Evaluation Model on Regional Economic Plan Based on Environment

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Abstract. this paper constructs regional recycling economy and its concept model from perspective of system dynamics, it adopts comprehensive weighting method of AHP +entropy method to confirm and analyze weight index of model, and it innovatively uses TOPSIS method, which makes evaluation process much more simple and accurate. It makes real simulation on route evolution progress of recycling economy development through running track change of model space point during certain time sequence, and it finds out revolution rule of regional recycling economy development, so that it makes prediction on the future development direction of regional recycling economy.

Introduction

With the aggravation of global ecological environment problems, coordinating relations[1,2,3], between human activity and natural environment, seeking sustainable development of social economy have become to be one of the important problems concerned by society at present. Regional ecological industry chain plan is one of the important channels to realize sustainable development, it uses industrial ecology as basis and establishes upstream and downstream relations among industries by simulating mechanism of biological chain in the natural ecosystem, the byproduct of one production activity has become to be raw material of another production activity, which makes the whole industrial chain become to be various resources(such as energy, water and raw material), it protects ecological environment[4,5] on condition of increasing economic profit.

This paper adopts research method combined with empirical research and standard research, as well as quantitative analysis and qualitative analysis to make systematic research on plan of regional and ecological industry chain. It constructs evaluation and index system of regional recycling economic development with multiple levels and multiple indexes; it also makes complete explanation and exposition on the index system. It adopts comprehensive weighting method combined with AHP+entropy method, which makes confirmation process of evaluation index weight much more scientific. On making comprehensive evaluation of regional recycling economic development, it innovatively chooses TOPSIS method, which makes evaluation process much more simple and accurate.

Concept of regional recycling economy and structure model

Through reasonable plan and design, it uses resources as links(raw material, byproduct, information, fund and talent), which connects upstream, downstream and enterprises, which can form the structure similar to natural ecosystem, that is structure of regional industrial chain, so that it can effectively enhance resources utilization rate and reduce environmental pollution.

