Evaluation method of urban sustainable development based on entropy method

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Abstract. According to the problem of population saturation, resource shortage and so on with the development of the city, based on the entropy method, we establish the model to solve the relationship between development level, speed and subsystem coordination. And based on the analysis to make the sustainable development plan for the smart growth of a city.

Introduction

With the development of the society, the population of the city has become saturated. Today, many cities are in the implementation of smart growth plans.It is expected that in 2050, 66% of the world's population will be urban, which will lead to a projected 2.5 billion people being added to the urban population. Therefore, Urban sustainable development planning is important and necessary.

To apply the implementation of smart growth theory to the cities of the world, two medium-sized city , the New Orleans and Edinburgh is selected, combined with the the principle of sustainability, is selected as the example to analysis.In this paper , we will use the entropy method and fuzzy analysis method to determine the measure of a city intelligent development, three aspects of sustainable development in this process are in consideration.

Description Of Some Key Conceptions

First grade index	Second level index	Third level index
Sustainable development coefficient and development coordination coefficient	Social progress index	Urban population density (people/km2)
		Urban residents per capita housing area of
		Engel coefficient
		Per capita water consumption (l)
		Power consumption (KWH) per capita
	Environmental support index	City green coverage rate (%)
		Industrial waste gas emissions
		Industrial wastewater emissions
		Industrial emissions of wastewater
		Industrial waste gas purification rate (%)
	Economic development index	GDP per capita ($)
		GDP ($)
		The GDP growth rate (%)
		Social labor productivity ($)
		The total import and export ($)

Assuming that the ideal value of J is x, Its size varies due to the nature of the evaluation index.For positive index x, the bigger the better; For negative index, x as small as possible.As a result, we can found in the initial data matrix X evaluation index of extreme value as the ideal value according to the nature of the evaluation index;

For Positive index: $x_{ij}^{'} = x_{j\max}^{'}$

For Negative index: $x_{ij} = x_{j\max}$

Define its standardized values: $y_{ij} = x_{ij} / \sum_{i=1} x_{ij}$

Data standardization matrix: $Y = \left\{ y_{ij} \right\}_{m\times n}$

Index of information entropy and information utility valued

$e_j = -K\sum_{i=1}^{m} y_{ij} \ln y_{ij}$ $y_{ij} = \frac{1}{m}$

$K = 1/\ln m$ $d_j = 1 - e_j$

Establishment Of Some Evaluation Index

The sustainable development of the ith a sample sustainable coefficient is:

$$F_{ki} = \sum_{j=1}^{n} W_j^* W_{ij}^*$$

The sustainable development of the ith a sample sustainable coefficient is:

$$S_i = \sum_{k=1}^{3} W_k F_{ki}$$

The sample i coordination coefficient is:

$$C_i = 1 - S_i / \overline{F_i}$$

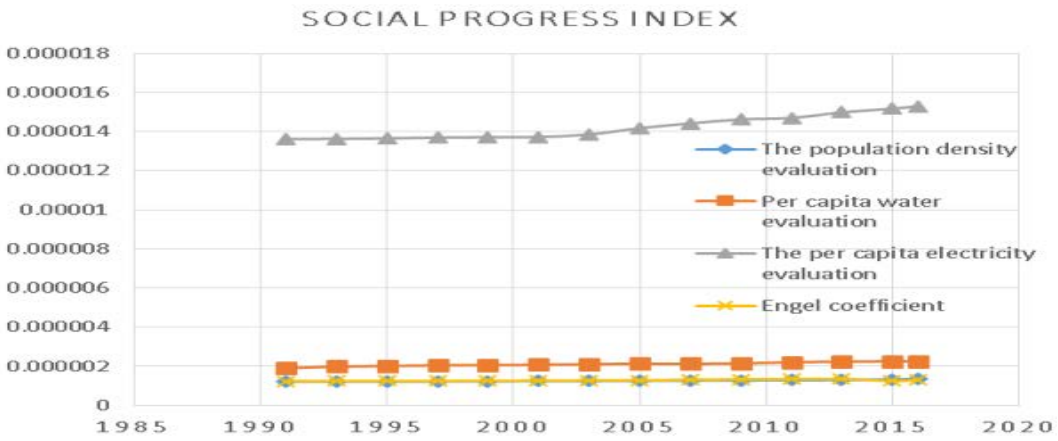
Data collection and analysis

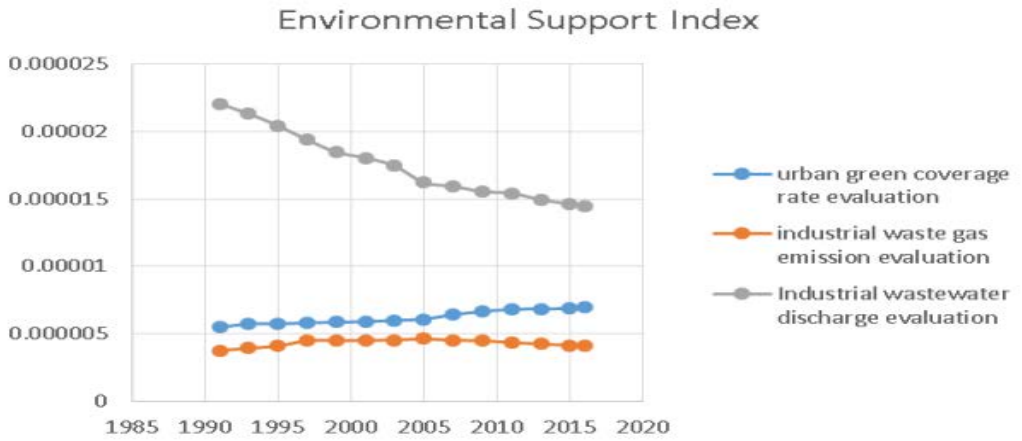
Take Edinburgh as an example, to accurately make related to the urban development index of evaluation, we collect the following data.（data from government yearbook）

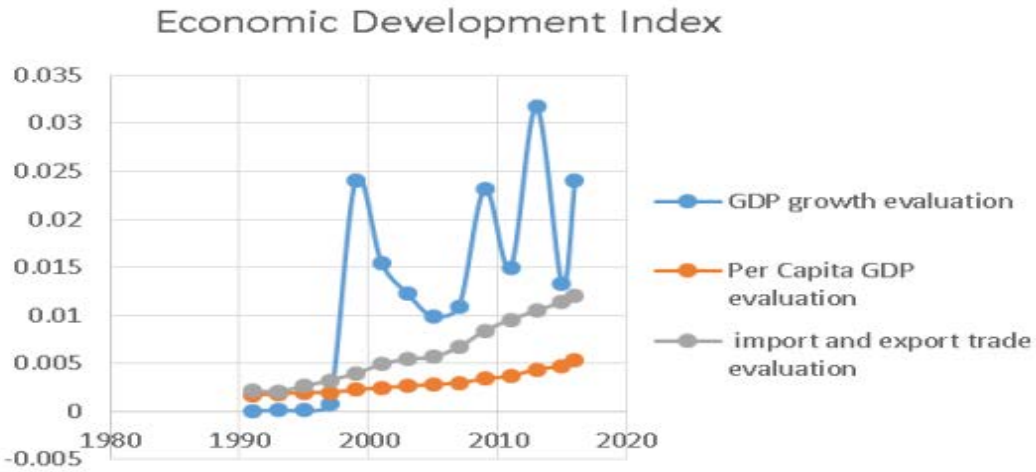
Year	Population	Social Progress		
		Per capita water	The per capita electricity	Engel coefficient
1991	460000	175	5110	0.0896
1995	463320	185	5125	0.0832
1999	468420	189	5147	0.0855
2003	472320	193	5200	0.0876
2007	480890	195	5412	0.0891
2011	488420	203	5517	0.0897
2015	498810	207	5695	0.0903

Calculation and analysis by using entropy value method

On the basis of existing data selected, using entropy method to get all the evaluation index (as shown), through the chart we can choose the index that is obviously higher than that of other indicators. And this index is important measure of the success of urban development.







It shows that industrial wastewater discharge and the GDP growth evaluation are used to measure the success of the urban development of important factor.

Result analysis

Based on the above analysis, we can find an important factor in evaluating a city's smart growth, so we can make a series of programs that are conducive to sustainable urban development. Through the collection and analysis of the above two urban development indicators, we can draw the following conclusions by considering the future population saturation and resource shortage.

Adopt a compact land use model, the use of urban land should attach great importance to the principle of high density, intensive and mixed functions. We promote using mixed land to shape the town or community center, which will enhance cohesion, improve the density of living, through the use of mixed land.

Create employment opportunities and increase jobs to provide with the increasing population in

the urban. Also we should make enough use of the infrastructure to plan the existing industries in various fields. Besides, the establishment of "priority areas", which is the focus on providing funds and technology to help reduce taxes is important. At the same time, to encourage small business investment, and investment in the construction and maintenance of the existing community, to achieve regional balanced development.

Protect the natural ecological environment at the same time of development, we can not destroy the ecological environment within the city and surrounding. Take the implementation of forest ecological barrier to increase greening area, protect biodiversity, enhance the greening quality fully expand the ecological space.

Conclusion

Through the entropy method and fuzzy comprehensive evaluation method to evaluate the current city index, ranking the weight of each index, the most important factors which influence the development of smart city, and combined with the above analysis system put forward suggestions on the future development plan of the city.

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