Study on Regional Water-Saving Evaluation System Based on Extension Evaluation Method

MAO Jian-sheng1, MAO Jian-rong2, XU Ri-gong1, YU Ya-zhen1
1Zhejiang Tongji Vocational College of Science and Technology, Hangzhou 311231, China
2Zhejiang Jiangxin Construction Co., Ltd, Hangzhou 311231, China

Abstract. Insufficient qualitative analysis in regional water-saving system needs to be solved, as it affects the effective implementation of comprehensive evaluation system. Though the unilateral quantitative indicators can be able to make the sure results of the evaluation data, it is short of qualitative index guiding, data monitoring and management. Therefore, the evaluation results lost sufficient convince conditions. This paper puts forward a kind of evaluation index system of regional water based on extension evaluation method. Based on the national water-saving society indicators, a comprehensive evaluation index system of water-saving combining quantitative and qualitative analysis is built, and a comprehensive evaluation quantitative model is established based on the correlation function and analytic hierarchy process (AHP). Finally, the water-saving cases for Zhoushan City in 2014, 2018 years and Yuhuan County in 2014 years of Zhejiang Province are taken as an example. The evaluation results show that the water-saving condition of Zhoushan City in 2018 year is much better than at 2014 year’s done. And in 2014, both Zhoushan City and Yuhuan County are done in basically same result, but there qualitative and quantitative evaluation results are different because of the geographical environment and size of the area. Thus, feasibility and effectiveness of the method are verified.

1. Research background
There is no consistent standard at home and abroad on how to divide the regional water-saving level and how to determine the evaluation index. At present, the determination of this index is mainly based on the three main aspects of production water, domestic water and ecological water related to human activities. The research on the application of water-saving evaluation index system in specific regions includes: the research on the evaluation index system of sustainable utilization of water resources in Guangdong Province [1], the research on the comprehensive evaluation index system for the purpose of ecological health in Guangdong Province [2] and the research on the evaluation system of water-saving evaluation results in 2010 for Zhengzhou City predicting the water-saving target in 2020 [3]. The construction of water-saving evaluation system in these documents combined with the specific local actual conditions. However, considering the differences between regions and the national water-saving social indicators, the formation of a universal evaluation index system with regional characteristics needs to be refined.

The key researches on one aspect of the evaluation system are: research on the construction of agricultural water-saving evaluation system [4], research on the ecological index system [5], research on the ecological index system of inter basin water transfer [6], research on the benefit of water-saving irrigation [7], research on the evaluation system of water-saving irrigation and the construction of its benefit satisfaction [8] and research on the bearing capacity [9]. The evaluation index systems in these
aspects have their own advantages and there are large index differences. Each industry indicator system contains indicators based on quantitative calculations and a small number of qualitative indicators, which can be upgraded to the objective reference basis of Huawei regional water-saving evaluation indicators. However, simple integration will cause confusion and incompleteness of the evaluation system, resulting in tedious calculation process.

The comprehensive modification of evaluation indexes includes: improvement of water-saving system [10], Gini coefficient support vector machine coupling evaluation model [11], discussion of water-saving standard, evaluation index system based on the connotation of water modernization [13], and re-evaluating the evaluation index based on the classification system of rating index for water conservancy development [14], etc. In the process of building the water-saving evaluation index system, the above literatures evaluate the regional water-saving status or water-saving effect through objective data, and lack of consideration of soft factors such as water-saving system, management regulations, and staffing, etc. Human initiative plays an important role in the whole water-saving process, and the generation and acquisition of objective data are subject to methods. The constraints of process design, the correctness and applicability of data, in turn, affect the revision of method process design.

Therefore, it is urgent to establish a universal regional water-saving evaluation system which combines qualitative and quantitative analysis. In this paper, extension evaluation method is used to study the construction and quantification of regional water-saving evaluation system. In the regional water-saving research, the advantages and disadvantages of subjective evaluation method and objective evaluation method and their application scope should be further explored to make the regional water-saving evaluation more reasonable. Thus, a regional water-saving evaluation system research based on extension evaluation method is proposed.

