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Construction of Index System of Desert Oasis Eco-city —Take the City of Alar as an Example

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Abstract: The establishment of an eco-city indicator system is the main basis for measuring the effectiveness of eco-city planning, construction and management. This article starts with the economic, social and resource environment construction of Alar, southern Xinjiang, and builds an index system for the construction of an ecological city with local characteristics. In the determination of the weights of each indicator, the coefficient of variation method that is objective, simple and easy to understand and has a high utilization rate of the original data is adopted. Finally, cluster analysis is used to cluster the comprehensive scores. The results show that: the ecological environment of Alar City Urban construction can be classified as two types of ecological cities.

Keywords: Ecological City Construction; Index System; Variation Coefficient Method; Cluster Analysis; Alar City

Introduction

Ecology refers to the state of living and developing in a certain natural environment. Ecology studies the relationship between living things and their environment [1]. Therefore, the eco-cities described in the following point of view are human-centered, forming a highly complex artificial ecosystem that enables the coordinated development of natural resources and social economy, such as garden cities, garden cities, and ecologically civilized cities. Parker, Burgess (EW Burgess), and Mackenzie (RDMckenzie) believe that the eco-city takes cities as the research object, uses social surveys and document analysis as the main methods, and uses communities, namely communities and neighborhoods in natural ecology. The research unit is to study the process of urban agglomeration, dispersion, invasion, division and succession, urban competition, symbiosis, spatial distribution pattern, social structure and regulation mechanism; use a systematic perspective to treat the city as an organism, a complex Human social relations are considered to be the product of the interaction between man and nature and between man and man. The final product is the various new personalities cultivated by it. [2] Yannissky, an ecologist in the former Soviet Union, believes that the eco-city is an ideal city model. On the other hand, Professor Huang Guangyu, a Chinese scholar, believes that eco-city is a comprehensive study of the relationship between people and "dwellings" in the urban ecosystem, and the application of science and technology to coordinate the relationship between the modern urban economic system and biology, protect and rationally use all natural resources and Energy integrates man and nature. Although there are differences in definitions, they are inseparable. Scholars believe that the eco-city is not a single concept, but a coordinated and unified development system. This article adopts the second point of view, starting from the three aspects of economy-society-ecology, and constructing the indicator system of ecological city construction in Alar City [3].

1. Overview of research on eco-city indicator systems at home and abroad

In terms of the principles of system construction, domestic research on the eco-city indicator system can be roughly divided into two categories: One is from the perspective of the city as a composite ecosystem, through the analysis of the various subsystems covered by the city, the eco-city Comprehensive evaluation carries out index decomposition. The most basic decomposition method is to divide the indicator system into three major indicators: economic ecological indicators, social ecological indicators, and natural ecological indicators. This type of decomposition method is now the mainstream research method, and it is also the decomposition method used in this article. The other is based on the analysis of the urban ecosystem, establishing an eco-city indicator system from three aspects: the structure, function, and coordination of the urban ecosystem.

In terms of data standardization, the dimensionless processing method currently used in most research studies is to compare the original value with a fixed value to obtain a dimensionless value corresponding to the fixed index. The calculation principle of this processing method is relatively simple, and the application is relatively wide. In addition, the standard index weighted comprehensive model evaluation method also has certain applications. The method used in this paper is also the first dimensionless processing method [3].

In terms of index weight determination, most of the current researches use the analytic hierarchy process to determine the weight of each index. This method obtains the weight of the secondary index through expert consultation, construction of a judgment matrix, and related calculations on the relative importance of each index. The weight of the first-level indicators adopts the method of equal distribution. This method is concise, practical and systematic, but it has less quantitative data and more qualitative data. It is subjective to a certain extent. It also involves evaluating eigenvalues and eigenvectors. The calculation is more complicated, and the complexity of its operations is also complicated. To a certain extent, the scope of its application is limited. Although computer software is now developing rapidly and can be solved with the help of computers, its principle will not become simple because of this, which will reduce the credibility of the method. Based on the above points, the weighting method used in this article is the coefficient of variation method. The coefficient of variation method improves the utilization of the original data and eliminates the influence of subjective factors of experts. Moreover, the principle of the coefficient of variation method is simple, and anyone who has a little knowledge of statistics can understand and apply it well [3].

