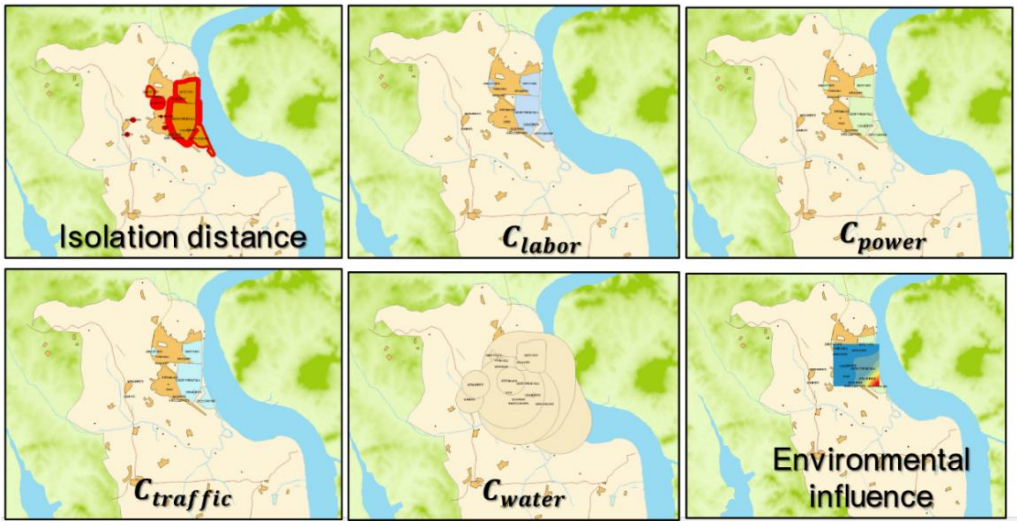

Figure 6. The analytic data about influence scope of the present enterprises in 00 industrial area according to the evaluation indices

On the basis of decision of influence scope, the industrial concentration district is searched according to the evaluation indices using the analytic function of aggregate district in GIS(Fig. 7).

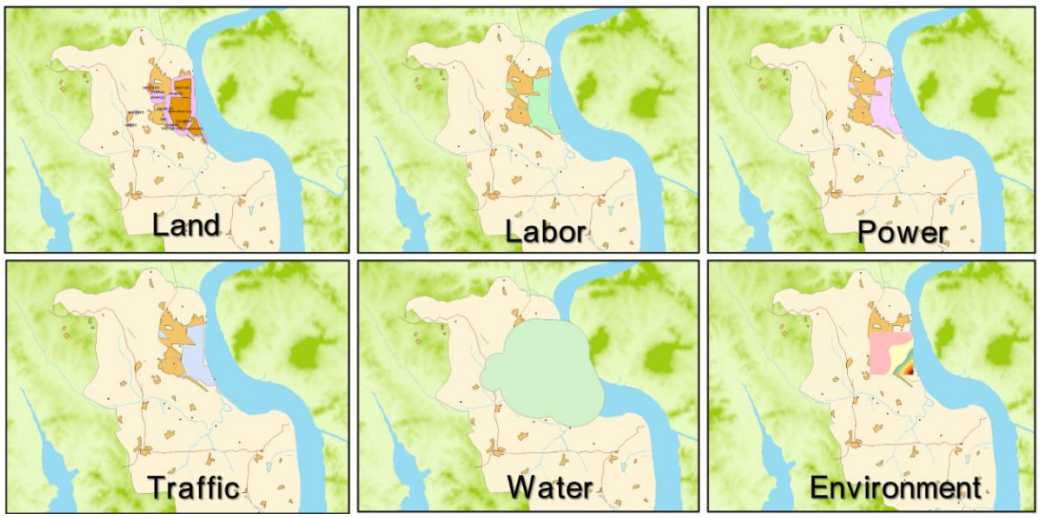

Figure 7. The analytic data about the research of the industrial concentration district in 00 industrial area according to the evaluation indices

3.3. The analytic data of the industrial concentration district is synthesized according to the evaluation indices and then the industrial concentration district synthetically in 00 industrial area is evaluated.

First of all, the importance weight of the evaluation indices is calculated by AHP (Table 2). Using the analytical function of weighted overlay in GIS with the importance weight of the evaluation indices in Table 2, overlay the analytic data about the industrial concentration district in 00 industrial area according to the evaluation indices and the industrial concentration district of the research area is decided synthetically (Fig. 8).

