

Study of land Use Economic Benefit in Development Zone by Choquet Integrals

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Abstract: By building an evaluation index system, using λ -fuzzy measure and Choquet fuzzy integral approach and using the software R, we make a more scientific evaluation on economic benefits of zone land use. The result shows: the total index value can be calculated by the basic indicator value, and then we get a more scientific evaluation value. The study conclusion is: the non-linear economic benefits evaluation on the every park's land use of the New Technology Development Zone of East Lake in Wuhan promotes the rational land use of development zone and provides a theoretical basis for management decisions.

Keywords: economic benefits of land use; λ -fuzzy measure; Choquet fuzzy integral; Development Zone.

I. INTRODUCTION

After 1980, in surging waves of the world's new technological revolution, Wuhan East Lake New Technology Development Zone in China's reform came into being. In 2001, it was approved of the state optoelectronic industry base by the former State Planning Commission and Science Ministry, namely "Wuhan • Optics Valley of China". During the past 10 years, we have made gratifying achievements in the building of China's development zones, however, in land use of the zone, there are idle land, dropped sharply decline in cultivated land and environmental quality, irrational structure of land use, ignoring issues such as human settlements and all of these led to increasingly serious consequences [1]. Chuan-jun Zhu, who select the five non-linear economic indicators, such as the intensity of the total land investment, output, profits and taxes, input-output ratio, the comparative economic efficiency of industrial land, as an evaluation index system, use the fuzzy integral method to evaluate the land use economic benefits of Wuhan East Lake New Technology Development Zone [2], avoiding the traditional land resources evaluation [3] assuming that indicators is independent. In the paper, on these basements, according the given five basic indicators of value that the experts scored, we use fuzzy measures formulas to calculate the value of all the indicators and apply the software R [4] to

obtain the more precise value. On the one hand, it reduces the difficulty of the survey and the errors of expert scoring, on the other hand it improves the real degree of the evaluation of the value. So we can furtherly understand the land-use zone status scientifically, not only for development zones provide a basis for management decisions, but also conducive the construction of Resource-conserving and Environmental-friendly Society in Wuhan Area.

II. λ -FUZZY MEASURE AND CHOQUET FUZZY INTEGRAL

Fuzzy measure promotes a traditional measure - Lebesgue measure, replacing their addition with the monotony, relaxing the requirements of the independence that selects the evaluation index system, so it can make the results closer to the true values and achieve a good evaluation of the results.

Definition 1.1 The fuzzy measure g called λ -fuzzy measure must meet:

$$\exists \lambda \in (-1, +\infty), \exists g(A \cup B) = g(A) + g(B) + \lambda g(A)g(B), \\ A, B \in \mathbb{F}(X), A \cap B = \emptyset$$

When λ is zero, g is the probability measure. The value of the single point $\{x_1\}, \{x_2\}, \dots, \{x_n\}$ are often referred to the fuzzy density.

As long as you can know the fuzzy densities^[5], the fuzzy measure of the finite set can be determined. Now,

$$\forall E \in \mathbb{F}(X) = \{x_1, x_2, \dots, x_n\}, g(E) = \begin{cases} \frac{1}{\lambda} \{ \prod_{x_j \in E} [1 + \lambda g(x_j)] - 1 \}, & 0 \neq \lambda > -1 \\ \sum_{x_j \in E} g(x_j), & \lambda = 0 \end{cases} \quad (1)$$

At the same time, we can determine the value of λ if we let E equal X to gain that $g(X)$ is 1 and obtain $1 + \lambda = \prod_{i=1}^n [1 + \lambda g(x_i)]$ from the formula (1).

Definition 1.2 The fuzzy measure of the Choquet fuzzy integral of the non-negative function f on X about the fuzzy measure g is defined as:

$$(C) \int dg = \int_0^{+\infty} g(\mathbb{F}_\alpha) d\alpha,$$

$$\mathbb{F}_\alpha = \{x | f(x) \geq \alpha \geq 0, x \in X\}, \int_0^{+\infty} g(\mathbb{F}_\alpha) d\alpha$$

When X composed of x_1, x_2, \dots, x_n is a finite set, Choquet fuzzy integral is reduced to

$$(C) \int dg = f(x_n)g(X_n) + [f(x_{n-1}) - f(x_n)]g(X_{n-1}) + \dots + [f(x_1) - f(x_2)]g(X_1) \quad (2)$$

$$X_1 = \{x_1\}, X_2 = \{x_1, x_2\}, \dots, X_n = \{x_1, x_2, \dots, x_n\}, f(x_1) \geq f(x_2) \geq \dots \geq f(x_n)$$

It is not difficult to find that when the fuzzy densities of $g(x_1), g(x_2), \dots, g(x_n)$ are given, $\lambda, g(X_1), g(X_2), \dots, g(X_n)$ and integral values can be derived easily.