2. Overview of the study area and ecological and environmental issues

2.1 Overview of the study area

Alar City starts from the southern foothills of the Tianshan Mountains in the north, to the northern edge of the Taklimakan Desert in the south, Shaya County in the east, Keping County in the west, and adjacent to the Aksu River, Tarim River, Tailan River, and Duolang River. 79°30′-81°58′, north latitude 40°22′-40°57′, belongs to the warm temperate zone extreme continental arid desert climate, the warm temperate zone extreme continental arid desert climate, rich in light and heat resources, long sunshine time, evaporation The amount is large, the rainfall is small, the temperature difference between day and night is large, and the sandy weather is more frequent. The average number of days for sand and dust is 55 days, of which the average number of days for sand and dust storms is 7.4 days. The annual average temperature is 10.8℃, the extreme maximum temperature is 43.9℃, and the extreme minimum temperature is -33.2℃. The average annual precipitation is 73.5mm, and the maximum monthly precipitation is 50.9mm. The landforms are composed of Tianshan Mountains, alluvial plains and deserts from north to south. Among them, mountains account for 8.60% of the total area of the study area, and plains account for 83.20%. Desert accounted for 8.20%. The regional rivers are mainly supplied by melting ice and snow water. The Tarim River mainly undertakes the Aksu River. The dynamics of the river for many years are similar to those of the Aksu River. However, the flood inflow of the Hotan River has changed greatly, especially the sudden increase in floods that makes the Tarim River different from Aksu. River, Tarim River Alar Station has a maximum annual runoff of 6.655 billion m3, a minimum annual runoff of 2.67 billion m3, a multi-year average runoff of 4.801 billion m3, a multi-year average flow of 155.06m3/s, and a minimum flow of 0.42m3/s during the dry season. The study area covers an area of 6919Km2, with a permanent population of 409,000.

2.2 Status Quo of the Ecological Environment

In recent years, the city of Alar has entered a period of rapid urbanization. While urbanization has brought huge economic benefits and promoted social progress, it has inevitably produced a series of problems such as water shortages, environmental degradation, and intensified land desertification and salinization. The impact of these environmental issues on the future development of Alar cannot be ignored. Therefore, it is necessary to construct an eco-city indicator system in Alar [4]. Based on the actual situation of the city of Alar, this article analyzes the characteristics of the Israeli ecological city, draws on its successful experience, increases investment in agricultural science and technology, and constructs an index system with XPCC characteristics from the three aspects of economic construction, social construction and environmental construction of the urban ecosystem. Based on the data taken from the China Economic Statistics Database and the 2020 Alar Statistical Yearbook, the coefficient of variation method is used to assign weights to the indicators, calculate the scores of each city, and perform cluster analysis on this to obtain ecological information of each city, and its ecological Comprehensive evaluation of urban construction.

3. Desert Eco City-Israel

Israel has little arable land, deserts occupy two-thirds of the country's land area, and water is scarce. The per capita water resource is less than 400 cubic meters, while the world's per capita water resource is 8,800 cubic meters, making it the world's poorest country in terms of per capita water resources. one. However, Israel's agricultural workers, which account for 5% of the country's labor force, provide more than 90% of the country's food; agricultural products are exported in large quantities, occupying 40% of the European fruit and vegetable market, and are known as the "European Fruit Basket."

3.1 Precision drip irrigation: use less resources for greater output

The advantages of Israel's dropper technology are: First, it is controlled by a computer, based on the soil data returned by the sensor, to determine when to water and to water more or less, which will never waste water and fertilizer resources while ensuring the needs of crop growth; second, it is to prevent The root growth of the crop blocks the nozzle, and the spray hole is precisely coated with a special agent, which only inhibits the root production in a very small area around it. The third is to prevent the soil from naturally sinking and blocking the nozzle when the water is not sprayed. It is necessary to arrange an aeration system in parallel in the water spray system, and it will be inflated and blocked immediately after the irrigation is completed.

Israel uses science and technology such as plant engineering, genetic engineering, hybridization and genetic modification to improve fruit, vegetable and flower varieties to adapt them to the natural environment such as the climate, soil and water in the desert area. Israeli agricultural experts are highly targeted and highly specialized in researching issues.

