

# Key Influencing Factors Identification of the Urban and Rural Environmental Injustice Problems based on Fuzzy Analytic Hierarchy Process (FAHP)

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**Abstract.** In the society of sustainable development and the integration of urban and rural economic, the urban and rural economic and environmental gap has been more and more attention. How to solve the gap between urban and rural environment is a key step in building a sustainable society. In this paper, the factors affecting the gap of urban and rural environment are identified through literature analysis. Based on Fuzzy Analytic Hierarchy Process (FAHP), the identification model of the key influencing factors of urban and rural environment gap was established. It provides a reference for identifying the key influencing factors of the urban and rural environment gap, reducing the gap between the urban and rural areas and constructing the harmonious and society.

## 1. Introduction

In China, the rapid economic development has raised the standard of living of the people and caused environmental pollution problems. Nowadays, due to some reasons that are the unbalanced economic development between urban and rural areas, the unequal investment in environmental protection and the differences in environmental awareness among urban and rural areas, and so on, which makes the situation of environmental pollution unsightly. [1] Foreign researches on the injustice of the environment are earlier than China. The researches have focused on the environmental risks posed to groups in some countries and regions where have ethnic conflicts and ethnic conflicts. [2] In China, the urban-rural environment between the developed areas and the backward areas is mainly caused by some reasons that are imbalances in regional development, urban-rural dual structure and so on. The unfair environmental problems between urban and rural areas have seriously hampered China's economic development and people's living standards. If not resolve, they will trigger even more serious social problems. In this paper, through questionnaire and literature analysis of the factors that cause urban and rural environment unfair carding. Using FAHP to classify the factors that cause the unfairness of urban-rural environment and screen out the important factors to provide reference for the governance of unfair urban and rural environment.

As the Chinese people's living standards improve, people pay more and more attention to the living environment. In advocating the construction of environmentally friendly cities, eco-cities, energy-saving cities and the sustainable development of the city, the urban environment has indeed been greatly improved. However, the environment in rural areas is deteriorating day by day, and

peasants whose health and safety are being endangered more and more. The unfair environment between urban and rural areas has become a major obstacle to the coordinated development of urban and rural areas. [3] Many scholars have also studied the issue of injustice in urban and rural areas. According to the definition of environmental equality, Qian proposed that environmental equity should become the basic idea of rural environmental protection law. [4] Jin pointed out that we can achieve urban and rural environmental justice by resolving the urban-centrism in our environmental law, realizing the equal political, economic and social rights of urban and rural residents and guaranteeing the peasants' rights. [5] Shi et al. commented on the phenomenon of urban and rural pollution transfer and attempted to find a legal countermeasure to prevent and control unreasonable urban and rural pollution transfer from the legal point of view. [6] He pointed out that the injustice of China's environmental rights and interests are inextricably linked with some factors that are the development model based on comparative advantages of resource endowments, the special stage of the ternary economic structure, the environmental injustice of market failure and market mechanism, the public participation in the plight of public policies. [7] Peng analyzed the deep-rooted causes of urban and rural environmental injustice and tried to build a fair environment in contemporary urban and rural areas. [8] From the perspective of sociology, Ye explained the causes of rural pollution problems with the dual structure of urban and rural areas and the unfairness of the environment, and put forward corresponding prevention and control policies. [9] Wei analyzed the current situation of urban-rural pollution transfer in China with a large amount of data and examples, and summarized its harm. [10] Wang explored the balance of urban and rural environment through the analysis of the problem of rural environmental protection to show the imbalance of urban and rural environment in China. [11] Yang et al. started from China's current rural environmental management status, comparative analysis of urban and rural dual system structure led to the difference of management system. [12] Based on the unfairness of the environment in China, Wen analyzed the deviation of the current environmental policy on the value of environmental justice. [13]

## 2. Factors affecting the urban and rural environment

Based on questionnaire and literature analysis, the factors that cause urban and rural environmental injustice are identified and classified

A total of 86 valid questionnaires were obtained by filling in the questionnaires on site, of which 32.4% were over the age of 30, 67.6% were from 20 to 30 years old, 16.4% had doctoral degrees, 68.3% were master's degree students and 15.3% had bachelor's degree students. A total of 21 kinds of factors that affect the unfairness of urban and rural environment identified in the questionnaire and the literature are classified into 6 categories according to their attributes:

(1) Conceptual gaps. Concept gap refers to the gap between urban and rural residents in environmental awareness which caused different levels of environmental protection concerns, different understanding of the harm of environmental damage and the importance of environmental protection. That eventually led to a conscious discretion in participating in environmental protection. [1]

(2) Political gaps. The current policy system was established on the basis of the serious urban industrial pollution that took place in the process of modernization. Although it is striving for comprehensive policies, the dual structure in urban and rural areas has caused the duality of environmental protection policies.