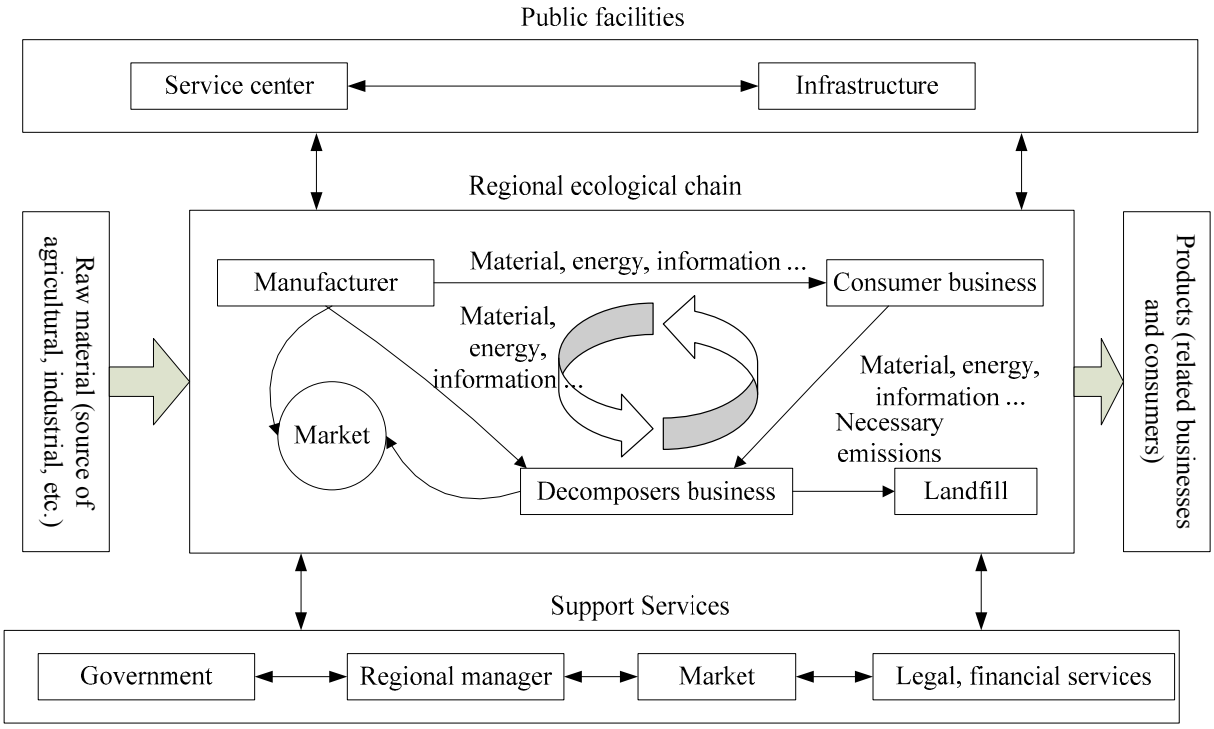

Diagram 1 Structure model of regional ecological industrial chain

This paper thinks that regional industrial chain means enterprise union with industrial link relations that mutually survive and restrict with the aim of expanding natural resources amount, increasing resources utilization rate by using resources (raw material, byproduct, information, fund and talent) as link and ecological process relations similar to trophic linkage of biological chain in the natural ecosystem. The structure model of regional industrial chain is indicated by diagram 1.

From diagram 1, it can be seen that regional ecological industrial chain is not separately exists, its operation needs infrastructure, service center and support system such as support services etc to together participate in it, their relations also have stronger dependency. In the following, we will make detailed analysis and explanation on structure model and its parts of ecological industrial chain.

Construction on evaluation index system of regional recycling economic development

This paper chooses indexes with higher frequency to complete the primary evaluation index system of regional recycling economy; it makes main part analysis on this primary system and makes partial increase and reduction on index system by combining with consultation and suggestion of experts. It combines with main part analysis; dependency analysis etc to make adjustment on index in the process of changing index, and it consults expert suggestion on the index system after adjustment. It will possibly make index simple and cover all the investigated problems, meanwhile, it should guarantee the index enters index system can obtain correct data from the formal channel, and deletes the complicated, obscure data from index. After experiencing several repeated adjustment and correction on the primary evaluation index system for many times, it gets the final regional recycling economic development evaluation and index system, which is indicated by table 1.

Table 1 Evaluation and index system of regional recycling economic development

Target layer A	Normal layer B	Element layer C	Index layer D
Regional recycling economic developement index	economic development index	economic strength	GDP growth rate D1
			per GDP D2
			per capita disposable income D3
		economic efficiency	consumer price index D4
			ratio of output value to profit and tax D5
	ecological development index	resources reduction	10000 Yuan GDP energy consumption D6
			10000 Yuan GDP water consumption D7
			10000Yuan GDP power consumption D8
			unit land square output value D9
		pollution reduction	10000 YuanGDP wastewater discharge D10
			10000 YuanGDP exhaust emissions D11
			10000YuanGDPsolid waste discharge D12
			Standard rate of industrial waste discharge D13
			removal rate of industrial dust D14
		reuse and resources	Comprehensive utilization rate of industrial solid waste D15
			Repeated utilization rate of industrial water D16
			garbage harmless processing rate D17
	social livable index	social state	Unemployment rate D18
			Engel coefficient D19
		living environment	Social security coverage rate D20
			Good rate of air quality D21
			Per greenland square D22
			Water quality standard rate of water functional area D23

Economic development index is roughly composed of 2 parts, the first one is economic strength, and the second one is economic efficiency. Ecological development index is composed of resources reduction, pollution reduction as well as reuse and resources, social livable is composed of social state and living environment.

