Research on the Cost and Value Assessment of Ecosystem Services

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Abstract

In order to assess the true economic costs of land use projects including ecosystem services, we establish a ecological services valuation system to obtain the true economic costs of a land use project and evaluate its comprehensive benefits. Firstly, we divide the environmental losses caused by air pollution, water pollution, soil pollution and noise pollution into damage to human health, agriculture, animal husbandry and fishery. Secondly, we utilize the model which is the combination of the fuzzy evaluation method and the analytic hierarchy process method to classify the benefits of the projects into three parts: economy, society and ecology. Finally, the principle of ecological priority is used to carry out a comprehensive evaluation of multiple indicators, giving an evaluation of one of the excellent, good, medium and poor, and calculating its total score.

Keywords

Ecosystem Services; Analytic Hierarchy Process; Environmental Losses; Benefits of the Projects.

1. Introduction

At most cases, land use projects are of service to facilitate our life as well as generate revenues, whether it is about constructing a large water conservancy station or simply building a few sewers. Obviously, the ecosystem plays a significant role in this process, as it provides raw materials and field. Ultimately, the raw materials and energy will return as waste products to the ecosystem, whose soil and vegetation are to be harmed or changed according to the productive requirement. Thus, it's inevitable that the projects impair the ecosystem services, cumulatively leading to the degradation of environment and the decrease in bio-diversity. Residents in certain areas may suffer from illnesses due to dreadful conditions. What's more, further utilization of land can be much more demanding.

Relieving this series of problems requires urgent and effective measures, treating wastewater, restoring vegetation included.

2. Costs Model

Traditionally, the majority of land use projects are prone to solely take their private costs into account, neglecting the ensuing ecosystem costs. Ecological environment is a publicly-owned resource, which means, everyone can get access to make use of it. Concerning that one's exploitation of shared resources equates to others' loss of them, we should contemplate the land-use costs issues in the context of society. In addition, the profits of a project comprises two parts in general, one is direct profit, the other is ecosystem service value that can't be measured directly. We propose an ecological services valuation model so as to assess the cost-benefit ratio of land-use projects.

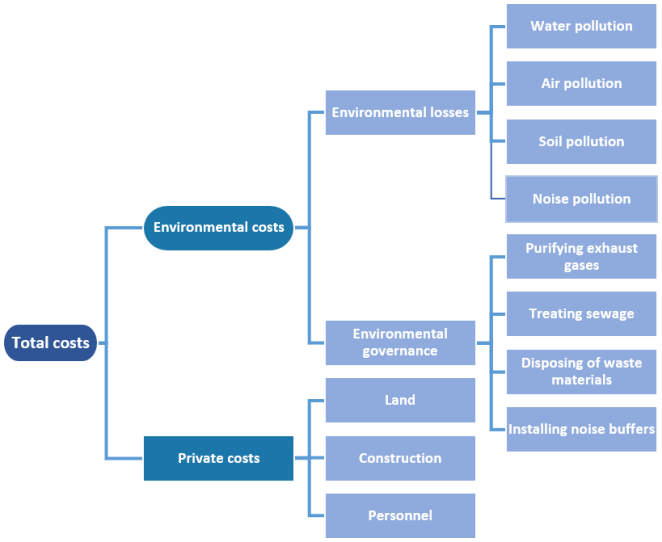

Figure 1 The Total Costs

In our model, We divide true economic costs into private costs $C_{private}$ and environ- mental costs C_{env}. Concretely, the private costs C_{env} consist of land costs C_{land}, con- struction costs C_{build} and personnel costs C_{labor}. The environmental costs C_{env} consist of environmental governance fees and environmental losses. The concrete indicators and the structure are shown in Figure 1. Specifically, we quantify the components of environmental losses in monetary units, which will be conducive for us to quantitatively comprehend the severity of environmental pollution. In this way, we can get the true economic costs of land use projects

3. Benefits Model

The fuzzy comprehensive evaluation method,aiming at properly evaluating objects that are restricted by multiple factors, quantifies and appraises the factors with unclear boundaries comprehensively.

