

Yuki Jatmiko
Parkside High School CTE
Salisbury, MD.
China, Water Scarcity

China, Water Scarcity: Realities and Solutions

Water is essential for life, yet over seven hundred million worldwide can't access all they need. This is a serious problem, but it is also an opportunity for people to try out innovative solutions and make better designs across the globe. Global issues with water include shortages of water, shortages of clean water, and waterborne diseases. Around eighty percent of all deaths from illness in the developing world are caused by lack of access to safe water. More than five million people die each year from water-related diseases such as severe diarrhea, hepatitis, and dysentery. One in three people lives in a country that faces a nationwide water crisis, and many other countries face severe restrictions on water availability in dry or heavily populated regions. "More than ninety-five per cent of humanity lives in countries where access to water per capita is at least somewhat more limited today than it was twenty years ago" (Cho). Water is vital to protect the health of all living things. We need available water to produce food, energy, maintain the environment and economy and to protect the health and livelihoods of people. China has almost twenty percent of the world's population yet contains only seven percent of the world's fresh water. In addition to a growing population, pollution further limits the amount of water available for use. At least one-third of China's lakes and rivers are contaminated and seventy-three per cent of the watersheds that supply water to China's thirty fast-growing cities face medium to high pollution levels. "China has roughly the same amount of water as the United States but five times the population" (Hays).

China stretches thirty-one hundred miles from east to west, and thirty-four hundred miles from north to south. It has mountains, deserts, forests, and high plateaus. Thousands of rivers are found in China, but the two most important are the Yangtze and the Yellow Rivers. China's climate varies from region to region across its wide landscape. Most of country is in the northern temperate zone where it is characterized by warm climate and well-defined seasons. Southeast region has substantial rainfall with semi-tropical summer. "China's population is 1.37 billion with fifty-eight percent of its people in urban areas and the balance in rural areas" (Rural). Agriculture accounts for fifty-five percent of land in China with the average farm size being one and half acres. The major crops are rice, wheat, corn, soybeans, and tubers. China has a communist type government.

The typical family size is three per household. Many urban families live in apartments while rural families tend to have traditional houses. The Chinese diet consists of more plants than animals. Typical Chinese food is cooked by steaming or stir frying. Depending on the region, food is prepared in various ways with rice, noodles and dumplings. Laboring jobs are prevalent in factories and farms and access to education varies across regions of China. State-run education system, funded by the Chinese government, requires its citizens to attend nine years of schooling. An education gap is forming between those in rural areas and those in the urban areas. Families have access to health care, and it is affordable to most of the population. Families have access to clean water and toilets, but those living in some rural areas may be at risk of unsafe water and poor sanitation. In China, access to electricity, telephones, roads, and local markets is available to most.

China's per capita availability of water is one third the world's average, and in the dry north where most of the grain and vegetables are grown, per capita availability is only one fourth of that in the south. Over three million people in rural areas have no access to safe drinking water and fifty-four percent of China's main rivers contain water unfit for human consumption (Cho). It is easy to understand how this problem arose. In China, decades of high economic growth driven by rapid industrialization were fueled by a

single-minded orientation to development, even at the expense of water quality. On the part of the West, corporations were happy to outsource production to Chinese firms that paid low wages and were unconstrained by environmental controls. For their part, Western consumers were content to turn a blind eye, so long as it meant lower prices for products. The problem is that the environmental impact of China's industrialization affects everyone, not just the people of China. Dirty water discharges into the world oceans. Pollutants are embedded in the food products that China exports. If polluted water cannot be used for irrigation, then Chinese agricultural production falls and global food prices rise.

In China, pollution has increased over the last three decades, penetrating coastal and inland water bodies, and both surface and groundwater. Rivers and lakes polluted by industrial wastewater discharge untreated sewage, and agricultural runoff force people to draw on groundwater, which results in falling water tables and the drying up of wells, wetlands, and lakes. As groundwater is pumped faster than it can be recharged, wells must be dug deeper, raising the risks for saltwater intrusion. "In 2005, thirty-six percent of north China's water supply was taken from groundwater, and ninety per cent of urban groundwater was reported to be polluted" (Xie). China's water pollution problems are widespread. Officials have monitored the quality of surface water at over twelve thousand sites across the country. In 2015 thirty-five percent were of good water quality, thirty-two percent are suitable for water supply not drinking, twenty percent are suitable for industrial or agricultural use – but not for human contact – and thirteen per cent are useless. Even in Shanghai, one of China's richest, most environmentally-aware and modern cities, fifty two out of sixty-five monitoring sites have water not suitable for human contact. In China, desert expansion has accelerated in each successive decade since 1950. "Desert scholar Wang Tao reports that over the last half-century or so some twenty-four thousand villages in northern and western China have been abandoned either entirely or partly because of desert expansion. China's Environmental Protection Agency reports that from 1994 to 1999 the Gobi Desert grew by twenty thousand square miles, an area half the size of Pennsylvania. With the advancing Gobi now within one hundred and fifty miles of Beijing, China's leaders are beginning to sense the gravity of the situation"(Youlin). China becomes drier each year—its freshwater reserves declined thirteen percent between 2000 and 2009. Severe droughts occurred in 2000, 2007 and 2009. Normally the southern regions receive eighty percent of China's rainfall and snowmelt, about eighty inches a year, while the north and west get twenty percent.

