

Water Resources Management: China's Water Scarcity Problems and Coping Strategies

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ABSTRACT

China is facing increasing water scarcity, especially in the counties of the North China Plain. Water is mainly used for agricultural, industrial and domestic purposes. China's rapid economic and population growth in recent years has exacerbated water stress. Long-term mismanagement of water resources is also a major cause of water scarcity. Most of China's surface water is recharged by rainfall. Since the rainfall in water-stressed areas is always unstable, the spatial distribution of water resources is uneven. Thus, we can learn that county water deficits across the year are caused by climate change. This paper aims to assess the water risk due to water scarcity and the State of China's water scarcity strategy.

KEYWORDS

Water Resources Management; Water scarcity; Water risk; China's water scarcity strategy.

1. INTRODUCTION

China is facing increasingly severe water scarcity, especially in the North China Plain counties. The water is mainly used by agricultural, industrial and domestic purposes. The rapid growing economics and population in the past years of China made water stress worse. Long-term poor water resource management is also one of the main reasons of water scarcity. Most China's surface water is recharged by precipitation. Due to highly water stressed areas always have unstable rainfalls, it creates uneven spatial water resource distribution. Thus we can learn that county water deficits cross the year are caused by the climate change. This paper aims to assess the water risk on account of water scarcity and state China strategy of water scarcity.

2. CHINA'S WATER RESOURCE

2.1. Current situation

In 2016, China's annual total water resources amounted to 324.64 billion cubic meters. In 2015, the total amount of water resources was 279.62 billion cubic meters, and the average annual precipitation was 660.8 millimeters. The total amount of water resources refers to the amount of surface and underground water produced by precipitation, that is, the sum of the runoff from rivers (excluding the amount of water coming from outside the area) and the precipitation infiltration recharge [1].

In 2016, the total water supply in the country was 604.02 billion cubic meters. Accounting for 18.6% of the total water resources; in 2015, the national total water supply was 610.32 billion cubic meters, accounting for 21.8% of the total water resources in the current year.

2.2. China's water supply and uses

From China's water supply structure, the surface water supply volume is 4912.4 billion cubic meters, accounting for 81.3% of the total water supply; the groundwater source water supply is 105.70 billion cubic meters, accounting for 17.5% of the total water supply; the other water supply is 7.08 billion cubic meters, accounting for the total water supply. 1.2%.

The demand for water resources has connection with almost every aspect of the national economy, such as industry, agriculture, construction, and living conditions. Severe water shortages have led to restrictions on China's urban modernization development, GDP growth, and residents' living standards. In 2016, the country's total water consumption was 604.02 billion cubic meters. Among them, domestic water accounted for 13.6% of total water consumption; industrial water accounted for 21.6%; agricultural water accounted for 62.4%; artificial ecological water supply (including urban environmental water supplied by artificial measures and some rivers and lakes, wetland recharge) accounted for 2.4%.

2.3. Water quality in China

Although the total amount of water resources in China is large, the large population and water consumption per capita is low, and the water resources that can be used as drinking water are limited. Industrial wastewater, domestic sewage, and other wastes entering rivers, lakes, and other bodies of water would exceed the self-purification capability of water use, endangering human health or damaging the ecological environment and causing deterioration of water quality. China's water quality is divided into five categories, as drinking water sources are only first, second and third category. In 2016, the proportion of water bodies of Category 4, Category 5, and Category 5+ that did not meet drinking water standards in China accounted for 28.8%, 33.9%, 32.9%, and 32.3% respectively in rivers, lakes (reservoirs), provincial waters, and surface waters[2]. Compared with developed countries, China's water pollution is mainly due to heavy pollution such as heavy metals and organic substances.