Comprehensive evaluation on regional recycling economic development based on TOPSIS

The 23 indexes enter evaluation system of regional recycling economic development are all indexes of super large type or super small type, suppose there is matrix$X=(x_{ij})_{mxn}$ composed by n decision-making indexes f_j（$1\le j\le n$）, a_i（$1\le i\le m$） of m plans, n index values, which is regarded as decision-making matrix, command

$$y_{ij}=\frac{x_{ij}-\overline{x_j}}{s_j},(1\le i\le m,1\le j\le n) \quad (6)$$

Of which, sample average and standard deviation are as follows:

$$\overline{x_j} = \frac{1}{m}\sum_{i=1}^{m} x_{ij} \quad (7)$$

$$s_j = \sqrt{\frac{1}{m-1}\sum_{i=1}^{m}(x_{ij} - \overline{x_j})^2} \quad (8)$$

Suppose A layer has allocation relations to layer B, then as for the above matrix, the weight of every element B1、B2、……Bn on layer B is determined by the relative importance through elements comparison on layer B, suppose we use bij to indicate this relative importance, that is as for A, the relative importance [7,8]degree of Bi and Bj. Measurement on this relative importance is regarded as scale. Saaty also gives one kind of scale method from 1 to 9 when puts forward AHP, and it makes quantitative description on elements of mutual comparison, as it is indicated by table 2.

Table 2 Meaning table of using AHP to judge matrix scale

Scale value	Meaning
1	indicate they have the same importance on comparison between element Bi and Bj
3	ndicate Bi is relatively important than Bi on comparison between element Bi and Bj
5	indicate Bi is obviously important than Bj on comparison between element Bi and Bj
7	ndicate Bi is rather important than Bj on comparison between element Bi and Bj
9	indicate Bi is extremely important than Bj on comparison between element Bi and Bj
2、4、6、8	2,4,6,8 are respectively indicate mid-value of 1-3, 3-5, 5-7, 7-9 through adjacent judgment
count backwards	Bji=1/Bijindicate it gets judgment Bij between element Bi and Bj, then it gets judgment Bji=1 on comparison between Bi and Bj

This paper uses entropy method to carry out empower, it is one kind of method by using information quantity provided by each kind of observation value to confirm index weight. Suppose there are m evaluation objects(they can be different time points), n evaluation indexes, the original data matrix is $X_{ij} = (x_{ij})_{m\times n}$， of which, x_{ij} indicates the value of the j index in the i investigation objects.

(1)Make standard process on x_{ij} according to linear percentage conversion method, and it forms matrix after standardization

(2)Calculate the entropy e and information efficiency value d of the j index

$$e = -k\sum_{i=1}^{m} y_{ij} Iny_{ij}, (i = 1,2,\ldots,m; j = 1,2\ldots,n) \quad (9)$$

Of which， $k = -(Inm)^{-1}$ is one constant related to system sample number m, as for one complete disorderly system, the degree of order is 0, its entropy is the largest, e=1, m samples are in the completely disorderly distributed state, $y_{ij} = 1/m$， at this time，

$$e = -k\sum_{i=1}^{m}\frac{1}{m}In\frac{1}{m} = k\sum_{i=1}^{m}\frac{1}{m}Inm = kInm = 1 \quad (10)$$

So， $k = 1/Inm$， because information entropy e can be used to measure information efficiency value of the j index(index data), when system is completely disorder, e_j=1, at this time the efficiency value of e_j的for comprehensive evaluation is 0. Therefore, information efficiency value of certain index is determined by difference d_j between information entropy e_j and 1.

(3) Confirm weight of the j index

It uses entropy method to estimate each index weight, its nature is to use value coefficient of this index to calculate its weight, the higher of its value index, the larger importance of evaluation, then the bigger weight. Finally, it gets weight of the j index is as follows:

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j}, j = 1,2,\ldots,n \quad (10)$$

(4) Sample evaluation uses entropy method to get weight of the j index, it can make evaluation on sample, evaluation method is to use product of standard y_{ij} of the j evaluation index of the i sample in standard matrix as evaluation f_{ij} of x_{ij} . Entropy method is one kind of objective empower method, it uses the inherent information of evaluation index to judge the efficiency value of index, so that it further avoids deviation caused by subjective factors to a extent.