Waste and inefficiency also contribute to the water shortage. Sixty two percent of all water usage in China is for agricultural "Forty-five percent of the water withdrawn for agriculture actually gets used by the crops. In addition, the water recycling rate for industry (which accounts for 24% of China's water consumption) is only forty per cent compared to on average eighty per cent in developed countries" (Xie). China's population of one point three billion, almost half of which is urban, is expected to reach one point five billion by 2020. National water consumption will go from six hundred billion cubic meters (158 trillion gallons) to six hundred thirty billion cubic meters by 2020. By then, fifty-seven percent of the population will live in cities, and by 2030, seventy percent will be urban dwellers—who consume three times as much water and energy as rural residents. Not only must China deal with a drying climate and the water needs of their fast-growing urban areas it must also satisfy the increased demands for energy which also requires water. By 2020, electricity generating capacity is expected to double and despite the country's investments in renewable energy, more than one-fourth of the added electricity will still have to come from coal, which today provides seventy per cent of China's energy. Coal mining, processing, combustion and coal-to-chemical industries are responsible for twenty-two per cent of the nation's total water consumption, second only to agriculture. In the future, China's new coal-to-liquid fuel plants that make diesel fuel and water-intensive coal-to-chemical plants that produce pharmaceuticals, pesticides, fertilizer, plastics, etc. will only multiply. "By 2020, the coal sector will be responsible for twenty-seven per cent of China's total water consumption, with an estimated thirty-four billion cubic meters of water

per year used by coal-fired power plants alone. The problem is that most of this additional water will be needed in the arid northern and western provinces of Xinjiang, Inner Mongolia, Shanxi and Ningxia where China's vast coal reserves lie. "Between 2004 and 2009, Inner Mongolia lost over forty-five million cubic meters of fresh water and Xinjiang lost ninety-five million cubic meters" (How).

China's climate change related impacts on water supply and agricultural production will be of concern in the future. Recent studies have concluded that climate change will negatively impact water availability and likewise impact yields of important crops such as wheat, rice and corn. Long term data shows that temperatures have increased steadily since 1960 and rainfall levels have decreased in the same time period. Since 1980 the frequency, magnitude and length of droughts have been increasing. Most scenarios for China forecast even larger deficits in available water supply resources when accounting for increased demand and weather-related stressors. The Gobi Desert blankets nearly five hundred thousand miles of northern China and southern Mongolia in dry, arid land. The Gobi is the fastest growing desert on Earth, transforming over two thousand miles of grassland per year into wasteland. Solutions to stop the invading deserts have relied on creating large sections of green wall tree plantings. While this has had some impact on slowing desertification it also uses precious water reserves.

China's leaders know that water scarcity is a huge problem and are addressing the issue in different ways. In 2015, China developed a concerted plan to address both water availability and pollution. The plan introduces new incentives and penalties for water polluting industries, promising to periodically announce lists of poor performing enterprises. "Several other aspects of the plan differ from previous approaches: It lays stress on the philosophy of total water cycle health including groundwater, surface water and marine water, acknowledging their connections. It directly addresses seaport pollution control, which has been given less attention in past environmental policies. It aims to give rise to the development of an extensive environmental protection industry and environmental protection services sector. It clearly assigns monitoring and compliance responsibilities to agencies and responsible persons. This has been a major hurdle to successful water management policy in China" (Han).

One solution is a plan to quadruple the country's capacity to desalinate seawater over the next decade. "Today China can desalinate 600,000 tons of water a day, but it aims to produce 2.5 to 3 million tons of desalinated water a day by 2020, mainly for use in the dry northern areas. However, desalination is expensive and requires energy, which, in turn, involves more water" (Yingq). China has been building a South-to-North Water Diversion Project (SNWDP), the largest such project ever attempted. When completed in 2050, it will link the Yangtze, Yellow, Huaihe and Haihe rivers, and divert forty-five billion cubic meters of water yearly from southern rivers to the arid north. The SNWDP will consist of three routes. The recently completed eastern route, begun in December 2002, will transfer fifteen billion cubic meters of water yearly from the lower Yangtze, via the ancient 1800-kilometer Hangzhou to Beijing canal, to Jiangsu, Anhui, Shandong and Hebei provinces and the city of Tianjin. The central route, begun in December 2003, will operate on gravity alone and divert thirteen billion cubic meters of water each year from the Danjiangkou Reservoir on the Han River (a Yangtze tributary) to Beijing, Tianjin and other cities. The western route will transfer water from three Yangtze tributaries across the Qinghai-Tibet Plateau through the Bayankala Mountains into northwest China. Economists, environmentalists, academics and other critics have raised concerns about the SNWDP, fearing that water from the lower Yangtze for the eastern route will remain too polluted to use even after passing through numerous water treatment plants that are planned, and that further industrialization along the routes could pollute diverted water. Because the south of China is also becoming drier, some worry that the southern provinces just do not have enough water to spare. And there are also concerns about the displacement of people, and the destruction of pasture and antiquities.

