The economic analysis of sustainable utilization of agricultural water resources in Shandong province

Jia Shua, Huang Ying

Abstract

With the social and economic development in Shandong Province and the acceleration of urbanization, water supply and demand have taken place great changes. Based on the supply and demand of the water resources in Shandong Province of the calendar year, and use Cobb-Douglas production function to analysis the economic relations of agricultural water resources’ sustainable utilization in Shandong Province.

Keywords: Agricultural water resources; Sustainable utilization; economic benefits

Water is the indispensable fundamental resource in maintaining the industrial and agricultural production in people's lives. It involves all departments with economic and society, therefore, in order to guarantee the sustainable development of society and economy, water resources must be rationally allocate. An agricultural water resource is one of China's basic agricultural resources, it not only provides the necessary supporting conditions for agricultural production, but also affects the region economic efficiency and sustainability.

1. The definition and characteristic of water

In nature, water has unique geographical features, which consists of river basins or hydro-geological units as a unit to constitute a unity, each basin of water resources is a complete drainage system, and various types of water realize recycling by constant movement and mutual transformation. But it has a

* Corresponding author. Tel.:+86531-86865230, +8615666012121
E-mail address: ying2008jn@gmail.com
very limited reserve, its Space-time distribution is severely differential, and also nature requires a lot of ecological environment water to maintaining ecological balance.

In production, water resources are mainly embodied in water supply. Water supply with regional natural monopoly, usually be provided and managed by the local government. Meanwhile, surface water and groundwater no matter from the reserves or supply is presence with a big difference.

From the consumer point of view, water demand includes two aspects that water quantity demand and water quality needs. There is a small elasticity in human basic water use, but most has relatively large elastic as diversification water. Agricultural water occupies a large proportion of water and precipitation has a reverse fluctuations. Water-saving agriculture depends on water management and water saving technology facilities, and it needs a huge water-saving investment.

From the economic point of view, water has the characteristics of mixed economy, not only with the properties of private goods, but also with the properties of public goods, both are mix together and can not be separated, also water has a nature of not-specificity. The fluidity of water leads it very difficult to measure and track. Following the current technical conditions, it is hard to divide which part of the water belong to someone, even if specific provision, it also cannot assure the water will not be used by others. Water in economics is a kind of exclusive and expensive resource, in establishing and protecting the special property of water is it very difficult and expensive, also the cost of regulation, guarantee and implementation for the property right of the proprietary is much more than any other profit we can get.

2. The problems and difficulties in utilization of Shandong agricultural water resource

2.1 Agricultural water contradiction between supply and demand is intensified

Since 2000, the demand of water resources in Shandong province is constantly changing. From the Fig 1, we can see that the Shandong province's water resources has been in declining trend, and agricultural water appears "V" type fluctuations, including the lowest numerical of 199.78 billion cubic meters in 2006’s Shandong province's water resources since 2000, in contrast to the demand 222.24 billion cubic meters of water that year. Meanwhile, the total supply of water is 225.53 billion cubic meters, which serious beyond the scope of water resources in Shandong province. The extra water supply is mainly comes from the groundwater resources by over-exploited except the guest water.
By the historical analysis, Shandong province agricultural water still exist serious contradiction between supply and demand. Shandong province water consumption and water supply is almost flat during 2002 to 2008 by macroscopic perspective from table 1. But through comparing the data we can easily see that Annual use of water has been basically achieved all the Shandong available water, also it have been increasing each year. In the future, the growing of population and the increasing of people demand on food will lead further growth in agricultural water consumption. However, with the rapid development of economy and industrialization and the acceleration of urbanization, the proportion of agricultural water is decreases, while the proportion of industrial and living water tends to increase gradually. From the table in 2002, it is known that Chinese agricultural water is about 192.87 billion cubic meters, accounting for the total consumption of water 78.8%, by 2008, this ratio descend to 74%. Meanwhile, the proportion of industrial and living water is from 21.2% rise to 27%. The profit of unit water resources in industrial and living department is much more than that in agriculture department, which is why the agricultural water is diverted by other water. Therefore, with nonstop development of industrialization and urbanization, as long as the existence of comparative advantage, the agricultural water share will continue to decline. So not only the shortage of agricultural water resources but also the contradictions will become more and more outstanding.