(5) Calculate the Euclidean distance between each target value and ideal solution

$$S_i^* = \sqrt{\sum_{j=1}^{n} (f_{ij} - f_j^*)^2}, i = 1,2,\ldots,n \quad (11)$$

$$S_i^1 = \sqrt{\sum_{j=1}^{n} (f_{ij} - f_j^1)^2}, i = 1,2,\ldots,n \quad (12)$$

（6）Calculate the close degree of each target value to ideal solution

$$C_i^* = S_i^1 / (S_i^* + S_i^1) \quad (13)$$

C_i^* measures the ratio between distance of each plan to negative ideal solution and positive ideal solution, so the larger value indicates the farther of this plan to the negative ideal solution, while it is closer to positive ideal solution. It makes ascending order or descending order according to size of C_i^*, confirm the priority of alternative, of which, the maximum C_i^* means it is closet to positive distance while farthest to positive distance, the corresponding alternative to it is the best plan.

Evolution and optimization on regional recycling economic development

The space point in recycling economic development route evolution model of Tianjin Binhai new district from 2005 to 2014 is in the different coordinate value, the coordinate value represents recycling economic development conditions in this year. Diagram 2, 3 and 4 intuitively indicate difference order of positive and negative ideal solution of economic development index, ecological development index, and social livable index of Tianjin Binhai new district from 2005 to 2014.

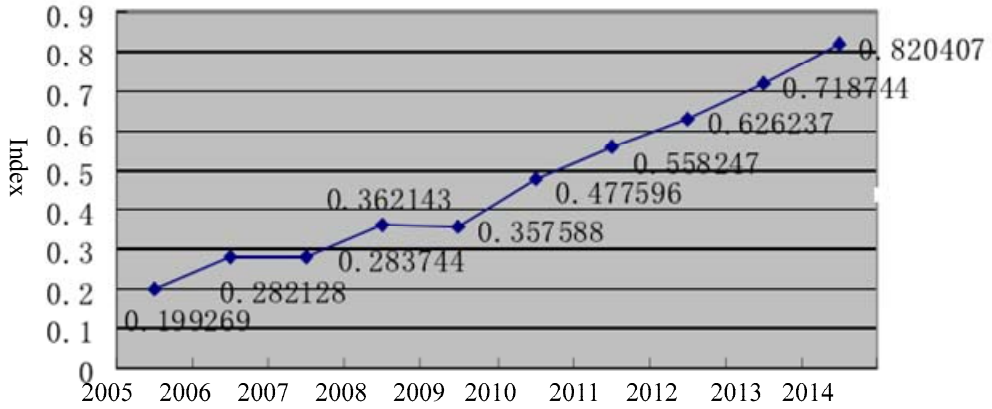

Diagram 2 Economic developement curve diagram of Tianjin Binhai new district from 2005 to 2014

Table 3 Difference order of positive and negative ideal solution on economic development index from 2005 to 2014

Index	difference of positive and negative ideal solution	Sequencing
Per GDP	0.17684563	1
per capita disposable income	0.127167978	2
GDP growth rate	0.08405815	3
ratio of output value to profit and tax	0.078370574	4
consumer price index	0.015704445	5

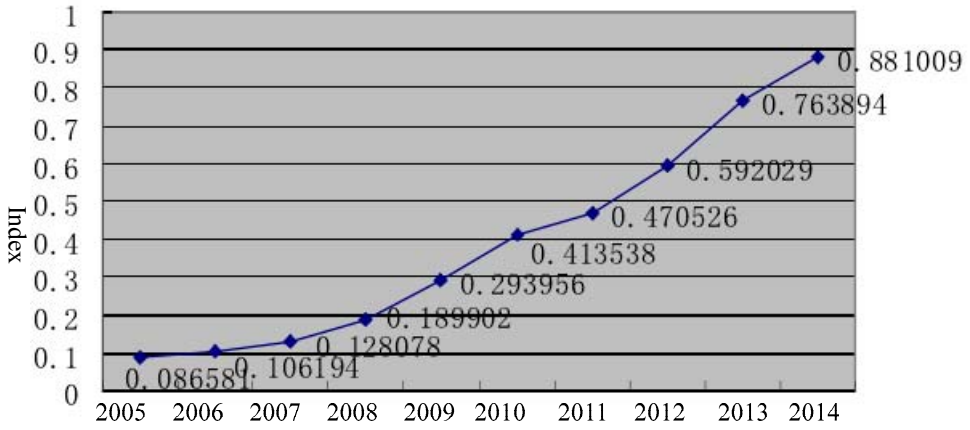

Diagram 3 Ecological development index curve diagram of Tianjin Binhai new district

