

The Status of Water Resources in Taiwan Area and the Measures to Promote the Sustainable Development

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Abstract. Taiwan is located in subtropical area and the rainfall is extremely rich. However, the limited factors, such as the special geographical conditions, steep terrain and the uneven spatial and temporal distribution of rainfall make only 18% runoff can be used. Furthermore, the dense population and high developed industry make the per capita average annual precipitation is only one-seventh of the world average and make Taiwan become a relatively water-scarce country. To thoroughly solve the issue of water resources in Taiwan area and in response to the impact of changes of water environment in the world, it is imperative to review the current status of the development of water resources and construct a complete set of water management strategies and measures. This article aims to analyze the problems of water resources in Taiwan and develop water management strategies in the future to promote the sustainable development of water resources.

Keywords: the status of water resources, the sustainable development, Taiwan area

1. Introduction

Water is the most important factor affecting the development of one country. Water resources are related to the quality of our life and the development of society and economy. Water is not only the limited resources that can affect industrial development and environmental protection, but also has a direct impact on the change of industry, economy and social culture.

Taiwan is located in subtropical area and the rainfall is extremely rich. However, the limited factors, such as the special geographical conditions, steep terrain and the uneven spatial and temporal distribution of rainfall make only 18% runoff can be used. Furthermore, the dense population and high developed industry make the per capita average annual precipitation is only one-seventh of the world average and make Taiwan become a relatively water-scarce country. From the perspective of the world, the global warming has deteriorated the world water environment and the extreme weather events have occurred increasingly in Taiwan. In addition, the rapid development of industry, concentrated urbanization and the overused of land resulting in the significantly decrease of the tolerance of water resources and the water, drought disaster become more serious.

To thoroughly solve the issue of water resources in Taiwan area and in response to the impact of changes of water environment in the world, it is imperative to review the current status of the development of water resources and construct a complete set of water management strategies and measures. For a long time, in order to provide stable, enough and good quality water for people's life and industry, the administrative departments in Taiwan have attached great importance to water conservancy construction, which has laded the foundation for booming economy. But after the drought caused by inadequate rainfall in 2001, 2002, 2003, 2004, 2009 and 2010 and the typhoons occurred in 2004, 2005, 2009 and 2010, the river became more turbidity and then caused water shortages. All these problems must be solved.

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In recent years, due to the high development and rapid changes of social and economic activities in Taiwan, the structure of supply and demand of water resources have changed substantially. How to set good policies and measures will be the important basis for sustainable development of water resources in the 21st century. Water resources include public, industrial and agricultural water supply facilities, watershed management and reservoir construction. All these are built in the considerations of public interest and the benefits are also shared by the all people. In addition to expand domestic demand of construction projects directly, they can also enhance our quality of life and promote social and economic sustainable development. On the occasion of the 21st century, water utilities are the important issue that the entire world must give priority to it.

2. The status of Water Resources in Taiwan

According to the estimates of Taiwan's economic department that the total water demands after 2011 will increase to 20 billion cubic meters in Taiwan. How to overcome the shortage of stream water, master the reliable water resources and avoid the water scarcity is an important policy direction. Despite the abundant rainfall in Taiwan, the factors such as the hydrological conditions, environmental change, the use of land and economic development make it still has following issues.

2.1. The lower average water source for one person per year

Taiwan is surrounded by sea and the climate is warm and humid, the annual average rainfall is about 2,467 mm, which is 2.6 times than the world average rainfall. But the average rainfall for each person is only about 4,074 cubic meters, which is just the one fifth of the world average rainfall. In addition, according to the study based on the data of global hydrological from 1961 to 1995 by Environmental Systems Research Center of the University of Kassel in Germany, Taiwan become one of 19 water-scarce countries in the world and the water scarcity is serious.

2.2. The higher uncertainty of hydrological

The annual average rainfall is about 2,515 mm in Taiwan, but the spatial and temporal distribution of rainfall is uneven. The annual rainfall in mountainous areas up to 3,000 to 5,000 mm, but some west coast plains region is only about 1,200 mm. On the one hand, the uneven distribution of rainfall is on the long time, the annual average rainfall up to 3,250 mm in the period that the rainfall is most abundant. But the annual average rainfall is only 1,600 mm in the period that the rainfall is least, and difference was more than 2 times. On the other hand, the uneven distribution of rainfall is on the short time, the average rainfall is 1,960 mm during the rainy season that from May to October, while the average rainfall is only 550mm during the dry season that from November to April of the next year, the differences up to 3 times.

2.3. The lower tolerance of drought

In the past time, the industry in Taiwan was dominated by agriculture and the main living lifestyle is rural-style. In that time, the using of agricultural water was flexibility and had high tolerance to waterlogged fields, so the losses of flood and drought disaster were relative small. With the economy development rapidly, industry increasingly take instead of agriculture and population is gradually concentrated in urban. In this condition, the slight lack of water could cause significant damage. In addition, flooding tolerance is also greatly reduced, which has impacted the supply system of water and the measures of flood control.

2.4. The over-exploitation of land in the upstream basin

The water structure of supply and demand in Taiwan is varies according to wet years and dry years. The water that can not be used takes account for 24%, the remaining is river runoff and groundwater infiltration, which take account for approximately 76 %. Theoretically speaking, all the remaining water resource can be used. But the river in Taiwan is short and the stream flows rapidly, coupled with intensive rainfall and the lower capacity of saving water, thus most of the rainfall come into the ocean.

