Evaluation Model of Residents' Waste Classification Participation Degree Based on Investigation in Changzhi City

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Abstract. Source waste separation can greatly reduce the cost of solid waste treatment and disposal, and has considerable economic value. However, there are many kinds of domestic waste and their composition is complicated, which makes it difficult for residents to participate in it. As a collective behaviour of public participation, the difficulty of its existence can test the level of the role played by all participants. Therefore, based on the field research and literature comparison of Changzhi City, this paper establishes the analytic hierarchy process (AHP) evaluation model, and takes residents, government and market as the main participants to evaluate the classified participation of residents' garbage, and puts forward some suggestions to provide the basis for policy decision-making of public management in the field of environment.

1. Status Quo of Waste Classification and Evaluation Models
Xu Lin[1] and others divided the influencing factors of waste classification participation into three aspects: waste classification policy, psychological level and individual background characteristics to establish a model, and reached the conclusion that priority should be given to enhancing residents' sense of value and mission through propaganda, so as to guide residents to consciously and voluntarily carry out waste classification. Liu Jintaot[2] established a fuzzy comprehensive evaluation model of waste classification and collection in residential areas by using fuzzy comprehensive evaluation and analytic hierarchy process, and gave some suggestions by taking Baoan District of Shenzhen as a case. Elegant[3] The entropy weight method is used to determine the index weight, and matter-element model is used to evaluate the classified collection mode of municipal solid waste in residential areas. Xiaoyan Meng[4] and others analyzed the structural equation modeling method based on the survey data of 709 residents in Suzhou, China, the main factors influencing residents' high-speed rail disposal behavior and the degree of influence, and discussed the decision-making mechanism. Subbasish Das[5] established the LCA model and evaluated it in terms of economy and environment.

2. Status Quo of Changzhi Waste Classification
In order to promote 24 pilot projects of municipal solid waste classification in urban areas, the government of the former municipal solid waste classification committee and district of Changzhi City (now Luzhou District, hereinafter collectively referred to as the Urban District) formulated and issued the Implementation Plan for Municipal Solid Waste Classification, Treatment and Recycling
(hereinafter referred to as the Plan) in April 2018. According to the characteristics of the composition and the main body of domestic waste, the "4 +2" classification method is implemented, and the quartering method is adopted in the pilot plot and the pilot school, which is divided into recyclable waste, hazardous waste, wet waste and other waste. The pilot organs, enterprises and institutions, and public places shall adopt the dichotomy method and be divided into recyclable materials and other rubbish. According to the data statistics of July 2018 of the former Urban Environmental Sanitation Department of Changzhi City (now Luzhou Urban Environmental Sanitation Department, hereinafter collectively referred to as Urban Environmental Sanitation Department), the awareness rate of classification of domestic waste in each pilot area of Changzhi City is over 90%, and the participation rate is over 80%. The accuracy rate of the pilot residential areas at the source is more than 60%, the accuracy rate of the second sorting is more than 80%, and the accuracy rate of the pilot farmers market, hotels and supermarkets at the source is more than 85%. Garbage sorting pilot involves government agencies, schools, various residential areas, vegetable farms and other places.

3. Model of household waste classification participation

The community is the basic unit of waste classification, and because of the strong correlation between the participation in waste classification and the participants, according to the characteristics of the residents, we can roughly divide the community into enterprise community, government unit community, village in the city, medium and low-grade commercial housing, high-grade commercial housing. Among them, the commercial housing district has the characteristics of complex personnel and weak kinship.