2. Construction of comprehensive evaluation system of regional water-saving based on qualitative and quantitative indexes

The regional water-saving evaluation system (a) consists of the following two systems: 1) regional water-saving qualitative evaluation system (A1) based on macro measures such as rules and regulations construction, inspection and management, publicity and demonstration; 2) regional water-saving quantitative evaluation system (A2) based on micro measurement of water use, water intake, drainage and other industries in the region. A1 and A2 complement each other and are indispensable. The effective implementation of A1 is the guarantee basis for the accurate acquisition of A2 data, and A2 also plays a feedback role on A1. However, compared with A1 and A2, the output of A2 has objective facts and can give accurate evaluation conclusions, while the output of A1 has great operability and can only give subjective evaluation results.

2.1. Construction of qualitative evaluation system of regional water-saving

The indicators of qualitative evaluation system are determined from the aspects of organization, system, cultural publicity, demonstration, guarantee and supervision, forming a multi-level secondary evaluation structure system. The system is composed of a 3-level qualitative index [A1 - (b1-b6) - (c1-c29)], as shown in Figure 1.

![Figure 1. Qualitative evaluation index system of regional water-saving](image-url)
construction, safeguard measures construction, supervision and management. These indicators need to be specifically decomposed and quantified, and the corresponding three-level index hierarchy is given.

See details of C1-C29 in the three-level index hierarchy of the system in Table 1.

### Table 1. The third level index content of qualitative evaluation system

| Number | Name                                           | Number | Name                                           | Number | Name                                           |
|--------|------------------------------------------------|--------|------------------------------------------------|--------|------------------------------------------------|
| C1     | Organizational structure and personnel integrity | C2     | Clear responsibilities                         | C3     | Goal and task of water saving society construction |
| C4     | Total water consumption control system         | C5     | Water-saving "three simultaneities" system of construction project | C6     | Water function area limit system                |
| C7     | Water efficiency control system                | C8     | Bulletin statistical system                   | C9     | Benefit adjustment mechanism of water conservation |
| C10    | Water-saving standard system and innovation mechanism of water saving technology | C11    | Regional water-saving evaluation system       | C12    | Demonstration system of water resources for construction projects and planning |
| C13    | Mechanism of public participation in water culture construction | C14    | Water Culture Architecture Platform           | C15    | Water-saving cultural awareness                |
| C16    | Water-saving irrigation area (Modern Agricultural Park) | C17    | Water-saving industrial enterprise (Park)     | C18    | Water-saving service unit (Campus)             |
| C19    | Working mechanism                              | C20    | Assessment                                     | C21    | Science and technology support                  |
| C22    | Capital guarantee                              | C23    | Annual total water consumption control management | C24    | Approval and issuing rate of water intake permit |
| C25    | Planned water management rate of water users   | C26    | Metering facilities for water intake of industrial, agricultural and domestic service industries | C27    | Strengthen water resource protection (water function area) |
| C28    | Strengthen groundwater management               | C29    | Strengthen water administrative law enforcement |        |                                                |

#### 2.2. Construction of regional water-saving quantitative evaluation syste

The construction of A2 evaluation system determines evaluation indexes from different industries and uses, mainly from industrial, agricultural, living and environmental water use, water intake, drainage and other aspects. Such index division and determination have clear significance, simple operation, and only monitor water inflow and outflow. Therefore, the regional water-saving quantitative evaluation system can form \([A2 - (D1-D3) - (E1-E5) - (F1-F22)]\), and the hierarchical structure is shown in Figure 2:
Figure 2. Regional water-saving quantitative evaluation index system

The second level evaluation indexes of A2 evaluation system are D1-D3: total regional water consumption, ten thousand yuan GDP water consumption, and waste water discharge. On this basis, each index of the first level evaluation is quantified; the second level evaluation index is derived, and so on. Finally, the whole quantitative evaluation index system is formed.

