Indicator System for Environmental Impact Assessment Of Water Resources Protection And Utilization Planning

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Abstract. The environmental impact assessment of water resources protection and utilization planning is a comprehensive assessment of the natural, economic, and social environment of the project area and its neighboring areas caused by water resources projects. The rational development and utilization of water resources, protection of ecology and the environment, and promotion of regional Sustainable development provides scientific decisions and basis. This paper analyzes the characteristics of the environmental impact assessment indicator system for water resources protection and utilization planning, points out the basic framework and principles for establishing an indicator system, proposes a specific indicator system, and clarifies the significance of each indicator.

1. Introduction
In order to rationally develop, utilize and protect water resources, prevent adverse effects on the environment after the implementation of the plan, and promote the coordinated and sustainable development of the economy, society and the environment. At the same time as the planning, the environmental impact assessment of water resources planning must be carried out. The evaluation must be objective, open and fair from a macro, strategic level, and comprehensively consider the possible impact on the various factors and the ecosystem they constitute after the implementation of the plan, and provide a scientific basis for decision-making; the establishment and improvement of the indicator system is the water environment The environmental impact assessment of protection, utilization, and planning provides the basis, and the environmental impact assessment of different projects can promote the deepening and improvement of the environmental impact assessment of water resources protection and utilization planning, thereby building a more complete evaluation indicator system. The establishment of an environmental assessment indicator system for water resources protection and utilization planning has important guiding significance for China's sustainable development of water conservancy.
2. Concept and connotation

2.1. Water protection
Water resources protection refers to legal, administrative, technical and economic measures adopted to protect the resource attributes of surface water and groundwater and to achieve sustainable use of water resources. Water connects the upstream, downstream, and the left and right banks in the basin through mobility, and links the socio-economic system with the eco-environment system through its support for the economic, social, and eco-environment systems [1]. Water quality, quantity and its ecosystem are the basic conditions for the sustainable function of water resources. Water quality, water quantity, and aquatic ecology are the organic whole of interaction and influence. Water resources protection should consider goals and needs of water quality, water quantity, and aquatic ecological protection.

2.2. Water resources planning
Water resources planning is based on guaranteeing a virtuous cycle of water resources and aquatic ecology, with the goal of realizing the continuous functioning of water resources. Based on the investigation and evaluation of water pollution, water resources, and aquatic ecology, in accordance with the principles of unified planning and coordinated management of water quality, water quantity, and aquatic ecology, consider the surface and groundwater as a whole, and formulate water conservation and protection, water pollution prevention, and aquatic ecological protection and restoration, Supervision and management of water resources protection measures. This will guide the protection and management of water resources in the near and long term [2].

2.3. Environmental Impact Assessment and Environmental Water Conservancy
The concept of Environmental Impact Assessment (EIA) was first proposed by scholars at the International Conference on Environmental Quality Assessment in 1964. China's environmental impact assessment law describes the definition of environmental impact assessment as "the environmental impact assessment referred to in this law, which refers to the analysis, prediction and assessment of environmental impacts that may be caused after the implementation of planning and construction projects, and proposes to prevent or mitigate adverse environmental impacts Countermeasures and measures, methods and systems for tracking and monitoring [3]. "

Environmental water conservancy not only solves water conservancy and environment-related issues (such as the impact of water conservancy on the environment and environmental problems caused by water damage), but also studies environmental and water conservancy-related issues (such as the impact of environmental changes on water resources, water areas and water conservancy projects). Including research and put forward the mutual requirements of environment and water conservancy, as well as countermeasures and measures to be taken to coordinate the development, utilization, governance, allocation, protection, conservation and conservation of ecological water resources to achieve the purpose of water conservancy, water pollution and environmental improvement [4].

3. Construction of environmental impact assessment indicator system for water resources protection and utilization planning
An indicator is a signal of a complex event or system. It is a set of information that reflects the characteristics of the system or shows what is happening. It is a quantitative description of certain attributes or characteristics of a certain social phenomenon. Its "language" is a number. The so-called indicator system is a scientific and complete population composed of a series of interconnected and mutually restricted indicators [5]. In planning environmental impact assessment, indicators can be used to describe, characterize, and judge the current state of the environment, predict environmental impacts, provide alternatives, and track changes in environmental quality after the implementation of the plan and its relationship with environmental protection goals. The essence of establishing an
evaluation indicator system is to establish the specific content of the environmental impact assessment of water conservancy planning. Only by establishing a series of indicators, can the environmental impact of planning behavior be predicted, monitored, evaluated, and feedback. Planning provides information support. The indicator system for environmental impact assessment of water resources protection and utilization planning reflects the internal structure, external state and development trend indicators of the regions affected by the strategy, the sustainable development system of the river basin environment, and a collection of indicators that partially reflect the status of relevant social and economic factors.