In Israel, there are many technology transfer companies specializing in scientific research institutions, marketing the inventions and know-how of well-known researchers and students, making science and technology out of the laboratory into a commercial product serving the society, and letting agricultural science and technology innovation results Really serve agriculture and improve agricultural production efficiency.

3.2 Innovation and entrepreneurship: Make agriculture more attractive and valuable

In Israel, agriculture is a high-tech industry with youthful vigor. Fantastic ideas and bold innovations are reflected in modern agriculture and related industrial chains. Israel's agriculture has specialized post-harvest disciplines of crops, which are mainly dedicated to the high-quality protection, preservation, processing, processing, storage and transportation of fresh crops. A piece of fruit cling film must pursue air permeability, disease prevention, and resistance. The perfect unity of storage. The detailed division of labor and thorough research in various fields in Israel also make all links of the modern agricultural industrial chain nurturing business opportunities. Israel's high efficiency has driven the development of related technologies and processes before and after delivery, thereby further breaking through the limitation of resource shortage and realizing greater agricultural added value.

3.3 The pearl in the desert-Tel Aviv-Jaffa

3.3.1 Tel Aviv-Yafo

Tel Aviv is a famous city along the Belt and Road. Located on the Mediterranean coast of Israel, with an urban area of 51.76 square kilometers, it was historically a land bridge connecting Europe, Asia and Africa. The city clusters centered on Tel Aviv include Bat Yam, Holon, Ramat Gan, Petah Tikva, Rishon LeZion, Ramat Salon, 3.3.2 Herzliya and other cities.

It is also a city of immigrants. It is the most international center of Israel and the heart of the so-called "Silicon Creek" area. It has the characteristics of active, modern and cosmopolitan, and is recognized as the cultural capital of Israel. As a prosperous high-tech city economically, it has become "Little Los Angeles" and is the most prestigious innovative city.

The city adopted the urban planning of a garden city and designed many broad tree-lined avenues. The external traffic is developed and there are 4 railway stations. Relying on Tel Aviv University to build an industrial ecosystem and an innovative ecological chain to accelerate the construction of a national innovative city. At the same time, the smart city plan is implemented to meet the challenges of future urban development.

