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China: The Application of Water Pollution Control to Manage Water Scarcity in China

One of the largest countries in the world, China is currently growing in leaps and bounds; it is a country on the move. With an ever growing population consisting of an estimated 1.3 billion people (Small), China's astounding domestic and international economic-industrial progress has advanced rapidly. In this past decade alone, over 70 million new jobs have been created and still more are waiting in the wings. As a result of the fast-paced industrialization, China now possesses the world's largest markets for numerous industries, including cars, steel, energy, infrastructure technologies, and more (Schneider). This exponential rate of industrial growth, however, has come at a severe cost to the surrounding environment.

China does not have abundant freshwater resources for drinking or irrigation (Wang). In fact, for a country that holds a large section of the world's population, it is shocking to note that China has only one-quarter of the freshwater resources compared to the rest of the world. In the northern and central parts of China, where it is especially dry and arid, this fraction drops to a scant one-tenth of the world's freshwater resources (Schneider).

Because much global attention is given to air pollution problems and overpopulation issues, the matter of water scarcity is often overlooked by many. It is an extremely concerning predicament that has risen in its level of severity in recent years. Only a scarce 9% of the total freshwater resources, including ground and surface waters, are available to 40% of the total cultivated farmland around the major basins of the Yellow, Huaihe, Haihe, and Liaohe Rivers (Wang). Unfortunately, these basins are of relatively poor water quality. In 2006, a national surface water quality monitoring program surveyed 408 sections of these basins. They found that 32% were of Grade IV or V, and a significant 28% failed to even meet the Grade V standard, representing the most severe level of this ranking system ("Report").

Although northern China generally has an arid climate, it is ironically a major breadbasket in the country for grain. Since many of the towns facing water shortages are in the North, they do not receive sufficient aid from outside sources, and therefore frequently turn to groundwater reservoirs as a stopgap for their immediate needs. This has resulted in approximately 40% of the crops being dependent on groundwater for irrigation (Schneider). While this worked for a few years, overpumping soon resulted, leading to an overuse of water. Recent measurements of water levels have indicated that the water table is dropping at a steady rate of 1-2m per year on average (Wang). Supply capacity of the existing groundwater wells has also decreased by an estimated 40%. In addition to the statistical measurements, environmental degradations are easily observed in dried riverbeds, emptied reservoirs, and intensified desertification. In the past decade alone (2000-2009), freshwater reserves have declined by 13% (Cho).

Since not enough effective measures are currently being taken to improve the situation, this issue is progressively worsening, as the aforementioned statistics clearly display. Rapid industrialization is also taking a toll on this situation. The development of industry and agriculture, as well as the increasing, albeit slowing down, population rate have contributed significantly to the problem. These factors result in an increase of water consumption, with many areas, like villages and cities in northern China, unable to meet the growing demand with their available freshwater reservoirs. This increasing gap between supply and demand may hinder further economic development (Wang).

To further investigate the severity of water scarcity, I recently traveled to a rural village called in Gansu Province, China, where I have some relatives, and observed many concerning details. The farmland,

which I was told used to be quite prolific, had minimal growth and many dried out, dead crops. The soil was cracked and dry, and appeared quite incapable of sustaining any life at all. What was especially troubling, however, was the fact that there was a nearby river that could have been used for irrigation. My parents told me that due to factors like agricultural runoff, the river water was not clean enough for use; the arid atmosphere was also contributing to the dropping water level (Gansu). Unfortunately, not enough was being done to provide these people with a new, clean source of water to irrigate their crops. Furthermore, as the situation of water scarcity grows more and more severe, the prospect for the future of many of these people is quite bleak. If there is an increasing lack of suitable clean water resources, families will starve because they are unable to grow enough food to feed themselves.

I talked to many people to receive a detailed insight on what the typical subsistence farm family is like. People described the typical family consisting of two parents, at least two grandparents, and two children, a total of about six people. Many of the grains they grow are incorporated into porridges or noodles for consumption. Although the amount of people with a university level of education is increasing, the majority of the villagers do not have any education past high school. Health care is not an official government service and readily available, but there is a small local hospital and other infirmary areas that many people go to for treatment. Most families have a few plots of farmland that they use to grow enough crops, such as rice, wheat, and corn, to feed their respective families and to perhaps sell in local markets for profit. There are generally no agricultural practices like crop rotations, as the weather often limits the farms to one main growing season. Many barriers are present to improving the agricultural productivity, the most notable ones being poor irrigation technology, erratic weather, long dry seasons, and the general unsuitable quality of the water available to irrigate crops (Gansu).