3.1. Principles for the establishment of an indicator system

The environmental impact assessment indicator system for water resources protection and utilization planning should not only reflect the leading thinking of coordinated development of economy, society, population, resources and ecological environment, but also make each evaluation indicator the most sensitive. The most convenient measurement and the most abundant leading indicators make this indicator system accurately describe the degree of environmental impact and possible impact trends in water resources protection and utilization planning [6] [7]. The following principles should be followed when determining the environmental impact assessment indicator system for water resources protection and utilization planning, [8] [9]:

1) The establishment of the indicator system should follow the systematic and scientific principles
   There is an intricate and hierarchical relationship between water resources protection and utilization planning and the ecosystem. It is necessary to determine the corresponding evaluation level, consider each evaluation indicator from the perspective of a system theory, and form a systematic evaluation indicator system. At the same time, the evaluation indicator must be based on science. On the basis of that, it truly reflects the level of the quality of the ecological environment, and each indicator must have a clear concept and clear scientific meaning. There must be internal links between the indicators and avoid duplication.

2) Sustainability
   The water environment is one of the subsystems of the ecological environment, which can provide many service functions for human beings. Reasonable development and utilization planning is the direction of sustainable use and management of water resources. The selection of evaluation indicators must follow the principle of sustainability, with the goal of achieving scientific development and sustainable use of water resources.

3) Combining stability and dynamics
   Static indicators take into account the actual production capacity and level of the system. Dynamic indicators can well reflect the succession laws of system composition, function, and benefits, predict the development trend of the system, and analyze the stability and buffer capacity of the system structure. Ability to resist external shocks. In practical application, the two should be combined to reflect the overall view of the system in which the research object is located from both vertical and horizontal perspectives.

4) Practical and operable principles
   At present, although the indicator system established in the field of water resources sustainability research is relatively complete in theory, it is not very operable. Therefore, the evaluation indicators cannot be separated from the reality of relevant data and information. The indicator system established should be simple and clear, have strong comparability, easy to obtain parameters, and be easy to calculate and analyze in order to achieve quantitative indicators and improve operability.

5) Combining qualitative and quantitative indicators principles
   Qualitative indicators can vividly describe and clarify the attribute characteristics of the research object; while quantitative indicators can improve the accuracy of evaluation. Quantitative indicators and qualitative indicators are complementary to each other. Both are indispensable. In practice, the two must be combined.

6) Indicator sensitivity and stability principle
The selection of the environmental impact assessment indicator system for water resources protection and utilization planning should be sensitive to changes in the state of the water environment, and should also have a certain stability.

(7) Unity of space and time principles

Water environment health is a dynamic concept, which refers to a certain period of time and a certain region state, which require water resources to be orderly, stable, and coordinated under the constraints of the environment, resources, and population, to prevent the instability of water environment systems and the decline of functions. Therefore, when establishing the indicator system, we must fully consider the imbalance and multi-level of regional economic and social development, and divide the economic and social development into layers and stages, and combine with the regionality of the natural ecological environment to establish The corresponding indicator system, and strive to unify space and time.

3.2. Selection of indicator system

The evaluation indicators are mainly used to describe and identify the environmental background conditions and the overall trend of environmental changes, and grasp the possible environmental impact of the implementation of the plan from a macro perspective, as an important basis for determining environmental protection goals and optimizing the planning scheme [10]. The selection of evaluation indicators should not be too detailed and too much, and factors with macro, comprehensive and regional influences should be evaluated. According to the principles for determining the evaluation indicators, a total of 38 indicators from the three aspects of water environment, ecological environment, and social environment are selected to constitute the environmental impact assessment index system for water resources protection and utilization planning. The specific indicators are shown in Table 1.