This model is based on the way that participants participate in waste classification. Participants are divided into participants, government and market to establish a first-class index. According to different types of residential areas, representative residential areas were selected in Changzhi City for field research. Such as Aoruite Community, Xinfuyuan Community, Municipal Committee Family Courtyard, Zijin Leader Community and so on. The participation of each district was compared with the characteristics of the population, and the individual intention index was obtained; The policies of Changzhi government are compared with other local governments, and the government management indexes are obtained by querying the literatures. In the aspect of market participation, the main selling points of the existing garbage sorted products and the evaluation model of general science and technology products are used to determine the indicators. The establishment of specific indicators is shown in Figure 1.
3.1. Establishment of individual will indicators
Participants' participation in garbage sorting can be divided into two steps: the first step is the generation of willingness to participate, and the second step is the transformation from willingness to participate. The transformation from willingness to participate to participation depends on certain objective external conditions, such as the supporting municipal treatment system, the time and manner of sorting and releasing garbage, the convenience of releasing equipment and so on. The objective external conditions belong to the government's infrastructure and policy system, as well as the development of equipment in the market and so on. The second step is not included in the participants' indicator system. The generation of willingness to participate can be divided into background impact and subjective initiative impetus, the background impact indicators are age, gender, education, personal income, the proportion of leisure time due to occupation included, a total of five indicators. Subjective motivation, as an individual psychological characteristic, can be divided into three indexes: environmental awareness, policy awareness and environmental constraint awareness.

3.2. Establishment of government management indicators
Many scholars believe that the government plays a leading role in the promotion of waste sorting, and its main guiding influence can be divided into four aspects: policy-making, publicity and education, hardware facilities and organization equipment, which are divided into 11 secondary indicators combined with the investigation.

The policy system corresponds to the policy perception in individual psychology, which is divided into incentive measure attractiveness and punishment measure deterrence, incentive measure attractiveness is the correlation between incentive material value and the number of participants, punishment measure deterrence is the amount of fines, and the time taken to accept punishment is the correlation between the number of participants.
The propaganda and education is divided into channel diversity, propaganda content responsiveness, propaganda duration and classified knowledge acquisition cheapness. The channel diversity refers to the coverage rate of propaganda channel to the age group according to the different channels of receiving information in different age groups; The response degree of propaganda content is the degree of correspondence between propaganda content and the main knowledge acquisition ways preferred by residents. The duration of the campaign is the duration of the campaign in which a form or content of the campaign has been brought to the attention of the population so that it no longer produces a campaign effect; The rate at which classified knowledge is obtained cheaply to generate propaganda benefits for different propaganda approaches.

Hardware facilities involve the quantity of unit hardware and the cheapness of hardware sites. The quantity of unit hardware refers to the number of rubbish bins per unit area in a community, which reflects the distribution density of rubbish bins. Hardware location cheapness refers to the location of fixed-point trash cans and trash cans that can be placed all day long, which is convenient for residents to put trash into the trash cans every day.

Organizational staffing is divided into the number of personnel, the capacity and enthusiasm of personnel, and the suitability of supervision mode. According to the actual situation of each district, different numbers of supervisors and instructors will be provided beside each rubbish bin in each district to supervise and guide the waste classification. The number of personnel provided is one of the factors influencing the waste classification; In some pilot areas, it is found that supervisors and instructors' professional ability is not up to standard or their working enthusiasm is not high, which will also lead to the lack of residents' participation. The suitability of supervision mode is the adaptability of supervision and management mode of a certain region or a certain district to that region or that district.

3.3. Establishment of market participation indicators

The promotion of waste classification in the market provides products, the price of scientific and technological equipment and the comprehensive benefit of scientific and technological equipment are the influencing factors of household waste classification participation.

The price of scientific and technological equipment refers to the market price of classified garbage cans and other intelligent scientific and technological equipment, which affects the application of scientific and technological equipment in various residential areas, such as high-grade residential areas widely used but in the village or even the general community may have a low penetration rate.

The comprehensive benefit of sci-tech equipment can be divided into three aspects: classification behavior cheapness, incentive measures assistance benefit and publicity and education assistance benefit. Classification behavior cheapness refers to the reasonable degree of design of intelligent equipment for waste classification, such as whether it is convenient for residents to put in, whether the operation method is easy to understand, and so on. Incentive measures refer to the self-service points of the intelligent rubbish bins currently in use at each time they are put into use. When the points reach a certain value, residents can exchange the self-service points at the prize exchange machine attached to the rubbish bin, which is similar to the beverage self-service vending machine. The effectiveness of publicity and education assistance is the audience range of the publicity pages carried by the technology products themselves.

