A Study on the General Appraisal Model of Sustainable Development

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1. Establishment of the General Appraisal Model of Sustainable Development

This article divides the general appraisal models of sustainable development into three main systems: Economic Development Appraisal System (ED), Social Population Quantity and Quality Appraisal System (SP) and Resources Development and Exploitation and Ecological Environment Appraisal System (RE). Each system is composed of several appraisal items. The ED system is composed of two subsystems of aggregate economic development and economic development quality. In the subsystem of aggregate economic development, there are three appraisal items. They are U_1: net economic welfare; U_2: industrial capacity (including the total output of energy, steel, cement, etc.); and U_3: food deliverability (including grains, oils, etc.). The subsystem of economic development quality has three appraisal items of U_4: production quality index = $\sum_{i=1}^{n} K_i W_i$ K_1 is the rate of qualified products, K_2 is the market share, K_3 is the ratio of production environment meeting the standards, and W_i is the relevant weight; U_5: assets efficiency coefficient = GDP/average occupation of assets; and U_6: energy exploitation coefficient. The SP system is composed of two subsystem of social stability and development and residential living quality. In the subsystem of social stability and development, there are four appraisal items of U_7: human development index U_8: rate of change in Gini coefficient; U_9: rate of change in proportion of the population below the low-income level; and U_{10}: index of change in criminal rate. In the subsystem of residential living quality, there are three appraisal items of U_{11}: net economic welfare per capita; U_{12}: change in Engel coefficient; and U_{13}: major food output per capita. The RE system is composed of three subsystems of environmental expenses, environmental benefit and resources development and exploitation. In the subsystem of environmental expenses, there are three appraisal items of U_{14}: proportion of input of environment protection in GDP; U_{15}: environmental degradation (upgrading) index = $\sum_{i=1}^{n} K_i W_i$ K_1 is the air degradation (upgrading) index, K_2 is the water degradation (upgrading) index, and K_3 is the green coverage degradation (upgrading) index and U_{16}: proportion of loss from disasters in GDP. In the subsystem of environmental benefit, there are three appraisal items of U_{17}: comprehensive environmental benefit index; U_{18}: GDP contributed by recovery and comprehensive utilization of three wastes; and U_{19}: optimization rate of community environment. In the subsystem of resources development and exploitation, there are three appraisal items of U_{20}: rate of difference between supply and demand of resources; U_{21}: per capita possession of resources; and U_{22}: rate of green

coverage.

2. Item Benefit Appraisal Methods

Amongtheabove22appraisalitems,someareaggregateindexesandothersarerelativeindexes.Whenthevaluesofsomerelativeindexes(suchasU4,U5,U6,U7,U11,U13,U15,U17,U19,U21,andU22)goup,thebenefitsincrease.Whenthevaluesofotherrelativeindexes(suchasU8,U9,U10,U12,andU16)drop,thebenefitsincreasetoo.AdesirablevalueforU14maybegiveninlightoftheactualconditions.Inordertomakeiteasyforintegrationandcomparison,theaggregateindexessuchasU1,U2,U3,andU18areturnedintonon-dimensionalindexes.Theformulaisasfollows:

$$d_i = \frac{X_i - X_i^{(s)}}{X_i^{(h)} - X_i^{(s)}} \times 40 + 60 \qquad U_i^{'} = \frac{\sum w_i d_i}{\sum w_i}$$

With the non-dimensional treatment, $U_1^{'}$, $U_2^{'}$, $U_3^{'}$, and $U_{18}^{'}$ become the effect factors of the corresponding items. Now we can set comparative evaluation standards, adopt the fuzzy appraisal method, establish affiliation functions according to the fuzzy distribution patterns (ladder distribution and rectangular distribution) and integrate the single item appraisal results of various subsystems. Then, with this appraisal result, we can derive the fuzzy relational matrix $\tilde{R}$.

3. Integration of appraisal Results from subsystems to the main system

The fuzzy relation synthetic method used in the fuzzy appraisal shall is adopted for integration of various appraisal items and various subsystems. The appraisal factor fields shall be established for various subsystems and weights of various items determined. The weight vector is $\tilde{A}$. Combine $\tilde{A}$ with $\tilde{R}$, then $\tilde{B} = \tilde{A} \cdot \tilde{R}$. Then give scores to various appraisals. The values of various subsystems can be calculated respectively

In this article, the weighted average method is adopted to summarize the integration of appraisal results of subsystems and that of the main system. This appraisal model can be used to compare the sustainable development in different areas or to conduct a dynamic analysis.

The empirical analysis is omitted in this abstract.

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