(3) Social Causes. It mainly includes the apportionment of environmental pollution costs. The cost of environmental pollution is generally transferred to the under-classes (most rural residents), the economic income gap between urban and rural residents, and the unfair environmental rights and interests brought about by the allocation of urban and rural environmental resources, and so on.

(4) Economic reasons. It mainly includes the unbalanced economic development in urban and rural areas, the related costs of urban garbage disposal and transfer, the pollution treatment cost of

enterprises.

(5) Legal proceedings. Procedural justice means that the content of legislation and decision-making is fair and carries out the principles of non-discrimination and the evaluation of values. [14] In China, the legislative procedure of environmental protection is influenced by the characteristics of industrial development and the dual structure of urban and rural areas. The legislation and punishments of urban environmental protection are obviously superior to those of rural areas.

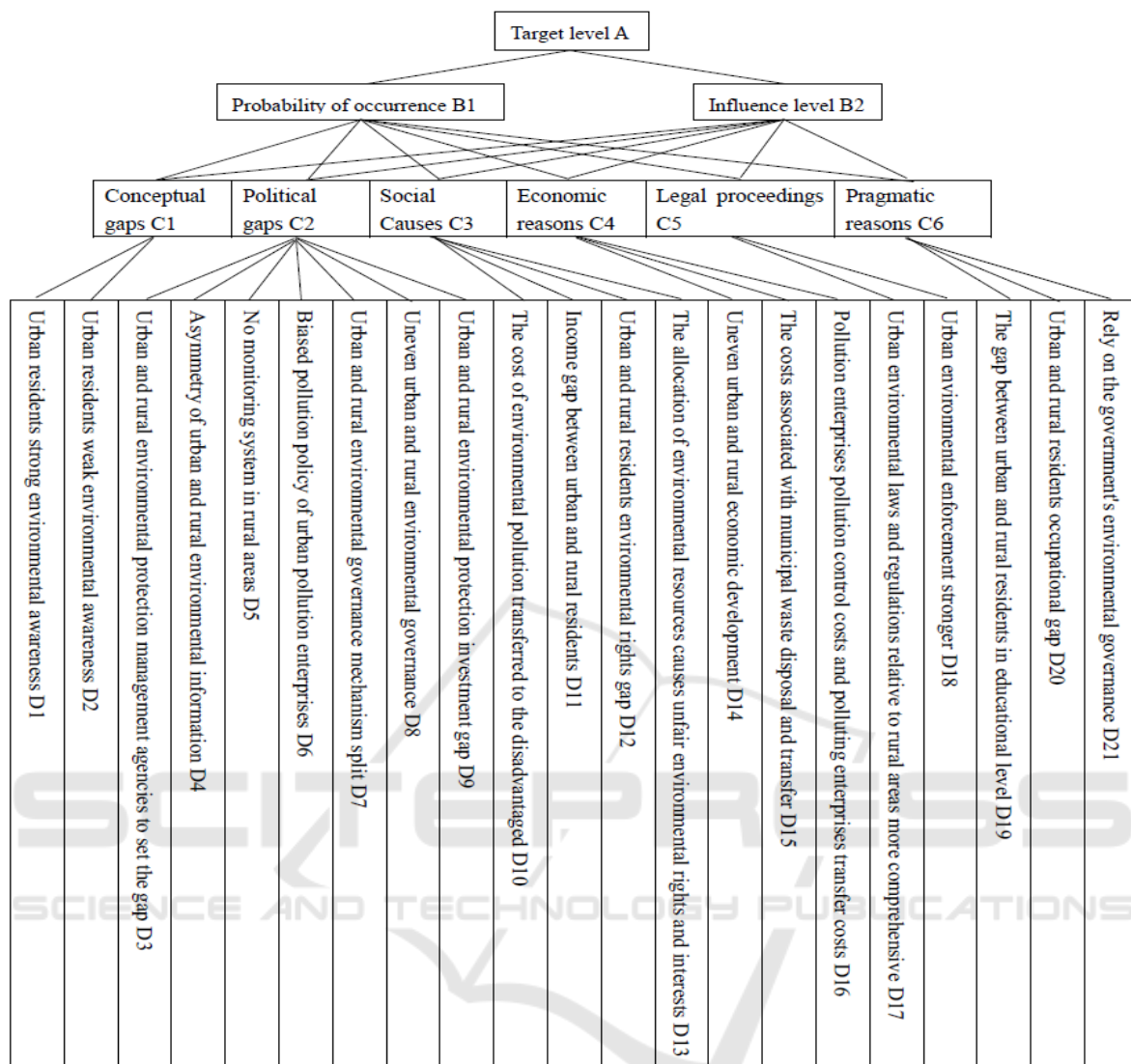
(6) Pragmatic reasons. It is mainly reflected that urban elites occupy an overall predominance position in environmental discourse rights, making it difficult for rural residents to realize the existence of environmental justice problems in urban and rural areas, education gaps between urban and rural residents, job gaps between urban and rural residents, relying solely on government environmental governance.