3. CAUSE OF SCARCITY

3.1. Water Pollution

China's 7 major river systems are generally polluted, and the Haihe River and Liaohe River are badly polluted. Among the 2800 lakes in the country, most lakes that receive urban sewage have experienced water eutrophication. More than 80% of the wasted water is directly pumped into natural waters without any treatment, 90% of the Chinese municipal water is polluted. The water that 700 million people drink has been detected has escherichia coli, and the water consumed by 300 million people has been detected has excessive iron content[3]. 1.1 billion people drink high-hardness water, and 0.5 billion people drink high-nitrate water. Only 23% of the water used by the residents in 35 key cities across the country basically meet the hygiene standards.

3.2. Over exploitation

About half of the water resources have been developed and utilized in China. The water resources utilization and development rate of Haihe River water resources has already reached 100%, which is greatly exceeds the upper limit of the internationally recognized water resources utilization and development rate (30% to 40%). The utilization of surface water of Haihe River, which has the highest water resources utilization and development rate, reached 94%. The development rate of the shallow groundwater of plains was 100%, and the total water consumption rate reached 96%. Other regions of China also have the problem of the overexploitation of ground water. The proportion of

groundwater of the water resources used in the cities of North China and Northwest China is as high as 72% and 66% respectively.

At present, the over-exploitation of groundwater in the Shiyang River Basin has resulted in the decrease of water storage content in the aquifer and a drastic drop in groundwater level.

3.3. Serious Waste Phenomenon

Agricultural water, industrial water, and municipal water are the three main uses of water resources in China. However, all of the three main uses of water resources have widespread serious waste phenomenon of water resources. According to statistics, in North China Plain, half of the agricultural water is lost through leakage through the conveyance of agricultural water process. China requires 972 m³ of water to irrigate and produce 1 tone grain, while Israel only requires 280 m³.

In the industrial sectors, due to the backwardness of existing water-using facilities, the current water consumption of ten thousand yuan output value is 103m³, compared with 8m³ in the United States and 6m³ in Japan. These conditions are part of the reasons why China's water volume is 10 to 20 times than that of developed countries. At present, the reuse rate of industrial water in China is only about 55%, while the average use rate of industrial water in developed country is 75%-85%.

3.4. Serious Soilerosion and ecological deterioration

At present, the area of soil erosion in China is 3.56 million square kilometers, which has reduced than few years ago. However, the area of water and soil erosion in western China still expands, especially the soil erosion in the upper reaches of the river is still serious. The areas subject to water erosion are mainly distributed in the upper reaches of the Changjiang River in the areas of Yunnan Province, Guizhou Province, Sichuan Province, Hubei Province as well as the areas located near the middle reaches of the Yellow River, like Shanxi Province, Shanxi Province, Inner Mongolia, Gansu Province and Ningxia. The water and soil loss in some of the regions in Heilongjiang Province, Liaoning Province, Shandong Province and Hebei Province, etc is also very serious. The regions that are most affected by wind erosion are Xinjiang, Inner Mongolia, Qinghai and Gansu which are located in the northwest region. The area of soil erosion in the Yangtze River Basin has increased increased to three times in the past 25 years, and the annual sediment deposition in the Yichang region has reached about 500 million tons.

4. RISK OF WATER SCARCITY

The risks associated with water scarcity are numerous and affect everyone on many levels. When we talk about the lack of water we think first of all in the African country who are more supported by "water stress". That is to say, people who live with less than 5 liters of water a day which is not necessary to satisfy human needs.

The countries affected by water stress are more than 40 and this number is likely to increase in the coming years, particularly in northern China.

4.1. Geopolitical issue

Water scarcity with serious consequences on the internal and external geopolitics of a country. In Asia 10 of the main rivers of the continent have their source in China. China has a strong demographic need more water, water management upstream by China can affect the water resources that have neighboring countries. All of this can lead in the future to conflicts over water see a water war. Of course, this is not just about China, there is the same problem in the countries bordering the Nile (Egypt, Sudan, and Ethiopia) or at the level of the Aral Sea.

