Design of index and standard system of water-saving carriers in Jinhua City

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Abstract: According to the needs of water-saving carrier construction and assessment in the process of national water-saving society innovation pilot in Jinhua City, the index system, construction standard and assessment method of water-saving carrier construction are analysed and studied. Combined with the water-saving demand of urban and rural life, this paper puts forward the evaluation mode of four construction carriers of Jinhua water-saving community, school, organ and institution, hospital, which provides support for the construction of water-saving society in Jinhua City.

1. Introduction

Jinhua Municipal Party committee and government attach great importance to water-saving work to promote industrial transformation and upgrading, promote economic quality and efficiency, reduce the generation and discharge of waste water and improve water ecological environment.

In 2007, the municipal Party committee and government made a strategic plan to build a water-saving society and a water-saving city, starting to build a resource-saving and environment-friendly society [1]. In 2015, Yongkang City, as one of the "six first" pilot counties to accelerate the implementation of the strictest water resources management system in China, successfully passed the acceptance and became one of the first batch of circular economy demonstration cities in China. All counties (cities, districts) have started the construction of water-saving society in an all-round way, and the water-saving work of the whole city has been continuously deepened and promoted. In 2018, Jinhua City was officially approved by the state as one of the four water-saving society innovation pilot projects in China. In 2020, Jinhua City has implemented the requirements of the national and provincial water conservation action deployment, and issued the implementation plan of Jinhua water saving action, which will promote the whole society to save water, improve the level of intensive utilization of water resources conservation, and build a new pattern of water saving led by the government, market power, social participation and national action. By the end of 2020, Jinhua City has completed the establishment of 21 water-saving irrigation areas, 244 water-saving enterprises [2-3], 101 water-saving communities and 1966 water-saving units. The creation of a series of water-saving carriers plays an exemplary role in the creation of a water-saving society. Through the creation of carriers, we can transform water-saving equipment, promote water-saving technology, improve people's water-saving awareness, and promote the construction of a water-saving society [4-7].

According to the evaluation index system of water-saving carrier in Zhejiang Province, combined with the actual situation of Jinhua City, it is necessary to study and formulate a set of scientific
water-saving carrier construction standards in line with the actual situation of Jinhua City, so as to better guide water-saving carrier construction in the future.

2. Research idea and principle

2.1. Idea
To measure whether the carrier meets the water-saving goal, it needs to be determined by technical evaluation combined with the conditions of the carrier itself and the supply and demand of water resources in Jinhua City.

There are two types in the selection of indexes. One is to measure the effectiveness (or effect) of water-saving carrier construction, which can be called technical indexes. It can formulate standards according to different water use characteristics and water-saving needs. The other is to promote the actual management work of water-saving carrier construction, which can be called management indexes. It can be divided into four types: organization construction, system construction, water-saving management, water-saving publicity and education, etc. In order to implement the principle of operability and avoid too many and cumbersome indexes, most indexes are comprehensive.

2.2. Principle
Comprehensiveness: the index system should not only reflect the relationship between carrier construction and urban and rural domestic water saving, but also reflect the characteristics of Jinhua water-saving society.

Representativeness: the selected indexes should be as independent as possible, and the data sources should be reliable, convenient, concise and clear.

Operability: the index system is simple and clear, the calculation is convenient, and the required information is easy to obtain.

3. Establishment of index

3.1. Index setting
The main evaluation objects of water-saving carriers in Jinhua City are communities, schools, institutions and hospitals. On the basis of comprehensive and systematic analysis of all kinds of water intake and water-saving indexes, referring to the relevant construction indexes and standards of water conservancy system and residential construction system, water efficiency leader and water-saving benchmark, the analysis and selection of representative indexes can not only reflect the water-saving level of various carriers of water-saving service industry and life, but also reflect the comprehensive level of water-saving society construction. In addition, some encouraging indexes are set, such as unconventional water utilization, innovative features, information management, etc. The evaluation index system is shown in Table 1.