Table 1: The water supply and used during 2002 to 2008 in Shandong province

<table>
<thead>
<tr>
<th>Year</th>
<th>The amount supply of water (Billion cubic meters)</th>
<th>The amount used of water (Billion cubic meters)</th>
<th>Agriculture</th>
<th>Industry</th>
<th>Living</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Used (Billion cubic meters)</td>
<td>Ratio</td>
<td>Used (Billion cubic meters)</td>
<td>Ratio</td>
<td>Used (Billion cubic meters)</td>
</tr>
<tr>
<td>2002</td>
<td>252.39</td>
<td>244.73</td>
<td>192.87</td>
<td>78.80%</td>
<td>36.59</td>
</tr>
<tr>
<td>2003</td>
<td>219.34</td>
<td>215.7</td>
<td>162.54</td>
<td>75.40%</td>
<td>27.96</td>
</tr>
<tr>
<td>2004</td>
<td>214.88</td>
<td>211.3</td>
<td>160.14</td>
<td>75.80%</td>
<td>24.81</td>
</tr>
<tr>
<td>2005</td>
<td>211.02</td>
<td>207.65</td>
<td>161.73</td>
<td>77.90%</td>
<td>18.38</td>
</tr>
<tr>
<td>2006</td>
<td>225.53</td>
<td>222.24</td>
<td>175.07</td>
<td>78.80%</td>
<td>18.93</td>
</tr>
<tr>
<td>2007</td>
<td>219.55</td>
<td>219.55</td>
<td>164.81</td>
<td>75.10%</td>
<td>24.12</td>
</tr>
<tr>
<td>2008</td>
<td>219.89</td>
<td>219.89</td>
<td>162.76</td>
<td>74.00%</td>
<td>24.69</td>
</tr>
</tbody>
</table>

2.2 The impact on sustainable use of agricultural water resource by urbanization

Shandong province is located in the north China plain where the place is the most shortage of water resource in China. In autumn and spring it cause drought frequently, agricultural development has been restricted by water shortage all the time. With rapid urbanization and high-speed economic development, the use of the water by urban life and production increased substantially, which bring tremendous influence on agricultural water resources and water environment, so the shortage of agricultural water resource is become more severely. According to the statistics from 2000 to 2006, the population of municipal water in Shandong province is growth from 1723 million to 2,476 million, six years has increased 43.7%; The output of urban water supply is from 231,941 million cubic meters increased to 279,058 million cubic meters, in which urban life-water quantity by 93,394 million cubic meters increased to 127,317 million cubic meters, the growth is about 36.32%[1].

In order to satisfy the growth of municipal water use and life use, increase in surface water supply from the surrounding areas at the same time, most of the city have to rely on over-exploited groundwater to increase water, groundwater become the mainly sources of the city water supply. In Shandong peninsula, the rate of municipal groundwater exploitation utilization has exceeded 65% except the city of Rizhao and Weihai. Because of the long-term mining of groundwater are more than supplies, underground water level drops seriously at the region of Shandong plain. Groundwater over-exploitation brings the surface runoff and groundwater resources available, which bring protection of local agricultural water resources a serious threat. Coastal cities in long-term excessive exploit groundwater have caused serious sea salt-water
intrusion. At present, Shandong have six coastal cities have a phenomenon that different degree of sea salt-water intrusion, seawater intrusion area is more than 1,000 square kilometers. The sea salt-water intrusions not only make the groundwater of different level salinization, but also destroy the agricultural land and agricultural irrigation facilities, which cause great losses to the agricultural economic benefits.