Even though measures are being taken by the Chinese government to restrain population growth, i.e. the “one-child law,” it is undeniable that the population is still increasing. With population growth inevitably will come further urbanization and industrialization. The expansion of factories will leach more toxic chemicals into the water supplies, further affecting the subsistence family in its quest to find clean water to make their livelihood, both for drinking and irrigation. Factories will also generate more pollution that will contribute to this growing problem. There will be increased volumes of sewage and other organic wastes that could infect the water supplies. Climate change plays a major role, as well. The warming of the Earth’s surface due to global warming may cause an increase in the demand of freshwater sources for irrigation. Since the supply of freshwater reservoirs cannot keep up with the demand in current conditions, if global warming persists the result may be disastrous as water supplies could be used up even more rapidly. The plight of the subsistence family will worsen under these conditions: warmer temperatures already provide an obstacle to crop growth, and the shortage of water supplies merely adds more to the burden. Already facing a dire need to alleviate the clean drinking water issue, China cannot hope to simultaneously address the issue of clean water for crop irrigation without taking some precautionary measures.

It is under these circumstances that I propose the following solutions:

First, governmental or corporation management must be in place to regulate factories and set standards for their waste disposals. Many of the freshwater reservoirs in China are often contaminated with dangerous toxins that originate from the ever increasing number of factories in the country; therefore, they are unavailable to use for purposes of irrigation. Some places have standards set in place but there is lax management that does not effectively enforce these standards; some rural facilities do not even have wastewater disposal standards (Wang). There must be further development of environmental controls to regulate this particular facet of the issue.

In 1973 the National Environmental Protection Bureau was founded for the purpose of refining environmental management systems (Wang). Since then, pollution has become the concern of specific organizations that could more closely monitor the factories' disposal of waste products.

Many laws have also been enacted for the sole purpose of regulating water pollution. In 1979 and subsequent years, the "Law of Environmental Protection, The Peoples Republic of China," "The Law of Water Pollution Control," and the "The Regulation of Discharge Fee" have all been established and enforced (Wang). By preventing water pollution, more clean water can be made available to those subsistence families who desperately need it.

Secondly, wastewater reuse can provide a temporary, if not permanent, solution. 75% of total wastewater comes from industry (Wang). If more effective wastewater treatment facilities could be erected, much wastewater could be converted back to safe, reusable water. Currently, though, only 20% of factories have wastewater treatment facilities. If wastewater treatment facilities are built with the rapid construction of more and more factories, this solution may be more feasible in the future.

Thirdly, rerouting of water may present an extremely effective solution to the water scarcity problem. Since the North is especially devoid of water resources, transferring water from the abundant South to the North would provide an immediate and environmentally friendly solution. Begun in 2002, the South-North Water Transfer Project is an ongoing development that plans to have some 36 billion cubic meters of water per year diverted from the plentiful southern rivers to the drier north. Altogether, China plans to have the three main lines completed by 2050 to connect the Yangtze, Yellow, Huaihe, and Haihe Rivers to various northern cities and towns (Cho). The Central line is due to be completed by 2014, and will allow 13 billion cubic meters of water each year to pour into the North to help curb water shortages in numerous cities (Schneider). Though the cost of such an endeavor will without a doubt be enormous, many consider it an essential aspect to solving the water crisis. Wei Zhimin, a water expert with the Ministry of Water Resources in Hebei Province, remarked that "[l]ifeline is one word to describe it, and by lifeline, I mean a lifeline for North China, Beijing, Tianjin, and Hebei included" (Schneider).

Lastly, and perhaps most importantly, improved water quality technologies may provide the most lasting solution to water scarcity. By finding efficient ways to clean water and prevent water pollution, more water can be made readily available to subsistence families. These technologies could also aid water treatment facilities in filtering wastewater for reuse. If more efficient methods are developed for the purpose of "cleaning up" wastewater, perhaps more wastewater treatment facilities would be erected.