The three-level evaluation indexes of the A2 evaluation system are E1-E5, which are industrial water, agricultural water, domestic water, ecological environment water and unconventional water. As there is a certain correlation and interpenetration between the upper and lower levels of the level 1 quantitative index, the next level index under each level 1 index is considered in the quantification. The four-level evaluation indexes of A2 evaluation system are F1-F22. See details in Table 2.

Table 2. Contents of the fourth level of quantitative index system

| Number | Name                                          | Number | Name                                          | Number | Name                                          |
|-------|-----------------------------------------------|-------|-----------------------------------------------|-------|-----------------------------------------------|
|       | Industrial water consumption                  | F2    | Decline rate of water consumption of ten thousand yuan industrial added value (%) | F3    | Reuse rate of key industrial water (%)        |
| F4    | Industrial waste water treatment and reuse rate (%) | F5    | Effective utilization coefficient of farmland irrigation water | F6    | Water-saving irrigation project area rate (%) |
| F7    | Water consumption per mu for farmland irrigation (m3 / mu) | F8    | Agricultural waste water treatment and reuse rate (%) | F9    | Domestic water consumption of residents (liter / person day) |
| F10   | Installation rate of domestic water users (%) | F11   | Leakage rate of urban water supply network (%) | F12   | Urban sewage treatment rate (%)               |
| F13   | Water quality standard rate of water functional areas of important rivers and lakes (%) | F14   | Water quality compliance rate of the river cross section at the boundary of the region (%) | F15   | Water quality standard rate of urban water supply source (%) |
| F16   | Real time monitoring rate of public water intake (%) | F17   | Decline rate of groundwater exploitation (%) | F18   | Water area ratio (%)                         |
| F19   | Utilization rate of reclaimed water (%)       | F20   | Rainwater collection and utilization capacity (10000 t / a) | F21   | Desalination engineering capacity and direct utilization of seawater (t / d) |
|       | Proportion of alternative water resources of unconventional water sources (%) |
3. Extension evaluation method based on regional water-saving index system

Extension evaluation method is the most important stage method of optimization after solution generated in extension science. The evaluation process includes two core calculation processes: 1) construction of correlation function, calculation of correlation degree and standard correlation degree; 2) calculation of comprehensive evaluation system model. The key steps of this method are: 1) determine the evaluation object of each scheme; 2) determine the index parameter boundary of the evaluation object; 3) preliminarily delete and select each scheme; 4) establish the weight assignment of the evaluation object; 5) comprehensive evaluation output based on the correlation function. The core of extension evaluation is the process of constructing the correlation function model for evaluation index, which has the advantages of subjective and objective quantification and formalization.

3.1. Data processing of regional water-saving index

Regional water-saving index data contains two different types of numerical representations, namely discrete data and continuous data, which correspond to qualitative and quantitative water-saving indexes respectively.

1) The qualitative index is discrete data, that is, the given evaluation value is hierarchical, in a given range (such as 1, 2, 3, 4, 5 or 1, 3, 5, 7, 9, etc.). The evaluation value of this index belongs to the same dimension level, so it needs to be normalized. Assume that the 1~S type of given value method is selected. Association function of this type is:

\[ \rho(x,x_0,X_0) = \frac{x}{x_0} \]

Then the extension model of qualitative evaluation index system is as follows:

\[ C(A1) = \frac{1}{S} \sum_{j=1}^{3} \sum_{i=1}^{m_1} \lambda_{j,k}^1 x_i \]

\[ \lambda_{j,k}^1 \] is expressed as the weight of the k-th indicator in the j-th layer of the qualitative indicator system. \( m_1 \) value is the number of indicators in each layer (that is, the first to the third layer corresponds to 1, 6, 29).