Table 2. The estimate matrix for decision of the importance weight of the evaluation indices of the industrial district and the value of weight

	Land	Labor	Power	Traffic	Water	Environment	Importance weight
Land	1	3	5	3	5	3	0.3977
Labor	1/3	1	3	1	3	1	0.1613
Power	1/5	1/3	1	1/3	1	1/3	0.0593
Traffic	1/3	1	3	1	3	1	0.1613
Water	1/5	1/3	1	1/3	1	1/3	0.0593
Environment	1/3	1	3	1	3	1	0.1613

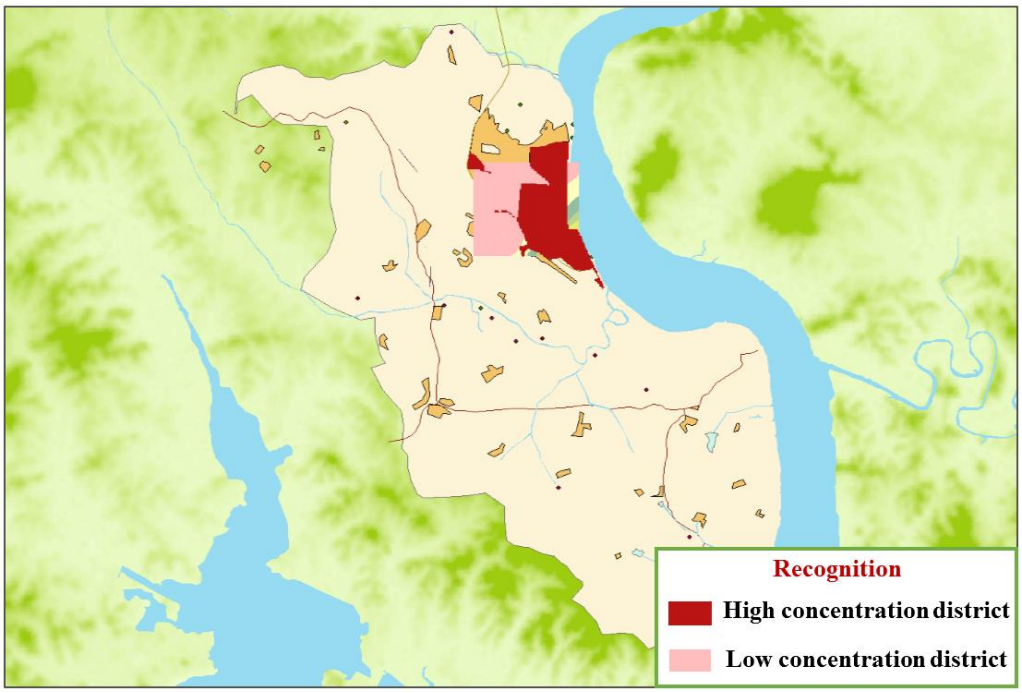

Figure 8. The analytic result of industrial concentration district in 00 industrial area

In Fig. 8, deep red district is the one that the present enterprises in 00 industrial area are very concentrated, and light pink district is the one that the enterprises are not concentrated relatively.

That is, on the side of industrial arrangement and development, deep red district is dangerous one.

In this paper, we have studied the method for search of the industrial concentration district in order to protect various negative impacts due to inordinate industrial concentration and realize the reasonable industrial structure in economic geographical space.

Through study on various references including Hongbo Z., 2009., Wang Yu-hai., 2009 and so on and analysis about the actuality, we have found the following problems[1] [2] : (1) The industrial concentration should be condsidered on the negative side as well as the positive side. (2) The danger of the industrial concentration should be considered from the viewpoint of the development of the enterprises as well as the problems such as the ecoenvironmental problem of the area and tension of the areal resources use.

Hence, in this paper, we have established the methodology to evaluate the district that industry is concentrated locally in order to solve the problem of environmental destruction and the tension of the areal resources use due to the indsutrial concentration, realize the continual development of the areal economy and sustain the dominance of the economic geographical location.

Qian Li, 2011 discussed the concentration rate of the market as the ratio of sale data of superior enterprises to sale data of total enterprises [7]. From this, we have got a clue and newly created the concentration coefficients such as the coefficient of labor concentration, the coefficient of power concentration, the coefficient of traffic concentration and the coefficient of water concentration to use for evaluation of the industrial concentration district in order to evaluate the degree of the concentration of the enterprises in the area from the viewpoint of the area and industrial arrangement objectively and suggested the method that combined several analytic functions in GIS and searched the industrial concentration district easily.

5. Conclusion

Applying the method of evaluation of the industrial concentration district in the area, we have searched the indsutrial concentration districts in 00 industrial area. As a result of search, we have obtained the analytic data as Fig. 8. In Fig. 8, deep red district is the concentration one that industry is very closed and in this district, the whole conditions of land use, areal resources use and environmental pollution are tense. In order

to solve such tension during the prospect period, we had a result that we had to realize the industrial relocation in this district and also had not to arrange new industry in this district during the prospect period. The methodology that realizes the industrial relocation and control the industrial structure reasonably in the high concentration district of industry will be seen in our further study.

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