The Chinese leadership is trying not only to increase water supply, but also to curb demand through conservation and efficiency measures, and it's committed to spending over six hundred billion on water

conservation. “Since 1998, China has taken twenty-one million acres of farmland out of production and required farmers to use more water conserving irrigation practices, reducing the water consumption of agriculture from eighty per cent to sixty per cent” (Hays). Industry is conserving water through a system of water rights transfers in arid Inner Mongolia and Ningxia. The coal industry pays farmers for irrigation upgrades that save water which it can then use. State-of-the-art coal plants are producing more electricity and using less water, while coal mines in Inner Mongolia and Shanxi Province are consolidating to use water more efficiently. Proposed industrial plants must prove there is enough water available for them to operate before construction begins, and once approved, must recycle their water. New buildings in big cities like Beijing are outfitted with plumbing systems that recycle water for washing clothes and flushing toilets. China is also investing in water-saving renewables such as wind, solar, and seawater-cooled nuclear power, and expects that their generating capacity will go from fifty-three gigawatts in 2010 to two hundred and thirty gigawatts in 2020. New solar, wind and nuclear plants will replace one hundred coal plants, conserving almost four billion cubic meters of water per year. In 2017 China launched nearly eight thousand water clean-up projects with projected total investment of 100 billion dollars. The projects were devised as a action plan to treat and prevent water pollution, and cover three hundred contaminated groundwater sites across the country. A total of over three hundred contaminated sites had been identified, meaning that ninety five percent had drawn up plans to bring water quality up to required standards.

Initially China focused on improving water efficiencies in agricultural usage through two methods: pricing and water rights exchange. However, both have been difficult to manage, have high transaction costs and burden small farmers with higher costs. An experiment conducted in 2005 in the Taocheng District of Hebei Province created a new kind of water-saving mechanism that involves several institutional innovations, including “flexible total management”, “collect then refund” and “collect and subsidize, then refund”. This system has shown both promise and potential for scaling up. Flexible management means that towns/provinces have allotments of water usage that they manage. Farmers are given quotas based on usage estimates and then pay in advance. Through national and local subsidies farmers are supported with cost supports. If farmers have saved water, they will be rewarded with refunds. “Therefore, the new mechanism appears to be a more promising alternative than increasing agricultural water prices or introducing water marketing, the main farmer-level agricultural water-saving mechanisms currently adopted in northern China” (Chen). Another potential opportunity to scale up water efficiency is to switch to more drought tolerant crops and the use of drip irrigation. In Yaoba, an area plagued by drought near the Tengger Desert became reliant on aquifers to irrigate the corn they grew on the area’s four thousand acres of farmland. Using a technique known as basin irrigation, in which fields are flooded typically five times a year using seventy metric tons of water. Farmers in this area have switched to growing drought tolerant millet and using drip irrigation their water usage now averages 29 metric tons. “There were 470 hectares of millet planted in Yaoba last year thanks to encouragement from the Society of Entrepreneurs and Ecology, an NGO promoting remedies to desertification” (Switch). The quality of water in small tributaries feeding China’s main river systems are recognized as being poorer than the main water courses themselves. This cause of poorer water quality is due to reduced dilution capacity of small streams, poorer regulation of industrial wastewater discharge to small streams, and poor oversight in rural areas. In 2015 China developed a concerted plan to address both water availability and pollution. The plan introduces new incentives and penalties for water polluting industries, promising to periodically announce lists of poor performing enterprises. “Several other aspects of the plan differ from previous approaches: It lays stress on the philosophy of total water cycle health including groundwater, surface water and marine water, acknowledging their connections. It directly addresses seaport pollution control, which has been given less attention in past environmental policies. It aims to give rise to the development of an extensive environmental protection industry and environmental protection services sector. It clearly assigns monitoring and compliance responsibilities to agencies and responsible persons. This has been a major hurdle to successful water management policy in China.” Chen

There are some innovative solutions being applied worldwide that I believe China should consider. Especially in these four countries, the people there are solving their water problems in creative ways. In Kenya, the use of sand dams, invented by the Romans, help trap water from rivers in layers of sand. The sand prevents the water from evaporating, it protects the water from disease-carrying mosquitoes, and the sand acts as a filter, making the water drinkable. The Africa Sand Dam Foundation work with local communities to build sand dams that will meet the communities' needs. These dams could be implemented in China along major river arteries in the south where water is more plentiful.