| Evaluation indicators                          | Determine method or basis                                |
|-----------------------------------------------|--------------------------------------------------------|
| $Z_1$ Water resources quantity                 | Data obtained by the water resources department survey or available |
| $Z_2$ Available water resources                | Data obtained by the water resources department survey or available |
| $Z_3$ Development and utilization of water resources | Water resources exploitation / water resources exploitation resources |
| $Z_4$ Water quality condition                  | Environmental testing data                             |
| $Z_5$ Water quality target                     | Planning regulations for water administration           |
| $Z_6$ Water function goal                      | Planning regulations for water administration           |
| $Z_7$ Water environment capacity                | Hydrological data calculation                          |
| $Z_8$ Water pollution index                    | Sewage water volume / total water volume                |
| $Z_9$ Wastewater treatment efficiency          | Sewage treatment capacity / total sewage discharge       |
| $Z_{10}$ Surface Water Modulus                 | Local surface water resources / calculated area         |
| $Z_{11}$ Groundwater recharge water modulus    | Groundwater recharge / calculated area                  |
| $Z_{12}$ Groundwater recoverable resource modulus | Groundwater recoverable resources / calculated area     |
| Ecological $Z_{13}$ Natural economic growth    | Statistics based on population changes                  |
### Environmental and Social Indicators

| Indicator | Description |
|-----------|-------------|
| $Z_{14}$ Vegetation coverage | Vegetation area / land area |
| $Z_{15}$ Soil erosion modulus | Salinized area / land area |
| $Z_{16}$ Ecologically sensitive area | On-site investigation or consultation with relevant departments |
| $Z_{17}$ Biodiversity | On-site investigation or consultation with relevant departments |
| $Z_{18}$ Fish habitat | On-site investigation or consultation with relevant departments |
| $Z_{19}$ Instream flow | Flow-based hydrology |
| $Z_{20}$ Ecological water demand | Flow-based hydrology |
| $Z_{21}$ Environmental water requirements | Flow-based hydrology |
| $Z_{22}$ Ecological and environmental water requirements | Flow-based hydrology |
| $Z_{23}$ Landscape water requirements | Consulting related departments |
| $Z_{24}$ Geolocation | GPS positioning system |
| $Z_{25}$ Economic status | Consultation with government agencies |
| $Z_{26}$ Human health | Consultation with the Bureau of Health Statistics |
| $Z_{27}$ Ground subsidence rate | $\frac{\Delta t\text{ ground subsidence during the period}}{\Delta t}$ |
| $Z_{28}$ Water resources per capita | Water resources / population |
| $Z_{29}$ Hectares of arable land | Water resources / arable land area |
| $Z_{30}$ Agricultural water ratio | Agricultural water withdrawal / total water use |
| $Z_{31}$ Industrial water ratio | Industrial water withdrawal / total water consumption |
| $Z_{32}$ Proportion of population with poor drinking water | Number of people with poor drinking water / total population |
| $Z_{33}$ Annual growth rate of agricultural output | Statistics on the scale of agricultural economic development |
| $Z_{34}$ GDP growth rate | Statistics according to the scale of economic development |
| $Z_{35}$ Water consumption per 10,000 yuan of GDP | Total social production and living water consumption / GDP output value |
| $Z_{36}$ Water consumption per 10,000 yuan of industrial output | Industrial water withdrawal / industrial output value |
| $Z_{37}$ Water-saving irrigation area | Water-saving irrigation area / arable land area |
| $Z_{38}$ Farmland irrigation water quota | Effective irrigation area / arable land area |

### 3.3. Explanation of the indicator system

Table 2 shows the significance of each evaluation index in the environmental impact evaluation index system of water resources protection and utilization planning.

**Table 2.** Explanation of each indicator of the environmental impact assessment indicator system for water resources protection planning.