Table 4 Sequencing of positive and negative ideal solution of every index on ecological development from 2005 to 2014

Index	Difference of positive and negative ideal solution	Sequencing
10000Yuan GDP waste water discharge	0.064437127	1
10000Yuan GDP energy consumption	0.063766014	2
10000Yuan GDP water consumption	0.052944151	3
Repeated utilization rate of industrial water	0.010225611	10
Removal rate of industrial dust	0.009015271	11
standard rate of industrial waste water	0.005437808	12

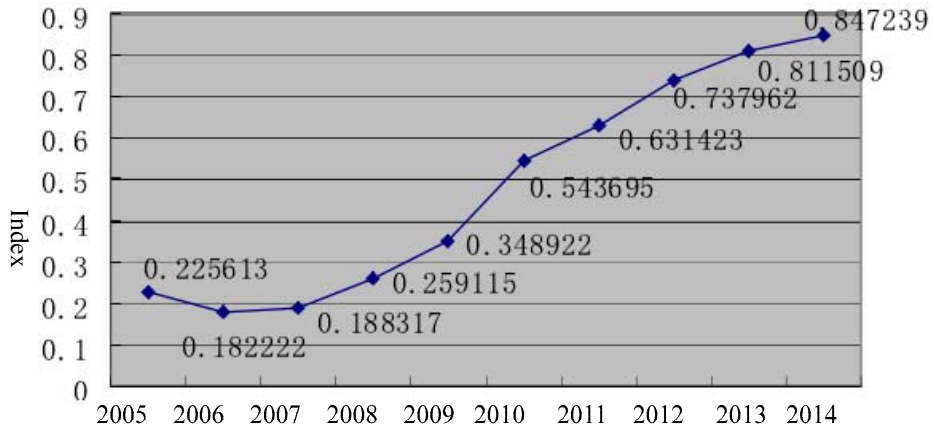

Diagram 4 Social livable curve diagram of Tianjin Binhai new district

Table 5 Difference sequencing of positive and negative ideal solution on social livable index from 2005 to 2014

Index	difference of positive and negative ideal solution	Sequencing
social security coverage rate	0.097418527	1
per greenland square	0.070713605	2
good rate of air quality	0.059104421	3
unemployment rate	0.0390903	4
water quality standard rate of water functional area	0.02996821	5
Engel coefficient	0.017175432	6

From the table we can see that per GDP and per disposable income have the biggest change, while CPI has the smallest change. It indicates that Tianjin Binhai new district not only keeps growth in economic aggregate, meanwhile the income level of people has increase to a larger extent, and during investigation in 10 years, the price is stable in Tianjin Binhai new district, which paves solid and powerful foundation for good growth of economy and enhancement of life quality. It indicates a series of symbolize events will take place such as the pre-stage engineering of Zhongxin ecology city project has been started etc, ecological development index in Tianjin Binhai new district has obvious increase. The index has larger increase from 2009 to 2010, in this year, the social security coverage rate in Tianjin Binhai new district has larger enhancement, and at the same time, the good rate of air quality reaches above 80% for the first time, which has become to be the main power of accelerating social livable index occur big increase. In addition, the unemployment rate in Binhai new district after 2010 is relatively stable, which is always maintains at 3.6, the fluctuation is very small, which guarantees the smooth increase in social livable index.

Summary

This paper is based on research of development model of regional recycling economy, it makes correct comprehensive evaluation on regional recycling economic development conditions from quantitative perspective, and it dynamically investigates development and change condition of regional recycling economy on this basis, it explores its route evolution rule and puts forward corresponding policy suggestion according to this rule, expecting to provide certain help for healthy and quick development of regional recycling economy. In addition, it makes dynamic investigation on development and revolution condition of regional recycling economy, it makes real simulation on route evolution process of regional recycling economy through change of space point of operation trace in certain time sequence, and it finds out rule of route evolution for regional recycling economy, so that it further makes prediction on future development direction of regional recycling economy.

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