Eco-remediation technologies are not only an effective method, but they are also a venue that China, as a rapidly industrializing country, is appropriately taking. These technologies are a natural method that wouldn't consume too much energy once implemented. After all, many of the coal mines that produce the means necessary for energy consume water to power the plants (Cho). With so many people to care for, China may benefit from this reduced energy plan. Furthermore, eco-remediation technologies probably won't slow down economic growth. Since these are new technologies being researched, they could potentially be developed and incorporated into a sector of China's economy.

Since 2000, China has initiated the research, development, and application of eco-remediation technologies, including aquatic vegetation restoration, bio-manipulation technology, and floating aquatic-plant bed systems. Aquatic vegetation may be the key factor in stabilizing the health of river and lake ecosystems. Introducing contamination-resistant aquatic vegetation was found to restore some of the natural features of lakes and rivers that had been destroyed by the toxic chemicals leached into the water. Bio-manipulation is the "deliberate alteration of an ecosystem by removing or adding species," thereby altering the food chain. This tends to be done in order to favor zooplankton that grazes on the algae that thriving in polluted waters. The ultimate goal of this procedure is to improve water quality by eliminating

the algal blooms. The algae often flourish in contaminated waters, monopolizing all the sunlight, nutrients, and minerals that were once available to all populations in the ecosystem. Removing the algae allows the other population of zooplankton to prosper once more, and perhaps decontaminate the waters. Phytoplanktivorous fish have also been introduced into many lakes to prey on the phytoplankton that can act like dominating algal blooms. Many experiments and applications have been conducted, and results concur that this method is quite effective. It is currently in use today (Jiuhui).

Floating aquatic-plant bed systems are a unique technology used to purify polluted waters. Its major functions include absorbing the surplus nutrients that lead to algal blooms from the waters and forming a microbial environment in its plant root systems that provides a favorable habitat to promote aquatic life. Experiments conducted by Song et al. in 2003-2006 found that these floating systems strongly promote the improvement of water quality and aquatic ecosystems. It is also in widespread use today. (Jiuhui).

I do not believe that this problem can be solved by 2015, no matter how widespread and effective the reforms are. China is simply too large and expansive of a nation for things to be quickly and successfully implemented all over the country. However, the MDGs of environmental sustainability and targeted developmental assistance would coincide nicely in making the transition to improving water scarcity conditions go more smoothly. Rural and farm families should try to get involved in the transition; they could pressure the government into making more changes to benefit the country. These rural peoples should attempt to contact local news stations so that their troubles could be broadcasted throughout the nation. While many people are aware of the water scarcity problem, most of them live in metropolitan areas where they cannot experience the severity of the situation. If the whole nation were to witness these rural peoples' hardships, it could perhaps encourage the top leaders in China to take a more active role.

It would also bring attention to larger organizations like the UN and international research agencies. These organizations could provide monetary assistance and perhaps more advanced technology research development that could uncover more efficient solutions. Although the national government should get involved, I believe that it is local communities that will have more power because they will have more direct access to the solutions being implemented in their vicinity. The recommendations stated above, however, are absolutely not the responsibility of one group or organizations. It will take the motivation and effort of the entire country to bring water scarcity to an end.

By improving this particular situation, the previously mentioned typical subsistence family may find an opportunity to lead a better life. More clean water will be available with the use of filtered wastewater and preventative measures for water pollution. Families may be able to grow not only enough food to feed themselves, but perhaps even a surplus to sell and make a profit. With more available income, parents can provide better care to ailing parents, and children may be able to receive higher education. In addition to the social aspects, the economy would jumpstart, as the gap between supply and demand of freshwater would be significantly narrowed. Desertification caused by overpumping of groundwater could be curbed, and measures could then be taken to reverse it, thereby preserving the current environment and developing a better one for the future.

水到渠成 (*shuǐ dào qú chéng*) is a Chinese proverb that means "water will find its own way to flow." It essentially means that no matter what problems are faced in the future, one will always find a way to overcome them. Despite the many challenges that China may come to face in trying to improve water scarcity conditions, one thing is for certain: China will power on to conquer these obstacles and help make food secure for all its inhabitants.

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