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| Evaluation indicators                                      | Representational meaning                                                                 |
|-----------------------------------------------------------|------------------------------------------------------------------------------------------|
| $Z_1$ Water resources quantity                            | Sum of effective quantities of surface water and groundwater recharge                    |
| $Z_2$ Available water resources                           | The amount of water resources that can be developed and used in a certain area under certain social and economic conditions |
| $Z_3$ Development and utilization of water resources       | Water use as a percentage of water available                                             |
| $Z_4$ Water quality condition                             | Reflects the stress of the water environment on external influences                     |
| $Z_5$ Water quality target                                | Reflects the stress of the water environment on external influences                     |
| $Z_6$ Water function goal                                 | Reflects the stress of the water environment on external influences                     |
| $Z_7$ Water environment capacity                          | Reflect the natural carrying capacity of the water environment                           |
| $Z_8$ Water pollution index                               | Reflects the stress of the water environment on external influences                     |
| $Z_9$ Wastewater treatment efficiency                      | Reflects the stress of the water environment on external influences                     |
| $Z_{10}$ Surface Water Modulus                            | Reflect the impact of surface water on the water environment                             |
| $Z_{11}$ Groundwater recharge water modulus               | Reflect ground water renewable performance                                               |
| $Z_{12}$ Groundwater recoverable resource modulus          | Reflect the ability of groundwater to resist external stress                              |
| $Z_{13}$ Natural economic growth rate of population        | Reflects the stress of the water environment on external influences                     |
| $Z_{14}$ Vegetation coverage                              | Reflect the stress of water environment stability on ecological environment              |
| $Z_{15}$ Soil erosion erosion modulus                      | Reflect the stress of water environment stability on ecological environment              |
| $Z_{16}$ Ecologically sensitive area                      | Reflects the stress of the water environment on external influences                     |
| $Z_{17}$ Biodiversity                                     | Reflects the stress of the water environment on external influences                     |
| $Z_{18}$ Fish habitat                                     | Reflects the stress of the water environment on external influences                     |
| $Z_{19}$ Instream flow                                    | Reflect the stress of water environment stability on ecological environment              |
| $Z_{20}$ Ecological water demand                          | Maintain corresponding water demand characteristic values under different water body ecosystem states |
| $Z_{21}$ Environmental water requirements                 | Demand for water that is dependent on the environment corresponding to the water ecosystem |
| $Z_{22}$ Ecological and environmental water requirements   | Based on the ecological water requirements of the water body ecosystem, it meets the requirements of the environment with different functional requirements |
| $Z_{23}$ Landscape water requirements                     | Reflects the stress of the water environment on external influences                     |
| $Z_{24}$ Geolocation                                      | Reflecting the natural attributes of water resources                                    |
| $Z_{25}$ Economic status                                  | Reflects the stress of the water environment on external influences                     |
| $Z_{26}$ Human health                                     | Reflects the stress of the water environment on external influences                     |
4. Discussion and suggestions

The environmental impact assessment index system for water resources protection and utilization planning is a health assessment of water collection environment, rational development and utilization planning of water resources, rational allocation of water resources, implementation of water abstraction permits, water resources environment supervision and management, ecological environmental protection, planning analysis, identification of environmental impacts, determination of environmental targets and evaluation indicators, environmental impact analysis and evaluation, environmental protection countermeasures, recommended planning schemes, public participation, monitoring and follow-up evaluation plans, etc. It is a systematic reflection of the functions of society and the government on groundwater resources. It involves many aspects such as nature, society, politics, economy, and technology. It is a complex system engineering of collection of technical, social, and policy aspects. The core content of the environmental assessment of water resources protection and utilization planning is to coordinate the relationship among water resources, water environment, economic society and ecological environment, and to achieve sustainable use of water resources. Each evaluation index in the evaluation index system constructed in this paper refers to the standards promulgated by the state and the previous indicators of sustainable use of water resources, water conservation planning, groundwater environment vulnerability assessment, and water environment assessment research [11 ~ 22]. Environmental impact assessment of water resources planning has just begun in China. The comprehensiveness of China's water conservancy planning indicators, the difficulty in obtaining environmental indicator data, and the problems in quantification. And research on the relationship between water conservancy development and the environment on a macro scale is still ongoing. This has brought new challenges to the environmental impact assessment of water conservancy planning in China.

It is suggested to strengthen basic research in the process of environmental impact assessment of water conservancy planning, establish a spatial system for environmental impact assessment of water conservancy planning, and build a basic database for evaluation [23]. At the same time, thematic management system [24] was established to construct thematic information, combining spatial data and
attribute data required for water resources and ecological environment assessment into an organic whole. Make the spatial data information serve the water resources and ecological assessment, and complete the two-way query of spatial data and attribute data on this basis. It can not only perform various types of query on the attribute database, but also directly display the query results on the map, or use the map as a tool to query the detailed information of each spatial element on the map. In this way, the information is visually detailed, detailed, and unified.

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