III. A CASE OF ECONOMIC EVALUATION OF LAND USE

After 10 years of construction, Wuhan East Lake New Technology Development Zone has 2,000 high-tech enterprise classification gathered into a photoelectron information industry as the leading, energy, environmental protection, bio-engineering and new medicine, electromechanical integration, and high-tech industry, agriculture, the development of competing Garden mainly by Nancy Kwan Park, off East Park and Chinese workers park composed of 10 parks. Although experienced in 1988 the Asian financial crisis and the global IT downturn in 2002 and a series of tests, but still there is duplication of park construction and excessive competition among the serious problems will ultimately lead to the overall level of economic development zone land use is not high, the gap between larger, and thus a direct threat to the industry as a whole and economic development of the layout is not conducive to the construction of "two-oriented society" in Wuhan Area, affecting our countries on implementation of the strategy of Central China.

To this end, we chose the relevant economic datas as a sample [2] of every park of East Lake New Technology Development Zone in 2007, construct the evaluation index system, and use mathematical tool about fuzzy measure and fuzzy integral to study the economic benefits of land use of the zone.

Table 1 the original value of economic benefit indicators in all park in 2007

	Value per unit area (1000RMB/m ²)	Profits and taxes per unit area (1000RMB/m ²)	The total investment per unit area (1000RMB/m ²)	Input-output ratio	Comparative benefits of Industrial land
Guan Nan Park	2.4594	0.1890	1.4921	1.6483	0.4667
Guan Dong	25.7015	1.3509	12.4917	2.0575	4.9290

Park					
HUST Park	4.4492	0.3105	2.3676	1.8792	0.9604
WHU Park	1.7676	0.0332	2.7966	0.6320	0.1554
HZNU Park	0.0415	0.0017	0.1962	0.2114	0.0045
WHUT Park	10.8385	0.6993	1.2042	9.0007	0.2519
Car Park	1.8313	0.1712	0.6797	2.6943	0.3067
Dong Yi Park	2.0677	0.1098	0.7492	2.7600	0.3301
Great Wall Park	3.1670	0.0500	0.9703	3.2639	0.4928
Dong Er Park	3.7101	0.1818	0.7111	5.2176	0.5458

Firstly, g and λ must be determined. By surveying and expert rating we can get:

$$g_1 = 0.244, g_2 = 0.29, g_3 = 0.186, g_4 = 0.45, g_5 = 0.324$$

Secondly, we can calculate $\lambda = -0.688923$ by R software and the error is 6.103516×10^{-5} , which is more precise than the identification results of the genetic algorithm [8] and the improved genetic algorithm [2]. Thirdly, we deal with the datas of Table 1 by the Dimensionless method.

In the end, we calculate the Choquet fuzzy integrals, which is the evaluation values of every park, and arrange them in accordance with descending order in Table 2.

Table 2 the result

	Value per unit area (1000RMB/m ²)	Profits and taxes per unit area (1000RMB/m ²)	The total investment per unit area (1000RMB/m ²)	Input-output ratio	Comparative benefits of Industrial land	fuzzy integrals
Guan Dong Park	1	1	1	1	0.210039	0.839733
WHUT Park	1	0.517047	0.420772	0.081981	0.050239	0.511774
Dong Er Park	0.569579	0.14297	0.133487	0.109924	0.041877	0.312123
HUST Park	0.228876	0.194111	0.189753	0.176603	0.171773	0.190522
Great Wall Park	0.347297	0.121804	0.099157	0.062958	0.035799	0.187984
Car Park	0.282491	0.12563	0.069751	0.061367	0.039323	0.170629
Dong Yi Park	0.289966	0.080122	0.078963	0.066118	0.044976	0.165737
Guan Nan Park	0.163483	0.138823	0.105396	0.094228	0.093857	0.132603
WHU Park	0.211492	0.067268	0.047854	0.030643	0.023347	0.063096
HZNU Park	0	0	0	0	0	0

By Table 2, we can see that the development zone in 2007 the value of land use economic evaluation of Guan Dong Park is best; Car Park's is not high; 4 University Park's as a whole are too low; HZNU Park's is worst. It is noteworthy that our result is more scientific than Chunjun Zhu's^[2], because the value of this indicator is based on the formula but not all taken from the survey and expert scoring.

IV Conclusion

We build evaluation indicator system, use fuzzy measure and fuzzy integral approach to make the non-linear evaluation of land use economic benefits of the Wuhan East Lake New Technology Development Zone, and take into account the correlation between the indicators, which can overcome the limitations of the traditional methods assuming that the indicators are independent each other, and broaden our study. Further more, we change the method relying entirely on the survey and expert scoring in the previous, and adopt the value of basic indicators given by expert scoring to calculate the remaining value of the indicators and take use of advanced software R which makes calculations quickly and accurately. Therefore, it is a scientific method to a complex land evaluation, but does not reflect specific values of the economic benefits. The results of Table 2 show that we should furtherly enhance the zone level of land saving and intensive use of every park ,fully tap the potential of the stock land , constantly optimize the structure of land use, improve land use efficiency, adjust the industrial layout appropriately, integrate enterprise resource of Car Park , intensify the transformation of research results of University Park. So it can enhance the overall level of land use of the development zone, promote the construction of "two-oriented society" in Wuhan Area and accelerate the pace of Rise of Central China.

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