The International Journal of Engineering and Science (IJES)
|| Volume || 6 || Issue || 10 || Pages || PP 52-55 || 2017 ||
ISSN (e): 2319 – 1813 ISSN (p): 2319 – 1805

Analysis of Current Solutions to Water Crisis in China

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ABSTRACT

This is a research paper specifically touching upon the general solutions to water crisis in China. The analysis of current solutions on prevalent water problem in China, including water diversion to alleviate the water shortage of northern China, water desalinization where seawater is more accessible and plentiful, as well as water treatment by giving different means to purify wastewater, are discussed. By so doing, water scarcity caused by geographical differences in supply and demand in China can partially be solved, and water pollution raised by factories, farmland and coal mines of laying waste to China's water supply can also be reduced. Despite of such efforts to improve quality of drinking water, we should bear in mind that the public awareness of water protection is a continuous project, and water innovation in technology should be advocated to better solve the water crisis. Understanding how to deal with the water crisis in China, focusing more on measures and investigating effectiveness of various modalities of proper water management and quality control should be our priority.

Keywords: *water crisis, water desalinization, water diversion, water treatment.*

Date of Submission: 26-09-2017 Date of acceptance: 09-10-2017

I. Introduction

China has a population of close to 1.5 billion people and the lack of ample water supply is one of the most challenging problems facing the country. Not only does China have approximately 20% of the world's population but only has 7% of the world's fresh water and a relatively low water availability[1], but also there is a high variance in the supply of water within the different geographies around the whole country. Thus, China faces a problem of not only having a per capita water supply of less than a third of the global average, but also where water is available, it is polluted[2]. The Chinese government has become increasingly focused on addressing the problem over the past decade and water quality is very concerned for consumption in Chinese culture. A thorough framework for addressing China's water problem would incorporate innovations in technology, policy directives from the government as well as campaign plans to raise public awareness. Fortunately, government and other institutions have taken serious note of this problem and have issued slew of measures in this direction. This study is a sequel to previous work in which I gave a skeleton of an overview of the progression of China's water problems. In the following, I will analyze the current technologies that are being utilized to combat water problems as well as its associated effectiveness and costs.

II. Causes of Water Problem

Geographical differences in supply and demand as well as conflicting interests of industry and government are two of the biggest factors causing China's water problem[3]. The problem can be largely separated into two branches: water pollution and water scarcity. Water pollution is the widespread contamination of freshwater and can be attributed to industrial and agricultural activities, while water scarcity is a national phenomenon but is more apparent when comparing northern and southern China. By addressing water pollution on human health and water scarcity in different parts of country, it is envisaged that economic growth should not be prioritized over water pollution prevention, and water innovation in technology should be advocated to solve the water shortage. There are several solutions to solve the water crisis that are currently being used, including water diversion, water desalinization, water treatment and other approaches. All these will be discussed in the next section.

III. Solutions to Water Crisis

In 2015, a new comprehensive water reform plan known as the "Water Ten Plan" was issued to codify the government's effort. The plan documents the Chinese government's resolve to reduce badly polluted water bodies and to improve quality of drinking water (Water Pollution Prevention and Control Action Plan). The following methods are the top methods being utilized to alleviate China's clean water problem.

3.1 Water Diversion

One of the famous actions is the South-To-North Water Diversion Project (i.e., “SNWDP”), which is a grand construction undertaken by the Chinese government to bring billions of cubic meters of water from the South to the North to alleviate the water shortage. The goal was to build an enormous canal that would redirect water from the Yangtze, the Han and its tributaries to the North. In 2002 when the project began, it was expected to cost $62 billion dollars, and planned for completion in 2050. It will be able to divert nearly 45 billion cubic meters of water annually to cities in the dry North.

While idealistic in concept, there are many concerns over the actual impact the SNWDP will have on China’s water problem. One criticism is that the Chinese government is ignoring the real problem causing China’s water shortages, which is high demand for water and inefficient use of water. This is because water in China falls significantly below the international market price. A statistic from 2014 showed that, most residential consumers in Beijing will pay 5 yuan (81 US cents) per cubic meter of water, compared with a global average of $2 per cubic meter (Price Full Cost). If water usage was priced at global market rate, prices would be higher and it would encourage efficient use of water. Instead, the government is scared that raising water prices would scare away industries from the cities and that consumers would line the streets in protest (A Canal Too Far). Researchers on China’s physical water transfer opined that “Improving water use efficiency is key to mitigating water stress, but the efficiency gains will be largely offset by the water demand increase caused by continued economic development” [4]. China’s Vice Minister of Housing and Urban Rural Development, Qiu Baoxing, even publicly denounced the project as “difficult to sustain” and unnecessary if cities would participate in conservation efforts[5]. Thus, the government is left paying for the wasteful behavior of consumers.