2) The quantitative index is continuous data, and its correlation function is:

\[ \rho(x,x_0,X_0) = \begin{cases} 
\frac{x}{x_0} & \text{if } D(x,X_0) \neq 0 \\
1 & \text{if } D(x,X_0) = 0, x \in X_0 \\
0 & \text{if } D(x,X_0) = 0, x \notin X_0, x \in X
\end{cases} \]

Then the extension model of quantitative evaluation index system is as follows:

\[ C(A2) = \sum_{j=1}^{3} \sum_{k=1}^{m_2} \lambda_{j,k}^2 k_j(x) \]

Among them, \( \lambda_{j,k}^2 \) is expressed as the weight of the k-th indicator in the j-th layer of the quantitative indicator system, and \( m_2 \) is the number of indicators in each A2 layer (i.e. the first layer to the fourth layer corresponds to 1, 3, 5, 22).

Then the evaluation model of regional water-saving evaluation index is:

\[ C(A) = C(A1) + C(A2) = \frac{1}{S} \sum_{j=1}^{3} \sum_{k=1}^{m_1} \lambda_{j,k}^1 x_i + \sum_{j=1}^{4} \sum_{k=1}^{m_2} \lambda_{j,k}^2 k_j(x) \]

3.2. Index database construction based on regional water-saving evaluation model

According to the use of regional water resources and the national, provincial and municipal standards for water resources, the standard interval \( X_0 \) of each evaluation index is constructed. Because there are
some differences in the instruments, statistical methods and standards used in the measurement or calculation process, the extension interval $X$ (i.e. the expanded standard interval) is constructed on the basis of $X_0$. At the same time, the ideal value $x_0$ of these indexes can be given as the best.

1) $X_0$, $X$ and $x_0$ corresponding to qualitative evaluation index $C_j$ of regional water saving ($j = 1, \ldots, 29$) are $X_0 = [h_1, h_2]$, where, $1 \leq h_3 \leq h_4 \leq h_5 \leq S$ and $x_0 \in X_0$. When $C_j$ tends to be small, $x_0 = h_1$ otherwise $x_0 = h_2$.

2) $X_0$, $X$ and $x_0$ of regional water saving quantitative indexes are divided into two types.

① $F_{ln1}$ is the indicator data of percentage measurement: suppose $X_0 = [g_1, g_2]$, when $F_{ln1}$ tends to be smaller, $\frac{x_0}{g_1} \leq \frac{g_2}{g_1}$; vice versa, $0 \leq g_4 \leq g_1$ and $x_0 = g_2$.

② $F_{ln2}$ is the index data represented by specific dimensions: suppose $X_0 = [g_5, g_6]$, when $F_{ln2}$ tends to be smaller, $\frac{x_0}{g_5} \leq \frac{g_8}{g_5}$; vice versa, $0 \leq g_7 \leq g_10$ and $x_0 = g_8$.

The value of the regional water-saving quantitative index data $g_1$-$g_{10}$ is determined by the actual situation of the water-saving evaluation region, $l_a + l_q = 22$.

3.3. Weight calculation based on regional water-saving evaluation model

The evaluation index system of regional water-saving adopts the combination of qualitative and quantitative methods, and combines the analytic hierarchy process (AHP) to establish the corresponding weight of each index. The analytic hierarchy process (AHP) is used to calculate the weight coefficients in the form of $1, 3, 5, 7$ and $9$ to compare the relationship between the two, from small to large. Now take the weight calculation of each index of regional water-saving qualitative index system as an example:

1) In the first layer of the regional water-saving qualitative evaluation system, the weight coefficients determined by the relative evaluation reference value are $(\lambda_1, \lambda_2) = (0.4, 0.6)$ respectively.

2) The weight of qualitative indicators in the second layer can be expressed as:

$\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5, \lambda_6 = AHP(b_{it})_{i=6,j=6}$, where $b_{it}$ is expressed as the importance score of the i-th indicator in the second layer relative to the t-th indicator, and $(b_{it})_{i=6,j=6}$ is expressed as the level judgment matrix composed of the importance score.