Israel's serious water problem had its leaders decide to desalinate Mediterranean seawater, turning saltwater to drinkable water, and reuse wastewater. Using this process is less costly and require less energy. They have four desalination plants, a fifth is coming soon. Their desalinating plants treat and reuse eighty-six per-cent of their domestic wastewater. It can cover more than half of their agriculture needs. China hopes to double its desalination production, yet these efforts can require energy production and can pollute ocean ecologies. Additionally, desalination remains obviously practical along the coastal urban areas.

People in India that live in places that lack rainwater rely on ancient stepwells, a water reservoir with steps going down to it. They are convenient because they accumulate rainwater right where people live. The gathered water can be used for a variety of purposes, even drinking if taken care of properly. However, stepwells are threatened by the growing industries and garbage. Fortunately, there are people that help to preserve them. Additionally, stepwells may be expanding to Morocco for its innovative uses. In China stepwells could be used in the North where seasonal fluctuations in weather related droughts could provide needed water during those periods.

In Peru, people rely on an ancient building called suqakollos, raised crop fields and irrigation ditches to promote water preservation for agriculture. Suqakollos create a microclimate more warm and wet than its surroundings. This microclimate protect crops from harsh weathers, important in places with harsh environment where crops tend to die. With the help of the Food and Agriculture Foundation, locals are working to revive their ancestors' ancient technique. This raised crop field technique could be implemented in the dry northern part of China where agricultural demand for water is high. In Peru's biggest city, engineers created a billboard that captures the air humidity and converts it into drinking water. This invention is especially crucial in the city of Lima, Peru where there is barely any rainfall. The billboard generated close to 10,000 liters of water in three months for hundreds of families.

China is already putting wheels in motion to address its current water challenges. The Chinese, who have demonstrated amazing capacity in their successful programs of economic reform, have begun and can take another bold move in reforming and moving forward with quality water resource management.

Chen, Sicheng, et al. "Exploring China's Farmer-Level Water-Saving Mechanisms: Analysis of an Experiment Conducted in Taocheng District, Hebei Province." *MDPI*, Multidisciplinary Digital Publishing Institute, 21 Mar. 2014, www.mdpi.com/2073-4441/6/3/547/htm.

Cho, Renee. "How China Is Dealing with Its Water Crisis." *State of the Planet*, Earth Institute Columbia University, 19 May 2011, blogs.ei.columbia.edu/2011/05/05/how-china-is-dealing-with-its-water-crisis/.
<http://www.globalwaterforum.org/2017/10/09/tackling-chinas-water-pollution>

Han, Dongmei. "Deep Challenges for China's War on Water Pollution." *Egyptian Journal of Medical Human Genetics*, Elsevier, 6 Sept. 2016, www.sciencedirect.com/science/article/pii/S0269749116310363.

Hays, Jeffrey. "WATER IN CHINA." *Facts and Details*,
<http://factsanddetails.com/china/cat13/sub85/item317.html>

How China Is Dealing with Its Water Crisis." *State of the Planet*, 19 May 2011, blogs.ei.columbia.edu/2011/05/05/how-china-is-dealing-with-its-water-crisis/.

Rural Population (% of Total Population)." *GDP Growth (Annual %) | Data*,
[data.worldbank.org/indicator https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS](https://data.worldbank.org/indicator/SP.RUR.TOTL.ZS).

"Switch to Drip Irrigation Helps Preserve Aquifers." *China Aims to Boost Industries along Yangtze River*, China Daily USA, 22 June 2018,
www.chinadaily.com.cn/a/201806/22/WS5b2c4e7aa3103349141ddb23.html

Xie Jian. "Addressing China's Water Scarcity." *Uruguay - Natural Resources Management and Irrigation Development Project - Environmental Assessment Report (English) | The World Bank*, The Worldbank, 1 July 2010, documents.worldbank.org/curated/en/537531468221676912/Addressing-Chinas-water-scarcity.

Xie, Jian. "Addressing China's Water Scarcity." Recommendations for Selected Water Resource Management Issues The World Bank,

Youlin, Yang. *GLOBAL ALARM: Dust and Sandstorms from the Worlds Drylands*. United Nations Convention to Combat Desertification (UNCCD),
www.droughtmanagement.info/literature/UNCCD_global_alarm_dust_and_sandstorms_2002.pdf.

Yingq, Cheng. "China Looks to Take Salt out of Saltwater." *Chinadaily.com.cn*, China Daily USA, 4 Sept. 2011, usa.chinadaily.com.cn/china/2011-04/09/content_12298084.htm