| S/ N | Type            | Classification     | Index                                                                 |
|------|-----------------|--------------------|----------------------------------------------------------------------|
| 1    | Water-saving community | Technical index   | ①Per capita monthly water consumption of residents②Ratio of one water meter per household③Popularization rate of water saving appliances④Allocation rate of public water metering⑤Leakage rate of public water facilities |
|      |                  | Management index   | ①Public participation②Water management③Facilities management         |
|      |                  | Encouraging index  | Unconventional water resources utilization                            |
| 2    | Water-saving school | Technical index    | ①Comprehensive water consumption per capita②Proportion of water meter measurement③Allocation rate of water saving |
| S/N | Type   | Classification                                                                 | Index                                                                 |
|-----|--------|--------------------------------------------------------------------------------|----------------------------------------------------------------------|
| 3   | Water-saving institution | Management index 1. Water management and measurement management 2. Teachers and students have water saving consciousness 3. Water saving publicity signs 4. Water saving publicity and education 5. Water saving practice education | 1. Substitution rate of unconventional water resources 2. Innovative features 3. Information management |
|     |        | Encouraging index 1. Substitution rate of unconventional water resources 2. Innovative features 3. Information management | 1. Proportion of water meter measurement 2. Popularization rate of water saving appliances 3. Comprehensive water consumption per capita 4. Leakage rate of water appliance 5. Cooling water supply rate of central air conditioning 6. Recovery rate of boiler condensate |
|     |        | Technical index 1. Substitution rate of unconventional water resources 2. Innovative features 3. Information management | 1. Proportion of water meter measurement 2. Popularization rate of water saving appliances 3. Comprehensive water consumption per capita 4. Leakage rate of water appliance 5. Cooling water supply rate of central air conditioning 6. Recovery rate of boiler condensate |
| 4   | Water-saving hospital | Management index 1. Leaders in charge shall be responsible for water saving work and establish office meeting system 2. There are water-saving departments and full-time (Part-time) water-saving management personnel 3. There is a sound water-saving management network and clear post responsibility system 4. Specific management system for planned water use and water saving 5. The original records and statistical accounts are complete and standardized and the statistical reports are completed and analyzed on time 6. The water use situation is clear and the problems of regular patrol inspection are solved in time 7. Carry out water balance test according to specified period 8. There is a complete pipe network diagram 9. Quota management, saving prize and exceeding punishment 10. Formulate and complete the ten year water saving plan 11. Regular publicity and education on Water Conservation 12. Water measurement management system 13. There is a complete recent measurement network diagram 14. Complete water saving targets and annual water saving plan 15. Regular maintenance system shall be adopted for water equipment pipes 16. The used water-saving equipment is well managed and operates normally | 1. Unconventional water resources utilization 2. Innovative features |
|     |        | Encouraging index 1. Unconventional water resources utilization 2. Innovative features | 1. Unconventional water resources utilization 2. Innovative features |
3.2. Standard setting

The quantitative standard of water-saving carrier creation index is aimed at the communities, schools, institutions and hospitals in the whole city. On the determination of the overall evaluation and the regional evaluation index value of water-saving society, it must be suitable for the current level of economic and social development in Jinhua City, with certain advanced nature, reflecting the regional characteristics of Jinhua's economic and social development. At the same time, we should also consider the imbalance of regional and industrial development, the differences of economic development, water resources conditions and people's living standards in Yongkang, Yiwu and other regions of Jinhua City.

In order to better connect the actual water-saving carrier of Jinhua City with the provincial water-saving carrier and water-saving benchmark in the future, the standard design mainly adopts the way of direct use and reference adjustment.

(1) Direct use

For the provincial water-saving carrier strict requirements of the standard, the standard should be set according to the requirements of the province to strive to achieve. For example, the allocation rate of public water measurement in water-saving community should be 100%, the leakage rate of public water facilities should not be less than 2%, the metering rate of primary water meter should be 100%, the popularization rate of water-saving appliances should be 100%, the recovery rate of boiler condensate water should be 60%, the circulation rate of indirect cooling water should be 95%, and the cooling water supplement rate of central air conditioning should not exceed 1%.

(2) Reference and adjustment

In terms of organization construction, system construction, water-saving management measures and water-saving education and publicity, there are limited indexes that can be quantified at present. Jinhua City generally promotes the policy and system construction of water-saving society according to the unified deployment of the whole province, and the indicator setting should be basically consistent with that of the whole Province. According to the above design ideas, the selection results of standard values of each technical index are shown in Table 2.

| Classification         | Index                                      | Standard value |
|-----------------------|--------------------------------------------|----------------|
| Water-saving community| Ratio of one water meter per household     | 100%           |
|                       | Popularization rate of water saving appliances | 100%           |
|                       | Allocation rate of public water metering   | 100%           |
|                       | Leakage rate of public water facilities   | 0%             |
|                       | Proportion of water meter measurement      | 100%, 95%, 85% |
|                       | Allocation rate of water saving appliances | 100%           |
|                       | Leakage rate of water supply network       | 2%             |
|                       | Area ratio of efficient water saving irrigation | 0%         |
|                       | Cooling water supply rate of central air conditioning | 1%          |
|                       | Recovery rate of boiler condensate         | 60%            |
|                       | Popularization rate of water saving appliances | 100%, 95%     |
| Water-saving school   | Comprehensive water consumption per capita | 100%           |
|                       | Leakage rate of water appliance            | 2%             |
|                       | Cooling water supply rate of central air conditioning | 1%          |
|                       | Recovery rate of boiler condensate         | 60%            |
|                       | Circulation rate of indirect cooling water | 95%            |
| Water-saving institution| Proportion of water meter measurement      | 100%, 90%, 85% |
|                       | Loss rate of water facilities (including self-provided water supply) | 2%           |
|                       | Leakage rate of sanitary ware              | 2%             |
| Water-saving hospital |                                            |                |
3.3. Score determination

