

Study on Evaluation of Agricultural Irrigation Zoning and Optimal Utilization of Water Resources in Yantai City

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Abstract. Agricultural water is the largest water user in Yantai City, and its water consumption accounts for more than 2/3 of the total water consumption in Yantai City. The potential for agricultural water saving is huge, but the overall level of agricultural water efficiency in Yantai City is not very high, and the waste of water resources is serious. Efficient agricultural water use in Yantai is a key issue for achieving efficient and sustainable use of water resources in Yantai. Different regions in the study area have different social and economic developments, different industrial structures, and different natural climates, and their investments in agricultural water conservancy facilities are also different. In order to better study the agricultural efficient water use model in Yantai City. This article will divide the agricultural irrigation sub-area according to the actual situation of Yantai.

1 Current situation of agricultural water in Yantai city

Yantai is a typical coastal water-scarce city. The situation of agricultural water use is very severe. Seasonal precipitation and uneven regional distribution. When the water use gap is large, agricultural water use is often squeezed out first. It can be seen from the table that even in the year of abundant water, the actual agricultural water consumption in Yantai City only accounts for 42% of the planned water consumption; the extremely dry year such as 2000 only accounts for 27% of the planned water consumption.

Since 2009, Yantai has accelerated the development of agricultural water-saving, developing water-saving irrigation of 340,000 mu accumulatively, saving 46 million cubic meters of water annually, and constantly improving its agricultural water-saving capacity. As of 2016, Yantai City's agricultural water-saving irrigation reached 4.85 million mu, accounting for 90% of the total irrigation area. Agricultural water consumption continued to grow negatively, effectively alleviating the city's water shortage. However, the form of agricultural water use is still grim, the phenomenon of waste still exists, and the efficient use of water in agriculture needs to be strengthened.

Table 1. Data table of actual agricultural water use of reservoir management units

Project	Designed agricultural water consumption (10,000 m ³)	Actual agricultural water consumption (10,000 m ³)		Actual proportion to plan	
		In 2012,	In 2016,	In 2012,	In 2016,
		Menlou reservoir	1000	0	20
Muyu reservoir	800	300	500	37.5	62.5
Taoyuan reservoir	360	50	100	14	28
Anli reservoir	320	20	80	6.25	25
Longmen reservoir	200	50	100	25	50
Washan reservoir	280	10	120	4	43
Lidian reservoir	300	50	100	17	33
A total of	3660	1000	1530	27	42

2 Agricultural irrigation zoning and evaluation in Yantai city

2.1. Agricultural irrigation zoning of Yantai city

Because the regional natural conditions, social development and residents' life style, different water

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resources distribution, the factors influencing the principal component analysis (PCA), will be a variety of weighting index screening indicators, again using the system clustering method, find out the index of similar areas, as a study area.1

In combination with the natural hydrological conditions, the current situation of social and economic development and residents' living standards in Yantai city, this paper adopts five index modules, including topographical features, climate characteristics, economic level, crop planting structure and agricultural water

irrigation district is more, so this paper first USES efficiency, including 11 indexes, to construct a complete index system, as shown in figure 1. In this paper, DPS data processing system is used for principal component analysis which simplifies the original complex multi-indicator system to a few representative and important comprehensive indicators. Then, DPS system is continued to be used for cluster analysis of the selected indicators, and a pedigree map is drawn, as shown in Figure 2.