Figure 1: Tel Aviv satellite imagery

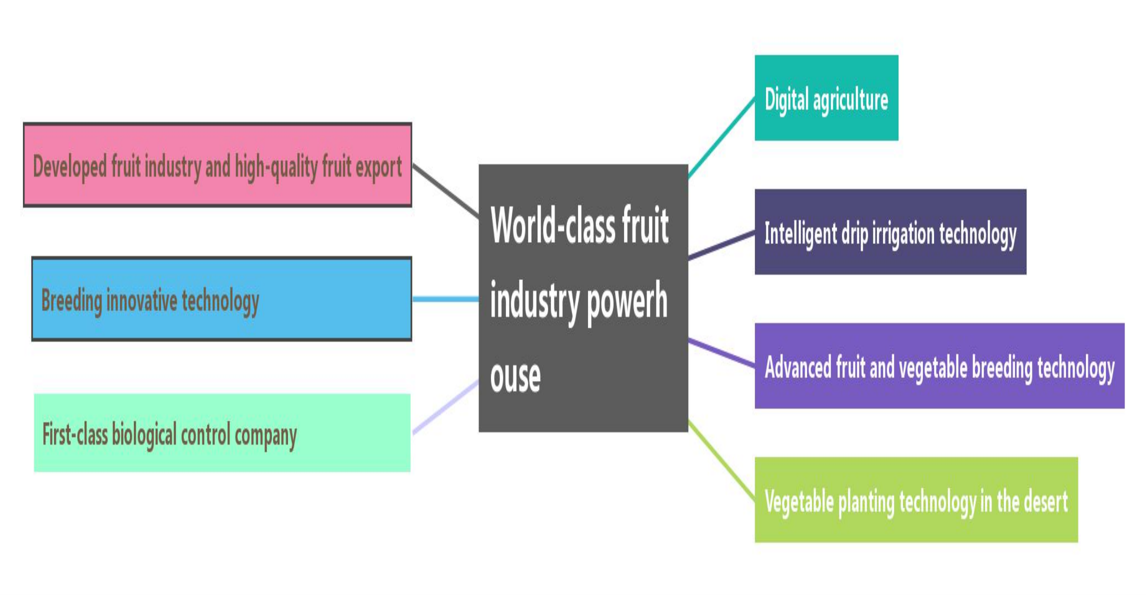

Figure 2: View of Tel Aviv

Figure 3: Schematic diagram of the industry

Analyze and study Israel, and draw a reference: improve the scientific and technological content of agriculture in industry, and build the world's modern agricultural science and technology base. Strengthen the ability of industrial innovation, scientific and technological innovation factors to promote urban development. In the urban space, the urban culture is preserved, the density is dense, the building density is high, but the number of floors is low. Create a low-altitude city, and appropriately build high-rise buildings in the innovative core area.

4. Construction of an indicator system for eco-city construction

4.1 Theoretical basis of the eco-city construction index system

The so-called eco-city is simply an economic-society-natural artificial composite ecosystem, which implies a coordinated development of society, economy, and nature and an overall ecologicalized artificial composite ecosystem. When evaluating whether a city is an eco-city, the criteria used are exactly from the economic-society-natural three aspects. The principle of economic ecology is to protect and rationally use all natural resources and energy, to improve the social and economic production structure as much as possible, and to increase resource utilization, so as to achieve a sustainable production model; the principle of social ecology is people-oriented, from population control, material resource allocation And public infrastructure construction, to meet people’s material and spiritual needs, and build a harmonious society; the principle of natural ecology, to give priority to the protection of the natural ecology to the greatest extent, so that development and construction activities are maintained within the allowable nature of the natural environment. Within the carrying capacity, on the other hand, it reduces the negative impact on the natural environment and enhances its health .

The indicator system for the construction of the ecological city of Alar City constructed in this paper is also based on the above standards. Comprehensively considering the influence of economic-society-natural factors, the eco-city construction index system of Alar City is divided into three major parts, and there are three level I indexes formed, namely: economic construction, social construction, and resource and environmental construction. To determine the second-level indicators of economic construction, a total of 12 indicators such as GDP and total industrial output value were selected from four aspects of economic scale, economic level, economic benefits, and economic structure; the second-level indicators of social construction were determined from the population structure. , Infrastructure, resource allocation and social civilization, a total of 9 indicators are selected, including population density and the number of students in colleges and universities; the determination of the second-level indicators of environmental construction is selected from the two aspects of greening and environmental governance. 6 indicators such as per capita public green area and per capita garden and green area were calculated, and finally formed the indicator system of the ecological city construction of Alar City as shown in the following table (Table 1).