4.2. Supply food issue

Indeed, water is so important to our human, agricultural and industrial needs as to doing nothing to manage global and non-local resources on the run for a new world war. But if water can create tensions between countries it can create also within the same country. Indeed, a lot of countries do not have the same climate everywhere, nor the same geography. This is particularly the case of large countries like China where part of the country does not have access to large rivers. In addition, water is not used only for human beings, this need besides a small part of the total consumption of water (1%). Water is partly used for agriculture. The lack of water for this area has less meat production, on average to make a kilo of beef it takes 15,000 liters of water, or grains such as rice that requires 2500 liters per kilo. If the production of the first firsts for the lowering of food, it causes a rise in food prices see a famine as in Yemen[4]. All of these factors can lead to internal conflicts such as civil wars.

5. CHINA'S STRATEGY OF WATER SCARCITY

5.1. Desalination project

According to the "Analysis of China's desalination industry in-depth survey and investment strategic planning analysis report", by the end of 2010 more than 70 desalination devices have been built, with a designed capacity of 600,000 cubic meters/day, with an average annual growth rate of more than 60% [5]. Breakthrough progress was made in technologies with independent intellectual property rights. Significant progress was made in reverse osmosis seawater membranes, high-pressure pumps, and energy recovery devices, and the salt rejection rate increased from 99.2% to 99.7%. Industrial development has met the conditions and the desalination market has basically taken shape.

According to the calculation of seawater desalination capacity increase of 1.7 to 2 million tons/day in the next 10 years, the investment in seawater desalination equipment is expected to reach 120 to 14 billion yuan in the next decade, and the industry is expected to enter a period of rapid growth. Taking into account the cost reduction brought by future technological advances and policy support and other factors, the desalination industry is expected to have explosive growth in the future. The aim is to produce 2.5 to 3 million tons of desalinated water a day by 2020 and quadruple the country's capacity to desalinate seawater.

At present, desalination technology is relatively mature, and it is mainly divided into distillation and reverse osmosis methods. The reverse osmosis method is filtration, using the high pressure applied by the high-pressure pump in the device, to squeeze the fresh water in theseawater to the side of the reverse osmosis membrane, and the inorganic salt and other components remain on the other side of the membrane. The cost of seawater desalination is still relatively high. The first is electricity. In the future, the domestic industrial electricity price will continue to increase. Under the current state of technology, the cost of energy consumption is difficult to reduce. Domestic reverse osmosis membranes and foreign membranes are still a bit of a gap, the cost is relatively high, and can only rely on imports. As for equipment and materials, seawater is corrosive, so that the flow-through components are resistant to corrosion, and the membrane materials are easily contaminated and have a service life. The reverse osmosis membrane is generally 3-5 years, and then it needs to be completely replaced. In addition, the plant's labor, technology, and related depreciation are also included in the cost. These are great expenses for the national finance.

5.2. South-to-North Water Diversion Project (SNWDP)

The South-to-North Water Diversion Project is a strategic project of China and is divided into three routes: East, Central and West. The starting point of the Eastern Route Project is located at the Jiangdu Water Control Project in Yangzhou, Jiangsu. The middle line project is located at the Danjiangkou

Reservoir in the upper and middle Hanjiang River. The water supply areas are Henan, Hebei, Beijing, and Tianjin.

The South-to-North Water Diversion Project planning area involves a population of 438 million people and a water transfer scale of 44.8 billion cubic meters. The total length of the east, middle and west lines of the project planning is 4350 km and the total length of the main line of the first phase of the East and Middle Lines is 2,899 kilometers, and about 2,700 kilometers of auxiliary support canals along the first line of the six provinces and cities along the line[6]. The South-to-North Water Diversion Middle Route Project and the South-to-North Water Transfer East Line Project (Phase I) have been completed and diverted to the northern region, but the West Route project has so far been in the planning phase and has not started construction.

The project will improve the quality of local drinking water in the North and effectively solve the water quality problems caused by natural causes in some areas of the North, such as high-fluorine water, brackish water, and other sources of water containing harmful substances harmful to the human body. Local wetlands and biodiversity have greatly improved the ecological and environmental conditions of the northern region, especially water resources.