2.5. The effect of the change of global climate

An article "Natural Disaster Hotspots-A Global Risk Analysis" published in 2005 by The World Bank described that the land that faced 3 kinds of natural disasters account for 73% and the population that faced 3

kinds of disaster threats is also 73%, which are the highest in the world. The land that faced 2 kinds of natural disasters and the population that faced 2 kinds of disaster threats account for 99%.

The effects of the change of global climate become increasingly significant, it will endanger the survival of the environment, resources, ecology, livelihood security and industrial development, especially affect the island such as Taiwan. According to a study, the rainfall of Taiwan will be reduced by 5-10 % in the winter in 2050, while be increased by 5-10% in the summer, and the rainfall from May to October will exceed 80% of total rainfall in the year. The differences of water volume between wet season and dry season will be greater, thus affect the ability of water allocation seriously.

3. The measures to promote the sustainable development of water resource

According to the water policy and strategic objectives of Taiwan and taking current and future water resources in Taiwan into consideration, it is important to take measures to promote the sustainable development of water resource. All in all, it should continue to set out the Water Department to manage all the water resource in Taiwan. Water Department should make the responsibility between related departments clear. It also needs to divide different water district in accordance with allocation of supply and demand of water resources, the characteristics of watershed and the distribution of groundwater. Furthermore, Water Department should establish a manage department in each water district, and the tasks of them is to help county government to strengthen water conservancy construction and improve the quality of water services .they should also help build major construction in Taiwan and promote social and economic development. Last, Water Department should promote “The plan to develop the water resource”, and take four strategies which include scientific management, rational distribution, amendment Act and education and advocacy to innovate the system of water rights and promoting rational allocation of water resources .

The development of water resource should mainly focus on the water on the ground, but it should take the river ecosystem into account. The development of groundwater should be supported with other water resource and focus on rescuing drought, and guided by the principles that diversify and complement the overall ecological environment. Promote the plan to develop watercourse systems and reuse the recycling wastewater. It can build water-park, ecological conservation and other facilities in the beach the river near the city, thus can provide the recreation space for public, protect river ecology and create new water culture. Drew up a plan of “Science and Technology Development of Water Resource “, integrating various research institutions and government agencies at all levels to make full use of limited manpower and resources. Combining forces of civil society to help relevant administrative departments to promote soil conservation near reservoir, protect reservoir safety, cultivate serious of water conservation. Educating people care resources and promote the sustainable use of water resources. The specific measures should as following.

3.1. Strengthen the governance of reservoir

At present, government has published the “reservoir catchments outline”, and the goal is to develop annual installments governance and management strategies by holistic planning. It also needs to strengthen land management, improve conservation and habitat, plant vegetation, conserve water and streams, protect forest and other works.

3.2. Update and improve existing facilities of reservoir

Under the condition that the new water resource is difficult to develop, it is important to make full use of the reservoir. If Shimen Reservoir is no longer available, it will cause a great impact on the northern area and southern reservoirs may also face the same problem. So it should give priority to improve the existing reservoir and make water supply system stably. The measures to improve the reservoirs contain three aspects. First, it should build spillway to increase the total drainage. Second, the height of reservoir needs to be increased to improve the capacity of supplying water and combating a flood. Third, review the operation in response to climate change and adjust storage space and flood control operations flexibility.

3.3. Strengthen allocation of regional water resources

In order to strengthen the flexibility of allocation of regional water resources, it should set pipeline through regional liaison for the joint use of regional water resources. Because the facts such as pressurized

water pipeline operation, leakage losses and cost-effectiveness, the current allocation is mainly among the northern, central and southern regions.

3.4. Promote the diversified way to develop water resources

Because of the uncertainty of hydrological condition, climate change and the existing conditions that limit the conservation of the natural environment, it is necessary to develop diversified way to develop water resource. In addition to the traditional way such as make plan to develop the reservoir water and groundwater, but still need to promote rainwater collection retention, seawater desalination, sewage recycling, industrial waste water recycling and the recycling of irrigation drainage water.

4. Conclusion

Water policy is not only related to the well-being of the people's livelihood, but also involves the land planning, water and soil conservation, and the problem of environmental protection in the overall development of Taiwan's economic construction. In the future, the government should provide good quality and quantity of water resources, shape the clean and pleasant hydrophilic environment, and serve to people positively. And on the concept and specific practice, the government should procure an organization of water conservancy with high-efficiency, and fully attaches great importance to the rights and interests of citizens and pay attention to reasonable and effective allocation of water and soil resources. At last, all the people should share the achievements of water conservancy.

Looking forward to the future, the policy and measures of water resource in Taiwan must be compatible with the development of the land, and should seek a balance between "cutting expenditure and revenue "and" conservation and development" to promote prosperity of society and economy and sustainable development of water resources. In order to promote the implementation of these measures, the government departments should strengthen the human resource management to make full use of professional manpower, change the water law and relevant regulations, and raise funds for water conservancy construction, properly deal with the water conservancy project planning. Only by these ways can government improve the quality of life of the people and promote the competitiveness of Taiwan.

5. References

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