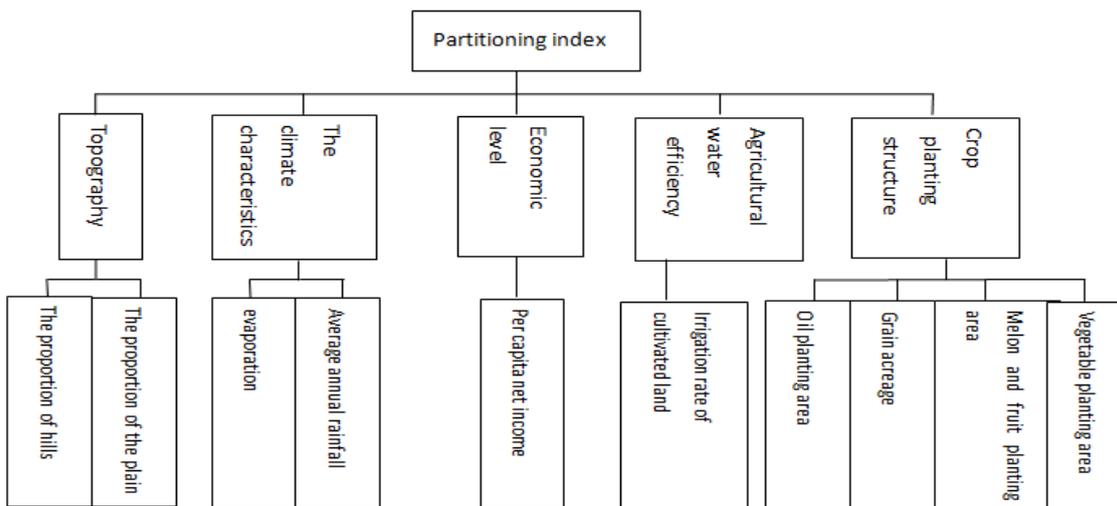


Fig 1. Index system of irrigated agriculture zone

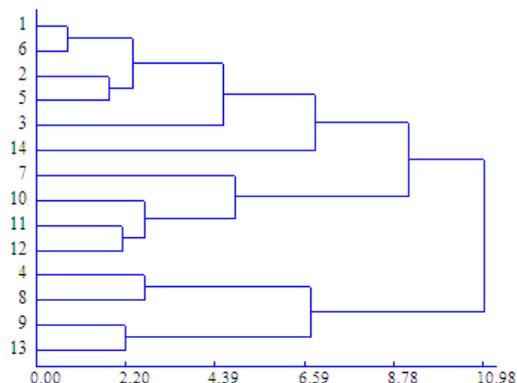


Fig 2. Cluster pedigree diagram

As can be seen from figure 2, when the threshold value is between 4.39 and 6.59, the difference in the sum of squares of dispersion between the same partition indexes is not large, but the difference in the sum of squares of dispersion between different partition indexes is large. Thus the classification at $4.39 << 6.59$ is the result of the irrigated agriculture subdivision of Yantai city. According to the results obtained by the method of dispersion sum of squares, the irrigated agriculture in Yantai city was divided into five districts (see figure 3). The basic partition units included for each partition are shown in Table 2.

Table 2. Irrigation zones

Partitin	Territorial
I	Zhifu district, Laishan district, High-tech zone, Development zone, Fushan district
II	Longkou city, Laizhou city, Penglai city, Zhaoyuan city
III	Mouping district, Qixia city
IV	Laiyang city, Haiyang city
V	Changdao county



Fig 3. Schematic diageam of agricultural irrigation zoning in Yantai city

2.2 Characteristics and evaluation of agricultural irrigation zones in Yantai city

I area: Temperate monsoon climate, the average annual rainfall is 698.3 mm. The spatial and temporal distribution of precipitation in the region is extremely uneven, often appear even years or even dry years. The terrain is complex, with rolling hills and valleys. This research area belongs to the urban area of Yantai city, which is mainly dominated by industry and commerce and residents' life, with a small proportion of agricultural production. Among them, peanut, melon and fruit are the main agricultural crops, and peanut is a drought-tolerant crop. Therefore, agricultural water-saving in this area is mainly targeted at orchards.

II area: Temperate monsoon region continental climate. There is plenty of precipitation in the area, but it is not evenly distributed between the year and the year. It is a major grain-producing area in Yantai city. The grain crop output accounts for 47% of the total output of Yantai city, mainly winter wheat, 31% of the total output of vegetables and fruits, and mainly grapes. Moreover, the water conservancy facilities are relatively perfect, and the effective irrigation area is close to 100%.

III area: Continental climate is temperate monsoon type, precipitation change of time and space, and for many years, the average annual rainfall of 729 mm, region distribution, decreasing from south to north, hill area accounted for 92.2% of total area, is an important vegetable melon and fruit production areas of Yantai. The construction of water conservancy facilities is relatively backward, the water conveyance channels are aging, and the water resource waste is serious. The proportion of advanced water conservancy facilities such as micro-irrigation, pipe irrigation and sprinkling irrigation is small, and the coefficient of water resource utilization is low.

IV area: Belongs to continental monsoon type sub-humid climate, annual average precipitation 686 mm. The terrain is high in the north and low in the south, with hills and hills accounting for 67.4% of the total area. Yantai city is a vegetable base, food crops large farmers. IV area in recent years, vegetable production in about half of Yantai production, food production accounted for Yantai more than 30% of the total grain output. The overall proportion of high-efficient water-saving agricultural irrigation area is small. The construction of water-saving agricultural irrigation has just started, the irrigation channels are aging seriously, and the water-saving construction is messy and not systematic enough.