The project itself has also left many environmental and social problems in its wake. The government says that it has already moved more than 345,000 people to government housing to make way for the construction of the canal. Relocated residents are often poor villagers or farmers and have been severely impacted by the relocation. They are forcibly moved by the government from village and land their families have lived on for generations. Instead they become immigrants surviving on government relocation packages, small and often undesirable plots of land, and money sent back from children who have left for nearby cities [5]. Xinhua news outlines some of the hardships facing relocated immigrants:

“However, discontent exists among immigrants who have found life harder in the new locations, where locals have different dialects and cultures. Added to this, living costs are higher with some houses having defects. Some immigrants are given low-grade farmland to work on and those who grew fruits in hilly regions do not know how to grow rice on a plain” [6]. Furthermore, diversion of water is creating new environmental and economic problems. When calculations were made to predict the impact that water diversion will have on water sources in the South, the numbers were based on river flow rates between the periods of 1950s and 1990s. By using a historical average, the calculation was done with only backwards-looking numbers. In that sense, they had assumed that the environmental conditions will stay the same, when in actuality, they did not. Now, river flow rates have changed and the SNWDP is predicted to have a large impact on the environment of the Han river and the communities that depend on it. As this is not a diligent way to plan for the future, it was destined to fail in application.

The Hubei provincial environmental authorities have reported that:

“The river level will fall and the cost of using water for people's life and irrigation will increase; the river's ability to cleanse itself will decline and pollution control will become more difficult; the number of days during which the river is navigable will decrease and water transport will be less efficient; fish will suffer a loss of breeding grounds and the decrease in water temperature will be harmful”[6].

3.2 Water Desalinization

Desalinization is the process through which salt and minerals are taken out of seawater to create freshwater. This is usually achieved by evaporating or distilling seawater through various energy sources. From 2006 to 2010, the water desalinization industry saw a boom and grew nearly 70 percent year over year[7]. At first, the government strongly looked towards desalinization as an alternative way to boost the supply of freshwater. The construction of desalinization plants was prioritized and aspirational goals were set for the freshwater these plants would be able to produce. However, the industry soon realized that water desalination is expensive. Desalination is a capital intensive process where the resulting product is neither economically or environmentally efficient. This is because the desalination process involves evaporating seawater in multiple stages to completely separate the salt and mineral crystals from the water and the resulting water cost more than what most Chinese paid for their water. A typical Chinese would pay roughly 4 yuan for a ton of tap water, while a ton of desalinated water would cost on average 7 yuan[8].

Furthermore, desalinization has other negative effects on the environment such as air and oceanic pollution. Energy used to power desalination facilities releases carbon dioxide into the atmosphere as plants devour coal-fueled energy. Alterations in the salinity of the ocean near desalinization plants affect the marine ecosystem as well as sea life. The net effect is that desalination is still too inefficient and causes too much pollution to be a primary source of

freshwater. Lijin Zhong et. al opined that, “Until desalination technology becomes more energy efficient, it should only be used as a backup source of water in China”[9].
Despite the cost drawbacks, desalinization provides a good backup for geographies where freshwater reserves are hard to access, but seawater is more accessible and plentiful. For example, the Jebel Ali plant in the U.A.E currently produces 564 million gallons of water per day from the sea[10]. As desalinization technology improves, it can still become a viable solution for China as more than 40% of China’s population and a large percentage of its megacities are located near the coastline. However, desalination technology as it is now should only be considered an intermediate fix rather than a true viable solution.