3) The formula for calculating the weight of the third level indicator can be expressed as:

$\lambda_{3, \lambda} = AHP(c_{it})_{i=1, j=6}$, where $j$ is expressed as the number of the third level indicators associated with the j second level indicator, $c_{it}$ is expressed as the importance score of the i-th indicator relative to the t-th indicator in the third level, $(c_{it})_{i=1, j=6}$ is expressed as the level judgment matrix formed by the importance score, and $y$ is the label of the weight indicator.

Therefore, the weight values of indicators under the system can be established, and the weight calculation of regional water-saving quantitative indicator system can be analogized, which will not be discussed in detail.

4. Application of regional water saving evaluation system

Taking the comparative analysis of water-saving situation in 2014 and 2018 in Zhoushan City, Zhejiang Province and water-saving situation in 2014 in Yuhuan County as an example, this paper gives a reasonable water-saving evaluation and uses this method to verify the effectiveness and accuracy of the implementation of water-saving measures.

Due to the limitation of island climate and geographical conditions, Zhoushan City is one of the areas with relatively short water resources in Zhejiang Province. The annual average per capita water
resources are only 657 m$^3$, which is nearly one third of the average level in Zhejiang Province. The lack of water resources has become one of the important bottlenecks that have restricted the construction of new areas on Zhoushan Islands. Yuhuan County also occupies an important strategic position in the economic development pattern of Zhejiang Province, but it is also one of the regions with relatively short water resources in Zhejiang Province. The average annual per capita water resources are only 577 m$^3$, which is 28.8% of the average annual per capita water resources in Zhejiang Province and 25.1% of the average annual per capita water resources in China. The shortage of water resources has become an important bottle that has restricted the social and economic development of Yuhuan County.

4.1. Determination of index parameters of regional water-saving evaluation system

Considering the difference of water use standards and management methods in each region, the default evaluation index in the evaluation system is taken as the default boundary value (the maximum or minimum value of the extension domain). The data of qualitative and quantitative evaluation indexes of the city can be obtained from the data. Here, the quantitative value of qualitative indexes is given by the form of 1, 2, 3, 4, 5. Then, the data of some indexes of Zhoushan City in 2014, 2018 and Yuhuan County in 2014 and the corresponding values of X0, X, x0 are shown in the table below:

| Water quantity name and parameters | X0       | X        | x0        | Zhoushan City 2014 | Zhoushan City 2018 | Zhoushan City 2014 | Yuhuan County 2014 | Yuhuan County 2018 |
|-----------------------------------|----------|----------|-----------|--------------------|--------------------|--------------------|--------------------|--------------------|
| 1. Industrial water consumption (100 million m$^3$) | [0.1, 3.0] | [0.05, 5.0] | 1.5       | 1.2                | 1.64               | 0.3                |                    |                    |
| 2. Decrease rate of water consumption of industrial added value of 20000 yuan (%) | [5, 15]   | [4, 16]  | 15        | 6                  | 8                  | 7                  |                    |                    |
| 3. Reuse rate of key industrial water (%) | [80, 100] | [75, 100] | 100       | 76                 | 80                 | 75                 |                    |                    |
| 4. Industrial waste water treatment and reuse rate (%) | [10, 50]  | [8, 50]  | 50        | 37.3               | 42                 | 20                 |                    |                    |
| 5. Effective utilization coefficient of farmland irrigation water (%) | [0.5, 1]  | [0.45, 1] | 1         | 0.64               | 0.65               | 0.65               |                    |                    |
| 6. Water-saving irrigation project area rate (%) | [50, 100] | [45, 100] | 100       | 45.2               | 52                 | 60                 |                    |                    |
| 7. Average water consumption per mu for farmland irrigation (m$^3$/mu) | [350, 500] | [330, 500] | 500       | 400                | 390                | 366                |                    |                    |
| 8. Treatment and reuse rate of agricultural waste water (%) | [50, 80]  | [45, 80] | 80        | 55                 | 60                 | 50                 |                    |                    |
| 9. Domestic water consumption of residents (litre/person day) | [100, 200] | [90, 210] | 200       | 175                | 196                | 125                |                    |                    |
| 10. Example rate of domestic water users (%) | [90, 100] | [85, 100] | 100       | 83                 | 90                 | 93                 |                    |                    |
| 11. Leakage rate of urban water supply network (%) | [5, 15]   | [5, 18]  | 5         | 14                 | 12                 | 16                 |                    |                    |
| 12. Scientific and technical support (%) | [3, 5]    | [3, 5]   | 5         | 3                  | 4                  | 3                  |                    |                    |
| 13. Annual total water consumption control management | [3, 5]    | [3, 5]   | 5         | 3                  | 3                  | 3                  |                    |                    |
| 14. Approval and issuing rate of water intake permit (%) | [4, 5]    | [4, 5]   | 5         | 3                  | 4                  | 3                  |                    |                    |
| 15. Planned water use management rate of water users (%) | [3, 5]    | [3, 5]   | 5         | 2                  | 3                  | 2                  |                    |                    |
| 16. Metering facilities for water intake of various industries shall be installed according to regulations (%) | [3, 5]    | [3, 5]   | 5         | 3                  | 3                  | 3                  |                    |                    |
| 17. Strengthen water resource protection (water function area) (%) | [4, 5]    | [3, 5]   | 5         | 3                  | 4                  | 3                  |                    |                    |
50. Strengthen groundwater management [3, 5] [3, 5] 5 2 3 2
51. Strengthen water administrative law enforcement [4, 5] [4, 5] 5 2 3 2

4.2. Weight calculation of each index of regional water-saving evaluation system

According to the AHP method, the relationship between them is compared in the form of 1, 3, 5, 7, 9 from small to large. Take the detailed calculation of the second level index weight of qualitative index as an example, that is, \((\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5, \lambda_6, \lambda_7, \lambda_8, \lambda_9)\) are as follows:

Table 4. Weight coefficient calculation of the first level index of quantitative system

| A1 | B1 | B2 | B3 | B4 | B5 | B6 | weight coefficient |
|----|----|----|----|----|----|----|--------------------|
| 1  | 3  | 3  | 3  | 3  | 3  | 3  | 0.3685             |
| 1/3| 1  | 3  | 3  | 3  | 3  | 3  | 0.2478             |
| 1/3| 1/3| 1  | 1  | 1  | 1  | 1  | 0.0959             |
| 1/3| 1/3| 1  | 1  | 1  | 1  | 1  | 0.0959             |
| 1/3| 1/3| 1  | 1  | 1  | 1  | 1  | 0.0959             |

The consistency test is CI = 0.0283; CR = 0.0224; CR < 0.1; therefore, it meets the requirements.

Similarly, the weights of other levels of regional water-saving qualitative indicators are:

\((\lambda_{11}, \lambda_{12}, \lambda_{13}, \lambda_{14}, \lambda_{15}, \lambda_{16}, \lambda_{17}, \lambda_{18}, \lambda_{19}) = (0.0382, 0.0382, 0.2189, 0.0953, 0.0382, 0.0953, 0.2189, 0.2189, 0.0382)\);

\((\lambda_{21}, \lambda_{22}, \lambda_{23}, \lambda_{24}, \lambda_{25}, \lambda_{26}, \lambda_{27}, \lambda_{28}, \lambda_{29}) = (0.0382, 0.0382, 0.2189, 0.0953, 0.0382, 0.0953, 0.2189, 0.2189, 0.0382)\);