V area: Is a warm temperate continental monsoon climate, years of average rainfall of 565 mm. The administrative area only includes changdao county, which is mainly farmed by Marine products and has only 78 hectares for food crops. Therefore, the agricultural water-saving in this area is mainly intensive farming without wasting water resour.

3 Analysis of efficient water use model and optimal utilization of water

resources in different irrigation areas in Yantai city

Based on the results of agricultural irrigation zoning in Yantai city, according to the actual situation of each zone, advanced engineering technology, agronomy technology and management technology are applied to study the efficient water use model of agricultural irrigation in each zone.

3.1. I Agricultural irrigation area water model research

More hills in the region, also belong to the semi-arid region, so the use of terraced soil moisture storage and moisture retention model; Secondly, melon and fruit like wetting and are afraid of standing water, so it is advisable to adopt the model of precise and efficient orchard irrigation [1]. 3I area, therefore, the terrace water keep moisture and orchard irrigation mix efficient water use patterns. Terrace soil storage and soil moisture conservation, the slope is built as a terrace, in order to achieve the effect of rainfall interception, water storage and soil moisture conservation. The orchards are irrigated with precision and efficient water use model, which adopts drip irrigation, micro-spraying engineering, automatic management, and precise irrigation according to the growing environment of crops.

3.2. II Agricultural irrigation area water model research

The agricultural water use in the region is mainly aimed at the winter wheat and grape crops to study the water-saving irrigation model. The planting method of winter wheat is furrow irrigation, and surface furrow irrigation, that is, small furrow irrigation mode of low-pressure pipeline, can be adopted. The irrigation quota for small furrows generally does not exceed 675m/hm, which greatly improves the utilization rate of water resources. The efficient irrigation system is shown in Table 3.32 The water-saving and efficient irrigation of grape drip irrigation means that the method of drip irrigation is applied in combination with the water-saving and efficient irrigation system of grape (see Table 4), which generally saves water by 30-50% compared with surface irrigation and 15-25% compared with sprinkler irrigation.

Table 3. Water-saving and efficient winter wheat irrigation system under surface furrow irrigation conditions

Irrigation period	The winter water	Filling water	Earing water	The whole growth period
Irrigation amount (m/hm) ³²	675	675	675	2025

Table 4. Water-saving and efficient grape irrigation system under drip irrigation

Irrigation period	SAP flow period Mid-march to early April	New growth period Middle April to early may	Young fruit growing season Late may to early June	Maturity of branches and tendrils October to November	The whole growth period
Irrigation amount (m/hm) ³²	300	300	300	300	1200

3.3. III Agricultural irrigation area water model research

III area is an important vegetable melon and fruit production areas of Yantai, and water conservancy facilities construction relative lag, water use coefficient is low. Combined with the actual III area, put forward the reasonable mode of agricultural efficient water use (see figure 3).

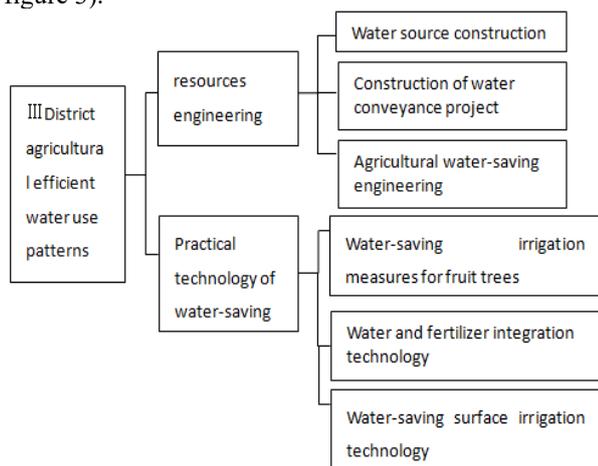


Fig 4. III district agricultural efficient water use patterns

3.3.1 Construction of water sources

Build reservoirs, DAMS and sluice gates and underground water retaining walls at suitable locations to increase water supply; Coastal counties and urban areas to carry out the construction of flood dyke, improve the ability to prevent storm surge; We will make overall plans for water conveyance projects through channels, build a number of new anti-seepage channels, upgrade and renovate aging channels, and reduce leakage and evaporation. We will vigorously develop water-saving projects in agriculture, build new irrigation facilities such as pipeline irrigation, sprinkler irrigation, and micro-irrigation, and make irrigation in grain fields, orchards, greenhouses, micro-sprinkler drip irrigation, and farmland irrigation more scientific

3.3.2 Practical technology of water-saving irrigation

First, fruit tree water-saving irrigation includes strengthening orchard coverage, reasonable shaping and pruning, and timely water-saving irrigation. Orchard coverage to maintain soil moisture, saving water; Reasonable pruning can reduce leaf transpiration, improve photosynthetic efficiency and promote root growth. Timely water-saving irrigation to ensure the normal growth of fruit trees need water. Second, water and fertilizer integration technology. Through the low-pressure pipeline system and the irrigator on the final pipeline, the water containing soluble fertilizer can be delivered directly to the soil surface or soil layer near the root of the crop uniformly and accurately. Third, water-saving surface irrigation technology. It includes leveling the land, designing reasonable size of furrow and furrow and technical parameters of irrigation, improving the way of wetting surface irrigation improving the way of water discharge, developing intermittent irrigation, vigorously developing water conservation and moisture film irrigation and so on.