The South-to-North Water Diversion Project is costly and involves a large number of immigration issues. Water pollution problems have occurred in parts of the east line of the South-to-North Water Diversion Project. Water diversion at the same time on the three routes will lead to incalculable changes along the Yangtze River basin along the Yangtze River, which is not conducive to protecting the existing ecology along the Yangtze River. It may also result in a lower carrying capacity of the navigation channel during the dry season of the Yangtze River[7]. The joint action of the Middle Route Project and the Three Gorges Water Control Project may cause incalculable losses to Wuhan. The impact of water transfer from the Eastern Route Project on the estuary of the Yangtze River may lead to secondary salinization of the soil in the northern irrigation area.

5.3. National measures for the management

On October 28, 2016, the National Development and Reform Commission and other nine departments issued the "National Action Plan on Water Saving for People" under the Central Development and Reform Commission [2016] No. 2259. The "Action Plan" divides agricultural water-saving production, industrial water-saving and efficiency-increasing actions, urban water-saving and loss-reducing actions, water-saving action in water-scarce areas, water-saving and pollution-reduction action in industrial parks, promotion and popularization of water-saving products, and festivals. Aquaculture industry cultivation activities, public agency water conservation actions, water conservation supervision and promotion actions, and national water saving publicity actions are 10 parts[8].

In February 2015, the Standing Committee of the Politburo Standing Committee reviewed and approved the Action Plan for Water Pollution Prevention and Control. The goal of the work is to improve the quality of water quality throughout the country by 2020, reduce the amount of heavily polluted water, increase the level of drinking water safety, increase the control of groundwater over-harvesting, and prevent the intensification of groundwater pollution[9]. The environmental quality of coastal waters has stabilized and the situation has improved in the areas of Beijing, Tianjin, the Yangtze River Delta, and the Pearl River Delta. By 2030, it will strive to improve the overall quality of the water environment in the country and restore the functions of the water ecosystem. By the middle of this century, the quality of the ecological environment has been comprehensively improved and the ecosystem has achieved a virtuous circle.

On April 5, 2018, the "2018 Global Renewable Energy Investment Trends Report" jointly issued by UNEP, Frankfurt University of Economics and Management - UN Environment Cooperation Center and Bloomberg New Energy Finance in Frankfurt, Germany showed that as of 2017, The annual global renewable energy investment has exceeded 200 billion U.S. dollars for eight consecutive years.

The decline in the cost of solar power and wind energy continues to advance the development of renewable energy. In 2017, total global renewable energy investment increased by 2% year-on-year to US\$279.8 billion (excluding large-scale hydropower).

The report shows that China is by far the largest renewable energy investor in the world. Last year, the amount of investment was increased by 31% from 2016 to reach US\$126.6 billion. At the same time, the major driving force behind the sharp rise in solar investment last year was China.

In 2011, the "12th Five-Year Plan" for the major special projects of water pollution control and treatment was released. The key tasks of this implementation plan involve three aspects.

The first is comprehensive watershed management and water quality improvement, including the rectification of key river basins and typical river basins, and the integration and application of basin water environment management technology.

The second is the comprehensive technology and platform demonstration of drinking water safety protection in key areas.

The third is to cultivate strategic emerging environmental protection industries, such as industrial waste water treatment technology, urban water pollution control key equipment and major equipment R&D and industrialization, ecological restoration engineering and industrialization, clean water materials, ecological environment monitoring equipment and industrialization, and The formulation and improvement of relevant policies.

According to the report of the Ministry of Environmental Protection, during the "Twelfth Five-Year Plan" period, China's water special project is to establish 36 projects with a total budget of 12.28 billion yuan, including a central government budget of 5.15 billion yuan, local fiscal and corporate investment, and other 7.1 billion yuan, including Taihu Lake. The river basin was 990 million yuan, the Liao River Basin was 435 million yuan, the Dianchi Lake Basin was 340 million yuan, the Songhua River Basin was 245 million yuan, and other typical watersheds were 1.42 billion yuan.

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