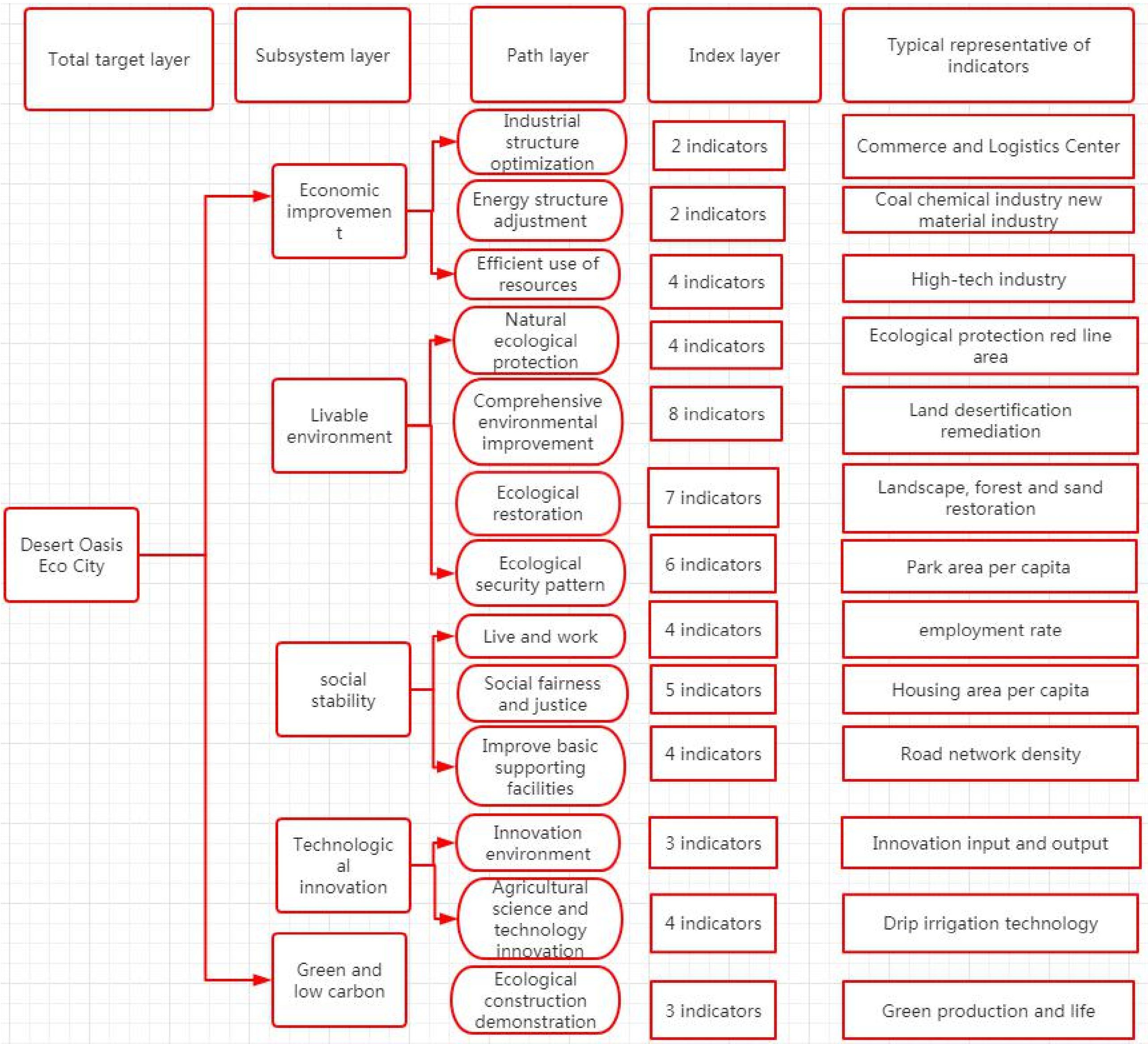

Figure 1. Alar City Desert Oasis Eco-City Index System Framework

Table 1: Ecological City Evaluation Index System of Alar City

Level I index	Level II index	unit
economic development	GDP per capita	845368 yuan
	Per capita disposable income ratio of urban and rural residents	4.02
	Energy consumption per 10,000 yuan of GDP (tons of standard coal)	0.20
	Energy consumption per unit of GDP	8.2%
	GDP growth rate	5.3%
	The proportion of tertiary industry in GDP	35.3%
Social construction	Road network density (km/km^2)	12.9
	Number of students in colleges and universities	30,000 people
	Proportion of persons with higher education (%)	55
	Housing area per capita	$50m^2$
	Road area per capita	$27.9m^2$
	Number of hospital beds per 10,000 people	0.19 Bed
	Area of emergency shelter per capita （m^2）	$30m^2$ 50%
Environmental construction	Park area per capita	$15m^2$
	Area of construction land within the red line of ecological protection（km^2）	≧4.2
	Coverage rate of parks and green spaces and squares within a 5-minute walk（%）	90
	Green coverage rate in built-up area	75%
	Urban domestic sewage treatment rate	100%
	Harmless treatment rate of domestic garbage	100%
	Comprehensive utilization rate of industrial solid waste	95%

4.2 Evaluation Method of Eco-city Construction Index System

Regarding the evaluation of the eco-city indicator system, many scholars have conducted discussions and studies, but it is not difficult to find from their research methods that the mainstream method is Analytic Hierarchy Process (AHP), which arranges complex evaluation objects into one The whole of the hierarchical structure of the order, and then compare and judge each pair of evaluation items, and calculate the relative importance coefficient of each evaluation item, that is, the weight. The analytic hierarchy process is good, but the method needs to combine expert opinions when comparing and scoring pairwise. Therefore, the score will have a large difference due to different expert opinions, which will eventually have a great impact on the weight. In view of the subjectivity of this method, this article uses a more objective method-the coefficient of variation method [5]. The coefficient of variation method is to directly use the information contained in each indicator to obtain the weight of the indicator through calculation. It is an objective method of empowerment. The basic approach of this method is: in the evaluation index system, the index with the greater the difference in the value of the index is the index that is more difficult to achieve. Such an index can better reflect the gap between the evaluated units.