### **3. Model establishment and analysis**

#### *3.1. Hierarchical model establishment*

This paper identifies and classifies the factors which affect the unfairness of urban and rural environment by questionnaire and literature analysis, and then establishes the AHP model of urban and rural environmental injustice (A). Figure 1 is an AHP model of the influencing factors of urban and rural environmental injustice.





**Figure 1.** AHP model of the influencing factors of urban and rural environmental injustice

### 3.2. Survey design

Through the questionnaire and literature identified 21 kinds of factors that affect the unfairness of urban and rural environment to establish a hierarchical model, and then scale according to the nine scale of the factors were scored. (Table 1). Experts compare the factors of C layer and D layer, and then scoring according to their relative importance to get the corresponding fuzzy complementary judgment matrix.

**Table 1.** Nine scales numerical scale.

Scale	Definition
0.5	Equally important
0.6	Slightly important
0.7	Obviously important
0.8	Much more important
0.9	Extremely important
0.1-0.4	Contrary to the above

3.3. Construct fuzzy complementary judgment matrix and test consistency

Through expert analysis and comparison of six factors of layer C, scoring is conducted according to the method of nine scales numerical scale to obtain fuzzy complementary judgment matrixes B1 and B2.

$$B1 = \begin{bmatrix} 0.5 & 0.4 & 0.6 & 0.6 & 0.3 & 0.4 \\ 0.6 & 0.5 & 0.5 & 0.8 & 0.2 & 0.3 \\ 0.4 & 0.5 & 0.5 & 0.6 & 0.6 & 0.5 \\ 0.4 & 0.2 & 0.4 & 0.5 & 0.1 & 0.2 \\ 0.7 & 0.8 & 0.4 & 0.9 & 0.5 & 0.8 \\ 0.6 & 0.7 & 0.5 & 0.8 & 0.2 & 0.5 \end{bmatrix} \quad B2 = \begin{bmatrix} 0.5 & 0.6 & 0.2 & 0.1 & 0.2 & 0.5 \\ 0.6 & 0.5 & 0.4 & 0.6 & 0.5 & 0.7 \\ 0.8 & 0.6 & 0.5 & 0.8 & 0.8 & 0.6 \\ 0.9 & 0.4 & 0.2 & 0.5 & 0.5 & 0.5 \\ 0.8 & 0.5 & 0.2 & 0.5 & 0.5 & 0.8 \\ 0.5 & 0.3 & 0.4 & 0.5 & 0.2 & 0.5 \end{bmatrix}$$