The methods to determine the weight of all levels of evaluation index system generally include expert estimation and analytic hierarchy process. Expert estimation method and analytic hierarchy process have their own advantages and disadvantages. The advantages of expert estimation method lie in strong explanation, good adaptability and close to reality. Analytic hierarchy process (AHP) is generally based on the mathematical model. The logical relationship of the calculation process is clear. There are strict initial assumptions, rigorous intermediate calculation steps and rigorous final calculation results. The weight determined by AHP is more accurate in most cases. However, in the multi-level index system, the meaning of the index is not very clear, sometimes it is contrary to the actual situation, and it is not accurate to the results the results are difficult to explain.

Jinhua City has accumulated some practical experience in the process of creating water-saving carriers in recent years, so this study adopts expert estimation method. Through the typical investigation, according to their own experience and understanding of the importance of each evaluation index, the weight of each evaluation index is allocated. Then we call experts to discuss, listen to everyone's opinions, and modify the weight value, so as to achieve a comprehensive and objective evaluation.

4. Assessment method

4.1. Construction scope

The communities, schools, organs and institutions, and hospitals that use groundwater, surface water, and tap water in each county (city, district) can voluntarily declare the title of "Jinhua water-saving community, school, organs and institutions, and hospital". The declaration focuses on:

(1) Community: it is a residential area in town managed by property management company and supplied with centralized water.

(2) School: within the administrative region of Jinhua City, non-universities, including kindergartens, nurseries, primary schools, junior middle schools, senior high schools and secondary vocational schools, refer to this evaluation standard. Colleges and universities (full-time universities, independent colleges and colleges, higher vocational schools).

(3) Administrative organs and institutions: municipal or county (District) level organs and institutions.

(4) Hospitals: Grade I, II and III hospitals, clinics, infirmaries and other health institutions in Jinhua administrative region.

4.2. Assessment method

The establishment of water-saving carriers generally combines self-examination, declaration, assessment and naming. The assessment methods include listening to reports, consulting materials, on-site inspection, etc. The total score of the water-saving carrier must be more than 90 points by using the Hundred Score System.

(1) Those who have occurred major safety, environmental accidents or other adverse social events in the past three years, who have been punished by relevant departments for wasting water in the past two years, and who continue to use the backward water use processes, technologies and products that have been banned and eliminated by the state and the province, should not be rated as water-saving carriers.

(2) If the first and second level meters of water meter measurement rate fail to reach the standard, no score will be given; the minimum standard of comprehensive leakage rate of water facilities (including self provided water source), leakage rate of sanitary ware and equipment shall not be higher
than 2%; if one of the single indexes fails to reach the minimum standard level, it can be rejected by one vote.

(3) If there are empty items, they can be converted according to the standards of other items. The formula is as follows: total score after conversion = score of other items / (100-total score of empty items) × 100

4.3. Supervision and inspection
Those who have been named as the water-saving carrier of Jinhua City shall be reevaluated once every three years, and can be postponed for no more than five years under special circumstances. Reevaluation mainly evaluates the actual performance and data statistics of water saving work after winning the title. Those who are qualified in the reevaluation will retain the original title, and those who are unqualified will be cancelled. The reevaluation work shall be organized and implemented by the municipal water-saving administrative department and other relevant departments.

The municipal water-saving authorities supervise and inspect the declared water-saving carriers, focusing on water-saving technical indexes, water-saving management system construction, water consumption measurement, water-saving technology transformation, water-saving publicity and education, etc.

5. Conclusions
Starting from the needs of Jinhua water-saving carrier, this paper puts forward the construction standard system of water-saving community, school, institution and hospital from three aspects of technical index, management index and encouraging index. The system can provide technical support for evaluating water-saving carriers, improving water-saving transformation and management of water-saving carriers, and implementing the strictest water resources management system. Community, school, institution and hospital can effectively regulate water use, improve water-saving efficiency, tap water-saving potential and improve water use efficiency by carrying out water-saving creation work, which has great economic, social and environmental benefits. According to the actual situation of Jinhua City, it is suggested to carry out demonstration first and then promotion, to gradually realize the national water saving.

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