5. Evaluation of Eco-city Construction

5.1 Standardized processing method

Because the dimensions of the various indicators in the evaluation indicator system are different, it is not appropriate to directly compare the degree of difference. In order to eliminate the influence of different dimensions of each evaluation index, it is necessary to standardize the original index values to eliminate the influence of dimensions [6]. For positive indicators, such as GDP per capita, the larger the indicator value, the better the city's economic development. For such "benefit" positive indicators, the standardized model is:

$$\mu_{\mathrm{ij}}=\frac{x_{ij}-\min\{x_{ij}\}}{\max\{x_{ij}\}-\min\{x_{ij}\}}$$

For inverse indicators, such as energy consumption per unit of GDP, the smaller the indicator value, the lower the cost of economic construction and the higher the utilization rate of energy. For such "cost-based" indicators, the standardized model is:

$$\mu_{\mathrm{ij}}=\frac{\max(x_{ij})-x_{ij}}{\max\{x_{ij}\}-\min\{x_{ij}\}}$$

Among them, μ_{ij} is the standardized value of the secondary index value; x_{ij} is the current value of the index; min{ x_{ij} } is the minimum value of the relevant city index; max{ x_{ij} }is the maximum value of the relevant city index.

5.2 Calculating the coefficient of variation

Calculate the average $\overline{x}_{\mathrm{j}}$ and standard deviation σ_{j} of the evaluation values of different indicators

$$\overline{x}_{\mathrm{j}}=\frac{1}{\mathrm{m}}\sum_{i=1}^{\mathrm{m}}x_{ij}$$

$$\sigma_{\mathrm{j}} = \frac{1}{m}\sum_{i=1}^{m}(x_{ij} - \overline{x_j})$$

Find the coefficient of variation V_j corresponding to different indicators:

$$V_{\mathrm{j}} = \frac{\sigma_{\mathrm{j}}}{\overline{x}\mathrm{j}}$$

Where: V_j is the coefficient of variation of the j-th index, also known as the standard deviation coefficient;

5.3 Determining the weight of secondary indicators

Calculate the weights of different indicators in the secondary indicators, the weight of the j-th evaluation indicator is:

$$W_j = \frac{V_j}{\sum_{j=1}^{n} V_j}$$

Using the coefficient of variation method to obtain the weight of each secondary index is shown in Table 2:

Table 2: The weight of each secondary index

First level indicator	GDP per capita	Disposable income per capita	Land yield	Energy consumption per unit of GDP	GDP growth rate	The proportion of tertiary industry in GDP
Weights	0.0361	0.0273	0.0884	0.0292	0.0932	0.0154
First level indicator	The population density	Number of students in colleges and universities	Housing area per capita	Road area per capita	Number of hospital beds per 10,000 people	Every 10,000 people own buses
Weights	0.0553	0.174	0.0531	0.0661	0.0303	0.0988
First level indicator	Public green area per capita	Per capita garden and green area	Green coverage rate in built-up area	Urban domestic sewage treatment rate	Harmless treatment rate of domestic garbage	Comprehensive utilization rate of industrial solid waste
Weights	0.0864	0.0781	0.0077	0.022	0.031	0.0077

5.4 Calculate the scores of first-level indicators

The first-level indicators are divided into three aspects: economy, society, resources and environment to evaluate the degree of a city's ecological construction, and the weighting method is used to calculate the scores of the three aspects of

Alar City. Use P_{hi} to represent the first-level indicator score of city i, where h=1,2,3 respectively refer to economic construction, social construction and resource and environmental construction:

$$P_{hi} = \sum_{j=1}^{12} \mu_{ij} \bullet W_j$$

5.5 Determination of the weights of first-level indicators

Use the coefficient of variation method to assign the weights of the first-level indicators to the scores of the first-level indicators. Use the same method to obtain the average P_h, standard deviation σ_h, and coefficient of variation V_h of the economic, social, and environmental scores, and obtain the weight W_h of each index of the first-level indicator:

The calculation results are shown in Table 3. It can be seen that when evaluating the ecological degree of a city, the environmental construction accounts for the largest proportion of the first-level indicators, which is 0.4278. The proportion of social construction is relatively small, with a value of 0.2013.