3.3 Water Treatment

Wastewater treatment currently processes the largest amount of water for consumption in China. From 2000 to 2014, the total number of wastewater treatment plants in cities increased from 481 to 3,717[11]. The technology for wastewater treatment is very mature, and different methods are selected based on the composition of the wastewater. It is the most cost effective, as well as the easiest solution to implement at scale for the Chinese government. Despite this, most of the treatment plants around the country are neither as effective nor as efficient as they should be. Jun Chen, Chief Engineer at the Jiangsu Institute of Environmental argues, “Many plants are marred by high costs, weak performance, short-termism, and cost-cutting” [11]. The average utilization rate for wastewater plants around the country is only 60 percent, with many city plants operating at below 30 percent capacity (“Strong Growth”).
Additionally, inadequate coordination between geographies leads to suboptimal operation of wastewater treatment plants. Due to the large processing capacities needed to treat wastewater, certain optimal sizes and economics of scale for the plants could be determined and achieved. Yet, it is common to see small, adjacent municipalities build their own suboptimal wastewater treatment plants instead of collaborating, increasing the overall national costs of wastewater treatment[12]. One reason for this is the fact that wastewater facilities are often owned and run by Chinese State Owned Enterprises - whose survival is independent of profitability. Instead, they follow the directives of the government and either receive subsidies from the government or get preferential treatment for loans from state-owned banks that have little consequence on default. Since there are little incentives to economize and be profitable, the plants are operationally inefficient. It is further worsened by the fact that the revenue collected by the wastewater treatment plants is often contributed to the associated local governments rather than making sure the plant has sufficient funds to operate. As a result, despite having the world’s largest wastewater treatment capacity, China ranks only 67 out of 178 countries in assessed government progress in wastewater treatment[11].

Nevertheless, an additional hazard of treated water is that it is still not safe for consumption. The chlorination process often used to treat water produces carcinogens and other chemicals that are still harmful for use in drinking and cooking. Knowing the questionable quality of tap water for consumption, Chinese consumers have made it standard practice to boil tap water before it is used. Unfortunately, this method is inadequate for removing carcinogenic chemicals.
Though wastewater treatment has its own set of problems, it is still a cheaper alternative to desalination. Wastewater treatment requires less than a fourth of the energy needed to process the same amount and quality of water as desalinization[9].

3.4 Other Solutions

Reusing and recycling water is another solution. It was estimated that some cities can meet a fifth of their water needs by doing so. Systems that treat and reuse wastewater are often the least costly and most efficient way to clean water but they have difficulty overcoming the aversion that many people have to drinking water derived from sewage.
Ultraviolet radiation is a popular means of disinfecting water but is less effective when the water contains sediments and sludge. In places where water is collected from dirty ponds and lakes, people have learned to clean the water by folding clean cloths several times, placing them over a jug, and pouring water through it. The cloth filters many kinds of disease-causing organisms. Progress in making clean water available at higher prices discourages the more people waste it. For example, Beijing raised water prices in 2009 for commercial and industrial use by 11 percent to 50 percent and for residential use by 8 percent. However, in many places water is subsidized, and the obvious solution here is to end subsidies so that water will not be wasted.

IV. Conclusion

Water problem in China is still challenging. It is well understood that water quality is very concerned for consumption in Chinese culture. This paper outlines an overview of the progression of China's water problem by addressing several solutions to it. Chinese government is working on methods to reduce badly polluted water bodies and to improve quality of drinking water. For example, SNWDP action is an ideal concept but it is costly and leads to new environmental or economic problems; water desalination is an effective way to areas where freshwater reserves are hard to access, but is still expensive and has negative impact on the environment; water treatment is more cost effective, but the situation is not that optimistic due to the conflicting interests of industry and government. Therefore, the SNWDP remains the key solution to water problem in China, which may help alleviate the water shortage in many Northern cities in the short term, albeit with plenty social, economic and environmental ramifications. However, many experts even question whether the SNWDP will be a long term solution at all, so it is too early to tell what other negative effects may arise as new routes for the project open and start delivering to the North. Atmospheric water generation technology, perhaps, will be an innovation that can effectively complement the solutions that are currently being implemented.

Acknowledgements

The author expresses his deep appreciation to Z.Y. Zhang of the Shenzhen Tourism College of Jinan University, for her technical assistance, helpful discussions and valuable suggestions.

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Tianxiang Zheng. " Analysis of Current Solutions to Water Crisis in China." The International Journal of Engineering and Science (IJES), vol. 6, no. 10, 2017, pp. 52–55.