3.4. Determination of indicator weights

The evaluation matrix shall be filled in by 7 relevant experts who are from vice chairman of the trade union of Changzhi City Environmental Sanitation Department, College of Environmental Engineering, Taiyuan University of Technology, College of Marxism, Taiyuan University of Technology, College of Politics and Law, Taiyuan University of Technology. Matlab program is used to calculate the weight of the second-level index corresponding to the first-level index, and check its consistency. The result is shown in Figure 2.
By multiplying the weight coefficients step by step, we can get the influence degree of different levels and different influence factors on the participation degree of household waste classification.

**Table 1.** Weights at various levels.

| Hierarchy C | A1 | A2 | A3 | The weight of each index relative to S |
|-------------|----|----|----|-------------------------------------|
| B1 | 0.318 | 0.587 | 0.273 | 0.14 | 0.032416 |
| B2 | 0.682 | 0.682 | 0.273 | 0.14 | 0.036176 |
| B3 | 0.36 | 0.201 | 0.273 | 0.14 | 0.028943 |
| B4 | 0.201 | 0.254 | 0.273 | 0.14 | 0.068933 |
| B5 | 0.254 | 0.184 | 0.273 | 0.14 | 0.020171 |
| B6 | 0.184 | 0.547 | 0.273 | 0.14 | 0.25836 |
| B7 | 0.547 | 0.453 | 0.273 | 0.14 | 0.066408 |
| C1 | 0.174 | 0.174 | 0.174 | 0.174 | 0.07562 |
| C2 | 0.194 | 0.194 | 0.194 | 0.194 | 0.060461 |
| C3 | 0.155 | 0.155 | 0.155 | 0.155 | 0.037996 |
| C4 | 0.369 | 0.369 | 0.369 | 0.369 | 0.017205 |
| C5 | 0.108 | 0.108 | 0.108 | 0.108 | 0.017574 |
| C6 | 0.645 | 0.645 | 0.645 | 0.645 | 0.010022 |
| C7 | 0.166 | 0.166 | 0.166 | 0.166 | 0.010174 |
| C8 | 0.189 | 0.189 | 0.189 | 0.189 | 0.010461 |
| C9 | 0.614 | 0.614 | 0.614 | 0.614 | 0.037996 |
| C10 | 0.386 | 0.386 | 0.386 | 0.386 | 0.017205 |
| C11 | 0.312 | 0.312 | 0.312 | 0.312 | 0.017574 |
| C12 | 0.32 | 0.32 | 0.32 | 0.32 | 0.010022 |
| C13 | 0.182 | 0.182 | 0.182 | 0.182 | 0.010174 |
| C14 | 0.185 | 0.185 | 0.185 | 0.185 | 0.010461 |
| C15 | 0.425 | 0.425 | 0.425 | 0.425 | 0.037996 |
| C16 | 0.575 | 0.575 | 0.575 | 0.575 | 0.017205 |
| C17 | 0.372 | 0.372 | 0.372 | 0.372 | 0.017574 |
| C18 | 0.398 | 0.398 | 0.398 | 0.398 | 0.010022 |
| C19 | 0.23 | 0.23 | 0.23 | 0.23 | 0.010174 |
| C20 | 1 | 1 | 1 | 1 | 0.010461 |
| C21 | 0.415 | 0.415 | 0.415 | 0.415 | 0.026362 |
| C22 | 0.328 | 0.328 | 0.328 | 0.328 | 0.02081 |
| C23 | 0.357 | 0.357 | 0.357 | 0.357 | 0.016303 |
4. Conclusion Conclusions and recommendations

Conclusion and Suggestion Through the weight of each index, it can be found that individual psychology, i.e. Subjective initiative, is the key for residents to participate in garbage sorting, in which the consciousness of active participation in environmental protection is much higher than that of policy and environmental constraints. Therefore, the cultivation and education of environmental protection awareness should be more popular among residents, especially for primary and secondary school students of environmental protection theme education should be put in the first place. Secondly, the conclusion can be drawn that it is easier to carry out waste classification in residential areas with strong affinity and maturity relationship if the perceived weight of environmental constraints is higher. For government departments to carry out waste separation, incentives and punishment measures and the convenience of hardware facilities will be the main reason to drive residents to participate in waste separation, which should be considered by government departments. If the market wants to develop technology products related to waste separation, the research and development direction should be to reduce costs rather than further improve efficiency under the premise of ensuring certain efficiency.

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