3.4 IV Agricultural irrigation area water model research

Research IV district agricultural efficient water use pattern, first of all, upgrade aging water conservancy facilities, constructing water-saving irrigation project, including small and medium-sized irrigation and water saving reconstruction project and small water projects, complete engineering system layout. Secondly, the introduction of appropriate advanced irrigation techniques, namely, adjust measures to local conditions of the fed, sprinkler irrigation and microspray irrigation technology, cooperate with the implementation of agriculture, water conservancy, management, technical measures, such as establishing different mode of water-saving engineering technology, after years of practice, has formed for haiyang city engineering technology of water-saving irrigation for different types of regional development pattern. Finally, according to the terrain features, formation of small and medium-sized irrigation channel gravity irrigation and dig a canal for irrigation gravity irrigation, since the pressure pipe irrigation system, fixed pump + + rf frequency conversion controller card + PVC - M + glass fiber reinforced plastic pipe outlet engineering irrigation irrigation mode, at the same time, with reference to the construction, the soil moisture monitoring system for pressure and flow of the above irrigation mode for real-time monitoring, precision measurement, according to the water supply, water price reform, ensure the long-term operation of the project.

3.5 V Agricultural irrigation area water model research

V agricultural irrigation area in the administrative areas including changdao county, only 56 square kilometers land area, its agriculture mainly farming, there are only

78 hectares of crops, wheat and corn are accounted for 50%, 39 hectares, vegetables and fruits planting area is zero. Agricultural water-saving measures in Changdao county mainly adopt water-saving irrigation technology, reduce flood irrigation, and promote sprinkling irrigation and drip irrigation. We will upgrade and renovate backward water conveyance channels, phase out earth canals, strengthen the construction of impervious channels, and reduce evaporation and leakage of water resources. According to the favorable terrain, reasonable scale of tangba and reservoirs should be built to realize the effective storage of surface runoff.

4 Conclusions and Suggestions

Yantai is a coastal city lacking water. With the continuous development of social economy and increasing population, the demand for water resources is increasing and the contradiction between supply and demand is intensifying. However, the phenomenon of flood irrigation still exists in the agricultural water consumption of Yantai city, which is the largest user of agricultural water. The low efficiency of agricultural water consumption leads to the serious waste of water resources, which restricts the rapid development of the social economy of Yantai city. Therefore, adopting reasonable measures to realize the efficient use of water for agriculture in Yantai city is an important way to ease the contradiction between the supply and demand of water resources in Yantai city and promote the sustainable development of social economy in Yantai city.

In this paper, the natural environment, social and economic development status, residents' living standards and agricultural development status of the area were taken into consideration, and the index system of irrigated agricultural zones was established. Then, the principal component analysis method and DPS system were used to draw a cluster genealogical chart. According to the genealogical chart, the research area could be divided into five different agricultural irrigation zones. I zone Zhifu, Laishan district, including High-tech zone, development zone, Fushan district; II area including Longkou city, Laizhou city, Penglai city, Zhaoyuan; III area including Lai Yang city, Haiyang city; IV area including Muping county, Qixia city; V area including Changdao county, and evaluate each partition for agricultural irrigation district.

On the basis of the evaluation results of irrigation zoning, according to the characteristics of each irrigation zoning, we made overall planning and adopted measures according to local conditions, combined with advanced engineering technology, agronomy technology and biotechnology, introduced advanced management theory, and developed a more effective and reasonable efficient water use model.

Agricultural efficient water use is an important link to realize efficient utilization of water resources, and Yantai city's agricultural water use is the largest user of water in Yantai city. Therefore, under the current situation of increasing demand for water resources in

Yantai city, increasingly prominent contradiction between supply and demand, and continuous occurrence of geological environment problems, the realization of efficient agricultural water use in Yantai city is an important measure to realize efficient utilization of water resources in Yantai city, the residents' living and working in peace and contentment, and the sustainable development of social economy.

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