2.3 Increasing levels of water pollution

Following the development of the industry and the city, a lot of contaminated water directly discharged into the river without processing; the wide use of fertilizers and pesticides on agricultural water resources caused extensive pollution, especially to the main sources that the Yellow River in Shandong province. In one hand this water is from the upstream, in another hand is from the Changping Beach, Dawin River, etc. Large quantities of industrial wastewater and sewage flow into the Yellow River caused the pollution levels has been rise year by year. Water quality in the early 1990s only a few months over standard, but in recent years there only have a few months not over standard, even year-round over standard. According to statistics, the water quality is almost 60% of the Yellow River’s mainstream belongs to IV-bad V classes, the pollution is very serious.[2]

3. The impact on economic development in sustainable utilization of agricultural water resources in Shandong province

3.1 Water problems affect the development of social economy

Water resources sustainable utilization will become the priority global resources in 21st century; it not only affects and restricts the sustainable development of modern society, but also threatens the human survival and development directly. Therefore, sustainable development of society and economy must be combined with resources and environment. In the future, we should not only follow the law of economic development we have found in economic development, the more to follow the natural evolution rule that according to the material circulation, regeneration and biodiversity coexistence alternate rule and so on, reconstruction economy and society coordinated development of ecological civilization between human and nature, in order to maintain the balance between them. The core of sustainable development is the sustainable utilization of resources, only depend on the sustainable utilization of resources, can we truly achieve the sustainable development of the human society and economy. Due to the development of social economy can not without water, so if the water resource is in a crisis situation, it will impact on the social economy development inevitably. For example, water pollution and the lack of water security threaten the human health, influence social stability and national unity. Simultaneously, the shortage of water resource directly affects industrial and agricultural production, thereby affecting the economic growth.

3.2 The impact on economic development by Shandong agricultural water resources

Water shortages directly affect the economic stability and economic sustainable development, and as the shortage of water resources, economic system is affected by the coupling between itself and resource system, will force the economic adjustment according to the various water’s changing, which affects the whole economic system’s sustainable development, this is the key to economic sustainable development[3]. In the process of production, the manufacturer will translate production factors into produce, the production factors can be divided into three types of labor, materials, capital, and raw materials include water. The relationship between production factors and the final output can be described with production
In the production process, the relationship between economic growth and resources can also be described by this formula:

\[ Q = f(X_1, X_2, \ldots, X_n, K, L) \]  

In this formula, \( Q \) is the maximum production; \( X_i \) \((i=1, \ldots, n)\) is investment of resources; \( K \) is capital input; \( L \) is labor input. According to Colby-Douglas production function, we can transform the input-output formula into:

\[ Q = AK^{\alpha}L^{\beta}X_1^{\alpha_1}X_2^{\alpha_2}\cdots X_n^{\alpha_n} \left( \alpha + \beta + \sum r_n = 1 \right) \]  

Formula assumed condition is the constantly technical level and the unchanged scale benefits, seemed as marginal benefit will not change with the scale of input. \( A \) is technical condition; \( \alpha, \beta, \alpha_i \) are equipment, labour and resources' coefficient of elasticity, reflecting their contribution for output; \( \alpha \) is the proportion of output brought by equipment; \( \beta \) is the proportion of output brought by labor; \( r_i \) is the proportion of output brought by resource input. Micronization the formula, then we can find out that:

\[ \frac{dQ}{Q} = \alpha \left( dK / K \right) + \beta \left( dL / L \right) + \sum r_i \left( dX_i / X_i \right) \]  

The formula means that relative growth rates' weighted sum of gross output, therein the weight is output elasticity coefficient, presumes \( X_1 \) as the inputs of agricultural water resource, then \( r_i \left( dX_i / X_i \right) \) is the influence coefficients of agricultural water resources to total economic output growth. When agricultural water shortages happened, namely expresses \( dX_i / X_i \) can not reach the requirements of the water resources growth rate for the economic growth target, especially when the inputs of agricultural water resources no increase or the growth of inputs decrease, the regional economic growth will be blocked or stagnation in Shandong province.

4. Summary

In order to realize the overall development goals of Shandong province, we must optimize the regional industrial structure; realize the coordinated development between departments and rational utilize the natural resources. Under the shortage condition of water resources, it is very necessary to establish an efficient production mode, not only to ensure the higher economic profit in the industry development, but pay attention to the optimal configuration in bottleneck resources - water resources. The basic idea in reasonable allocation of water resources is on the premise that ensures the ecological water use and the rise use of the water for living; we have to consider the water demand and the inter-constraint of each department. Thus to sustainable the development of the social economy and achieve the best goal of social overall income.

References