4.3. Comprehensive calculation of regional water-saving evaluation system

According to the above quantitative value of qualitative index, the calculation equation of qualitative evaluation index system can be simplified as:

\[ C(A1) = \frac{1}{2} \sum_{j=1}^{19} \sum_{i=1}^{18} \lambda_{j,k} x_i = \sum \lambda_a \times \lambda_b \times \lambda_c \times x \n\]

Then the calculation values of qualitative index system of Zhoushan City in 2014 and Yuhuan County in 2014 are as follows:

\[ C(A1)_{14} = 0.146 \quad C(A1)_{18} = 0.290 \quad C(A1)_{yuhuan} = 0.215 \]

According to the above evaluation index value and the index data in Table 1, the correlation function of these 22 regional water-saving quantitative indexes is calculated. Take the calculation of urban sewage treatment rate (%) (F12 = 80, 82, 65) as an example to explain:

\[ k_{F12}^{14} = \frac{\rho(80, X_0, X)}{D(80, X_0, X)} = 3 \]

\[ k_{F12}^{18} = 17 \]

\[ k_{F12}^{yuhuan} = -1 \]
The remaining 21 indexes can be calculated by analogy, and the calculation equation of quantitative evaluation index system can be simplified as

\[ C(A2) = \sum_{j=1}^{m} \sum_{k=1}^{n} \lambda_{jk} \times k_i(x) = \sum_{j=1}^{m} \lambda_{j2} \times \lambda_{21} \times \lambda_{24} \times k_i(x). \]

Then the calculated values of quantitative index system of Zhoushan City in 2014, 2018 and Yuhuan County in 2014 are: 

\[ C(A2)_{2014} = 0.8361, \quad C(A2)_{2018} = 1.138, \quad C(A2)_{yuhuan} = 0.8029. \]

Therefore, the comprehensive values of the regional water-saving evaluation system of Zhoushan City in 2014, 2018 and Yuhuan County in 2014 are:

\[ C(A)_{2014} = 0.9821, \quad C(A)_{2018} = 1.4285, \quad C(A)_{yuhuan} = 1.0179. \]

Through the calculation results of regional water-saving evaluation system, it can be seen that the water-saving effect of Zhoushan City in 2018 is significantly improved compared with that in 2014, which proves that the formulation, implementation and management of macro qualitative indicators of water-saving in Zhoushan City are in place and effective in recent years. Besides, the micro quantitative indicators data prove the accuracy and applicability of macro policies. The water-saving situation of Zhoushan City in 2014 is basically the same as that of Yuhuan County in 2014, all of which have achieved good results. However, due to the differences in geographical environment, regional size and rainfall, there are great differences in comprehensive evaluation index data, which leads to the differences in qualitative and quantitative evaluation results of water-saving evaluation.

5. Conclusion

Based on the principles of universality, systematization and standardization of regional water-saving evaluation, this paper puts forward a regional water-saving evaluation index system based on extension evaluation, establishes a qualitative and quantitative evaluation index system based on national water-saving society evaluation, constructs an evaluation model based on correlation function, and comprehensively evaluates the regional water-saving effect by using qualitative and quantitative evaluation mode. Finally, the water-saving situation of Zhoushan City in 2014, 2018 and Yuhuan County in 2014 are compared and analyzed. The evaluation results reflect that Zhoushan City in 2018 has done better and the effect has improved rapidly when compared with 2014. The evaluation results of water-saving situation of Zhoushan City and Yuhuan County in 2010 are basically the same, but there are slight differences in the evaluation of qualitative and quantitative systems. Therefore, verifying the feasibility of this method also reflects which indicators are insufficient and how to improve them.

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About the author:
Mao Jiansheng (1963 -), male, Jiangshan, Zhejiang Province, Professor, master's degree, mainly engaged in hydrological and water resources work. E-mail: sdmaojr7387@sina.com
About the corresponding author: MAO Jian-rong (1967-). E-mail: 346329864@qq.com

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