Let the above matrix be  $B = (b_{ij})_{n \times n}$ , and sum the lines of the B1 and B2 matrices as follows:

$$t = \sum_{k=1}^n b_{ik} \tag{1}$$

The equation (1) is transformed according to the equation (2):

$$t_{ij} = \frac{t_i - t_j}{2(n - 1)} + 0.5 \tag{2}$$

The fuzzy consistency matrix  $T = (t_{ij})_{n \times n}$  is obtained and normalized according to the equation (3) to obtain the factor ordering vector  $V = (V_1, V_2, V_3, \dots, V_n)^T$ . The proof process of equation (3) is detailed in the reference. [15]

$$V_i = \frac{\sum_{j=1}^n b_{ij} - 1 + \frac{n}{2}}{n(n - 1)} \quad (i = 1, 2, 3, \dots, n) \tag{3}$$

Get the weight vector of matrix B1 and B2:

$$VB1 = (0.1600 \quad 0.1633 \quad 0.1700 \quad 0.1267 \quad 0.2033 \quad 0.1767)$$

$$VB2 = (0.1367 \quad 0.1767 \quad 0.2033 \quad 0.1667 \quad 0.1767 \quad 0.1467)$$

Let  $V_{ij} = \frac{V_i}{V_i + V_j}$  ( $j = 1, 2, 3, \dots, n$ ), Then determine the characteristic matrix of matrix B is  $V^* = (V_{ij})_{n \times n}$ .

According to equation (4), calculate the compatibility between the complementary judgment matrix and its feature matrix of  $V^*B_1$  and  $V^*B_2$ .

$$I(B, V^*B) = \frac{1}{n^2} \sum_{i=1}^n \sum_{j=1}^n |b_{ij} + V_{ij} - 1| \tag{4}$$

According to the above equation,  $I(B1, V^*B1) = 0.0875$

Since the above compatibility indices are all smaller than  $\alpha$  ( $\alpha$  is 0.1) [16], it is considered that the weight distribution of B1 and B2 is reasonable. According to the same method, the complementary fuzzy judgment matrixes of target layer A and C layer can be established and their respective weight vectors can be calculated. The same method to calculate the compatibility of each complementary judgment matrix and its characteristic matrix is less than  $\alpha$  ( $\alpha$  take 0.1), so we can show the rationality of the weight vector.

### 3.4. Sort of factors

From the calculated complementary judgment matrix and the weight vector of its eigenmatrix, the relative weight values of the elements in the level relative to the previous level factors can be obtained. And the corresponding weight values can be correspondingly labeled in the established level mode.

Sort the vectors according to the importance of the probability of occurrence B1:

$$WB_1 = (0.096, 0.064, 0.0224, 0.024, 0.0224, 0.0288, 0.016, 0.0208, 0.0256, 0.0442, 0.0391, 0.0476, 0.0391, 0.0325, 0.0481, 0.0494, 0.09, 0.11, 0.054, 0.054, 0.072)$$

To sum up, get the vector of factors that affect the unfairness of urban and rural economy:

$$W = (0.0894, 0.0574, 0.02394, 0.02565, 0.02394, 0.03078, 0.0171, 0.02223, 0.02736, 0.04519, 0.046195, 0.05222, 0.042895, 0.038, 0.05624, 0.05776, 0.08505, 0.10395, 0.04905, 0.04905, 0.0654)$$

### 3.5. Results Analysis and Suggestions

According to the result of calculation, to get the order of importance of each factor under different categories. According to the frequency of influencing factors, the key influencing factors are stronger urban environmental law enforcement, urban residents have stronger awareness of environmental protection, urban environmental laws and regulations are more comprehensive, etc. According to the degree of influence, the key factor is that urban environmental law enforcement is stronger, urban residents have a stronger environmental awareness, urban environmental laws and regulations are more comprehensive, etc. Considering the occurrence frequency and influence degree, the key factor is that urban environmental protection law enforcement is stronger, urban environmental laws and regulations are more comprehensive, urban residents have strong environmental awareness, etc.

## 4. Conclusions

This paper identifies 21 kinds of factors that affect urban and rural environmental injustice through questionnaire and literature analysis. According to different categories, the factors are divided into 6 categories, which are sorted by fuzzy analytic hierarchy process under different standards. Finally get the key factors that affect urban and rural environmental injustice under different standards. All regions can also set the weight reasonably according to the local conditions so as to identify the key influencing factors for urban and rural environmental injustice that is suitable for the region so as to make targeted decisions and suggestions.

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