We use A_1 to represent the economic benefits, which refer to the cost-benefit ratio of the project. The higher A_1 is, the more the contribution of the land use project to the local economic development is. We use A_2 to represent the social benefits, which refer to degrees of the residents'satisfaction towards the project. It's a qualitative indicator, yet we can perform quantitative analysis of it by surveying residents. The score ranges from 0(very dissatisfied) to 10(very satisfied). The higher the score , the better the impact on the local social environment .A_3 for the ecological benefitswhich refer to the ratio of governance fees to the environmental losses caused by the project. The higher the governance fees are, the less the environmental losses are.Subsequently, we have:

$$u = [A_1, A_2, A_3]$$
$$v = [V_1, V_2, V_3, V_4]$$

Where we let u,v represent the factor set and the judgement set,V_1,V_2,V_3,V_4 represent excellent, good, average,fair,poor.In order to facilitate the later calculation of the score, each Vi is assigned a value. Then we define the score vector P=[3,2,1,0].We apply the AHP method to determine the weight of each indicator.AHP is a comprehensive decision-making method that combines qualitative and quantitative analysis closely.

With the increasing shortage of resources and the deterioration of the ecosystem Our cost-benefit evaluation system is different from previous ones that emphasize economic benefits. We reckon that ecological benefits have a great effect on regional sustainable development.

We obtain the following result:

$$w_1 = 0.3108$$
$$w_2 = 0.1958$$
$$w3 = 0.4934$$

The weight of ecological benefits is greater than that of economic benefits and social benefits, reflecting the significance of the ecological benefits to our cost benefit evaluation system.We can make a single-factor fuzzy evaluation of the three indicators, and establish the fuzzy relation matrix R by refering to the resident representative's evaluation score or expert's score.After a comprehensive evaluation, we have the equation:

$$B = A * R$$

Where B represents the degree of subordination,A the weight vector and R the fuzzy relational matrix. We use b_j to denote the degree of subordination of the rated object to the evaluation grade V_j. In the light of the maximum membership degree principle,we have:

$$b_i(x_0) = max(b_1(x_0), b_2(x_0), \ldots b_n(x_0))$$

Then x_0 is subordinate to V_i, we can obtain the integrated score:

$$S = B * P^T$$

Where S represents the score, B the degree of subordination,P the score vector and T the transposition symbol.

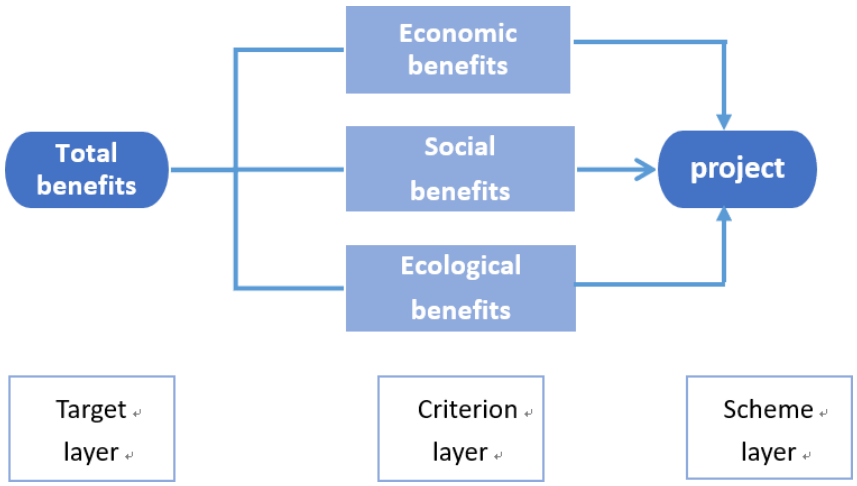

Figure 2 The AHP Structure

4. Conclusion

With the advent of high-speed developing technology and productivity, people find it a lot easier to utilize land resources. In the meantime, comprehending the consequent environmental problems has never been more crucial than it is today. Our evaluation model is based on the principle that we should give priority to ecological environment, emphasizing the significance of ecological benefits. In addition, it meets the requirement of green economic development under current environmental situation.

References

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