Calculation of common evaluation indexes for heritage evaluation of water conservancy projects

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Abstract. In this article, through further study of water conservancy engineering heritage, compiled a set of system of water conservancy engineering heritage research evaluation methods, namely analytic hierarchy process (AHP) method combined with the Delphi evaluation, through this research, hope that through quantifiable data model and offer reference for evaluation of the water conservancy engineering heritage. Thus, the system protection, effective management and rational utilization of water conservancy heritage can be better promoted.

1. Introduction
Water conservancy project is related to the well-being and health of the local people. It has the characteristics of promoting benefits and eliminating harms, establishing industries and benefiting the people, integrating peace and state, ecological landscape, inheritance and sustainability, etc.,[1] and has always been in a very important position. Only by reasonable evaluation and effective protection of the water conservancy heritage can we make the best use of the water conservancy heritage, which is the crystallization of the wisdom of the ancients, and let the wisdom of the ancients give full play to the light and heat. Since ancient times, the construction of water conservancy projects in China has been developing continuously, and many world-renowned irrigation heritages have emerged in succession. They are characterized by diverse types of projects, outstanding irrigation benefits and wide distribution range, appearing in different geomorphological backgrounds with different types of projects.

In recent decades, with the large-scale construction of modern water conservancy and the rapid development of economy and society, a large number of ancient water conservancy projects have been destroyed, abandoned or replaced by new projects. Although the sustainable utilization and reasonable protection of ancient water conservancy projects and water cultural heritage have received attention from all sides since entering the 21st century, the sharp conflict between constructive destruction and protection still exists [2]. It is urgent for us to evaluate the conservation value of these water conservancy heritages so as to carry out reasonable and effective protection.

2. Establishment of evaluation system
In the traditional heritage resource evaluation, qualitative research is often used, and the process of drawing conclusions is inevitably affected by subjective factors, so the results are often regarded as unbelievable. Because of the various forms of water conservancy engineering heritage, simple qualitative analysis is not enough to carry out accurate and systematic analysis, and simple quantitative analysis cannot analyze the current situation and problems of water conservancy heritage.
Therefore, the comprehensive analysis method should be adopted for the evaluation and analysis of the heritage of water conservancy projects. Based on the combination of qualitative and quantitative methods, it is more appropriate to adopt analytic hierarchy process combined with Delphi method to carry out comprehensive evaluation of heritage resources[3]. The comprehensive evaluation index of the water conservancy project is finally determined after empirical research and repeated argumentation by comprehensively referring to the sample scoring table of the evaluation of the national water conservancy project heritage and combining with the characteristics of the local water conservancy project and consulting the opinions of relevant experts. Indicators can be divided into three levels: target layer, criterion layer and indicator layer.

2.1. Building a hierarchical model
The evaluation of the heritage value of water conservancy projects is divided into three levels. Heritage value, preservation status and management status are the target layer of the evaluation project (A layer); Historical value, scientific and technological value, ecological value, economic value, social value, cultural value, authenticity of preservation status, integrity of preservation status, sustainability, management system, management planning, heritage monitoring, public participation as the criterion layer (B layer); The 35 factors, such as time-honored degree, witness degree and popularity, are the indicator layer (C layer), as shown in the table.

| Table 1. Water conservancy project heritage value evaluation table. |
|---|---|---|
| evaluation project | criterion layer | indicator layer |
| | | evaluation index | Assign points | score |
| heritage value | Historical value | time-honored degree |  |
| | | witness degree |  |
| | | popularity |  |
| | scientific and technological value | Basic science |  |
| | | planning thought |  |
| | | Engineering technology |  |
| | | engineering management |  |
| | | technology exchange |  |
| ecological value | Ecological concept |  |
| | ecological maintenance |  |
| | environmental improvement |  |
| economic value | national development |  |
| | Regional development |  |
| social value | Popular science education |  |
| | propaganda and communication |  |
| | memory and emotion |  |
| cultural value | Cultural diversity |  |
| | non-material culture |  |
| preservation status | authenticity of preservation status | Heritage ontology |  |
| | technology |  |
| | information sources, |  |
| | environmental places |  |
2.2. Construction of judgment matrix
Judgment matrix is the judgment of the relative importance of each element in the upper level. It is an important link to convert the unmeasurable factors into objective values after introducing reasonable measurement scale. In this paper, scale method of AHP model 1-9 was adopted, as shown in the figure.

| Scale | Implication                                      |
|-------|-------------------------------------------------|
| 1     | The two factors are equally important            |
| 3     | One factor is slightly important than the other  |
| 5     | One factor is more important than the other      |
| 7     | One factor is highly important than the other    |
| 9     | One factor is extremely important than the other  |

(2, 4, 6, and 8 are the intermediate values of two adjacent judgments, indicating that a discount value should be taken between the above two criteria.) The importance of each index is scored according to the importance scale of AHP1-9.

In order to ensure reasonable water conservancy heritage evaluation system, this paper USES the Delphi method, namely selected a group of experts in the field of water conservancy project, sent you selected experts in communication way for evaluation of water conservancy project information and evaluation consult expert advice, after being returned expert, observes, anonymous feedback to each expert, again again for advice, then concentrate, feedback, again until you get the consensus of opinion, the judgment matrix are obtained.

Judgment matrix weighting algorithm from the upper elements, then in turn based on top of the elements, for the next two layer elements, to establish judgment matrix (there are a few guidelines have several judgement matrix), the amount of the priority of each element of judgment matrix is calculated again, first calculate the NTH root of the product of all the various elements (n = the number of judgment matrix), secondly, the above calculation results orthogonalization, namely the above together first, and then divided by the number of each, in this way, you get the priority vector.
2.3. Consistency check

2.3.1. Start by calculating the product $AW$ of square $A$ (the judgment matrix) and the matrix $W$ (the matrix of weights)

2.3.2. Then calculate the maximum characteristic root $\lambda_{\text{max}}$

$$\lambda_{\text{max}} = \frac{1}{n} \sum_{i=1}^{n} \left( \frac{(AW)_{ii}}{w_i} \right)$$

2.3.3. Calculate CI and CR.

$$CI = \frac{\lambda_{\text{max}} - n}{n - 1}$$

Where $\lambda_{\text{max}}$ is the maximum eigenvalue; $n$ is the order of the matrix.

$CI = 0$, complete consistency; $CI$ is close to 0, there is a satisfactory consistency; The larger the CI, the more serious the inconsistency.

Table 3. The order of the matrix corresponds to the RI exponent.

| The matrix order $n$ | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  |
|---------------------|----|----|----|----|----|----|----|----|
| RI                  | 0  | 0  | 0.58 | 0.90 | 1.12 | 1.26 | 1.32 | 1.41 |

$$CR = \frac{CI}{RI}$$

When the random consistency ratio CR is less than 0.1, the consistency of judgment matrix is considered satisfactory. When CR is greater than or equal to 0.1, the judgment matrix needs to be adjusted until the corresponding requirements are met.

3. Conclusion

In this paper, combined with relevant references, the analytic hierarchy process and Delphi method are used to construct the evaluation model of water conservancy project heritage. The main influencing factors include heritage value, preservation status and management status. The quantitative data can be obtained through the evaluation model of water conservancy project heritage, which can directly reflect the value of water conservancy project heritage[4]. This study is only a basis for the evaluation of the heritage of water conservancy projects. It is hoped that the quantifiable data model can provide reference for the evaluation of the heritage of water conservancy projects. Thus, the system protection, effective management and rational utilization of water conservancy heritage can be better promoted[5].

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