Table 3: Weight values of first-level indicators

First level indicator	economic development	Social construction	Environmental construction
Weights	0.2444	0.2577	0.2145

6. Ecological comprehensive index evaluation score

In the comprehensive evaluation of the ecological degree of Alar City, the score of the comprehensive ecological index is finally used. The index score is obtained by multiplying each first-level index by their respective weights and then adding them together. The ecological comprehensive index score of city i is:

$$B_i = \sum_{h=1}^{3} P_{hi} \bullet W_h$$

7. Analysis of evaluation results

The results prove that Alar City should be basically rated as a second-class ecological city in the whole country. The main reason is that the more developed areas have invested a lot of capital in social construction and environmental construction, and they have done relatively well. Ecological construction mainly refers to the ecological restoration and reconstruction of the ecological system disturbed and destroyed by human activities. It is an artificial design based on ecological principles, making full use of modern science and technology, and making full use of the natural laws of the ecosystem to achieve high efficiency and harmony. , To achieve the unity of environmental, economic and social benefits [7].

Urban development and social stability influence and promote each other, that is, "there are complex and diverse associations between economic development and social stability. These associations are mainly reflected in the process of economic development and the direct and indirect results produced." Social stability promotion Urban development, urban development is conducive to maintaining social stability. "A country's economic situation is the basic factor that determines social stability, and it is at the core of social stability." A good economic development momentum can promote employment and increase national fiscal revenue [8]. The country has sufficient funds to solve the problems of poverty, the disparity between the rich and the poor, and maintain social stability. Therefore, economic development is the guarantee of social stability. And urban development is part of the country’s economic development.

8. Realistic significance

From the above analysis, it can be seen that for the city of Alar, as far as the construction of an ecological city is concerned, economic support is indispensable in order to achieve the unity of economic, social, and environmental benefits. In urban planning, it is necessary to balance the economy and the environment. The relationship between the society and the environment can do a good job in the construction of an eco-city.

Regardless of whether it is from the unilateral aspect of economic construction or the comprehensive aspect of ecological city construction, if Aral wants to develop in a balanced and comprehensive manner, it must improve the economic development of the entire Aksu area, especially the east and west wings of Aksu and the northern mountainous areas. The more backward areas[9].

It is the direction of Alar City to accelerate the transformation of economic development mode and vigorously promote the new industrialization of Alar. Adhere to the development of low-carbon and circular economy as an opportunity to carry out ecological .

References

[1] Chen, X., Peng, S., Zhai, D.T., Construction and empirical analysis of the evaluation system in Shanxi Province [J]. Journal of Shanxi University of Finance and Economics, 2015,32 (2): 136-137.
[2] Shen, Q.Y., The Urban Ecology and the Urban Environment [M]. Tongji University Press, 2018 (19): 46-47.
[3] Qi, F.Y., The Index System Construction and Evaluation of Eco-city Construction in Jiangsu Province [J]. Industrial Technology and Economy, 2016 (12): 93-97.
[4] Song, D.M., Xiao, D., Shengyuan Village. Evaluation of ecological city construction in the coastal areas of China [J]. Progress in Geography, 2014,23 (4): 80-86.
[5] Li, H.H., Analysis of Ecological City Construction in Guangdong Urbanization Process [Z]. China Urban Development Network, 2015-9-13.
[6] Zhang, K.M., Wen, Z.G., Du, B., Eco-City Evaluation and Index System [M]. Chemical Industry Publishing House, 2014.
[7] Shi, S.Q., Fan, Z.Q., Data Analysis and Statistical Modeling: Statistical Methods in Social Science Research [M]., Shanghai People's Publishing House, 2017.
[8] Ales W., Conifer L etc. Site glancing and design. Finale Wilson. ed. Green Development, New York.John Wiley &. Sons. Inc. 1998.2-24.124-156.
[9] Sim D.K., Stuart C.W., Attainability and design. In: Sim Dander Karyn ed. Ecological fatigue. Ingrate: Lapland Press，1996.3~33.

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