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China, Water Scarcity

Efficient Irrigation: a Solution for a Dry China

China, the most populous country, spans much of the Asian continent. It is the fourth largest country and the largest country solely in Asia. Its 1.4 billion people inhabit a varied landscape over the 3.7 million square miles it stretches (Chiu). The territory features the Tibetan plateau and numerous mountain ranges in the West, as well as bustling coastal cities east of the Yellow River. Along with its elevated mountains, China boasts a sizable economy. The country has seen rapid economic growth since it began exploring foreign trade and investment in the late twentieth century (Morrison). China, as the world's leading exporter, one of the biggest countries, and home to almost twenty percent of the human population, must be understood to tackle pressing issues worldwide.

China is struggling with increasingly scarce physical water resources. The amount of renewable water per inhabitant is 1,955m³/person/year (FAO). This number is noticeably higher in the United States: 9,441m³/person/year (FAO). This discrepancy is an effect of both China's low water resources and high population. China must support about 20% of the world's population with only 7% of its fresh water (Shemie). The issue is complicated further by uneven water distribution and pollution. Water resources are much less abundant in Northern China. Water resources in the North equal only one-fifth of those in the South (Lu). It is difficult to transport water to rural communities in the North. As China develops quickly, its expanding industries discharge wastewater into water sources. 90% of water in urban areas is polluted (Lu). To lessen the stress on its water supply, China should monitor its industries' use and treatment of it. Agriculture, an important aspect of food security and one of China's biggest industries, puts much strain on freshwater resources. To mitigate hunger, the Chinese government can address water scarcity by implementing sustainable irrigation.

The living situations of Chinese families vary. About half of the population lives in rural areas, where water is most difficult to access (Worldometer). Rural families usually rely on farming and eat self-produced meals (USDA). Farms are relatively small. In 2013, 86% of Chinese farms were under 1.6 acres. For comparison, U.S. farms are 441 acres on average and industrialized. Rural communities in China are mostly villages. Diets revolve around home-grown starches: vegetables such as beans and potatoes and grains such as rice. Families are purchasing more of their food as areas develop (USDA). Rising demand for animal products will put more pressure on water resources, as even more water is necessary to support animals. Many common foods are prepared with water, such as soups and steamed dishes.

Experiences with education vary between families. Jason Hung, a researcher for Stanford University's Rural Education Action Program, reports that while all parents are required to send their children to school for at least 9 years, rural students may receive a lower-quality education than urban students. According to Hung, impoverished rural areas often receive insufficient funding from higher levels of government. As a result, local governments have failed to adequately pay teachers and build teaching facilities. This may be a factor in why less than 20% of rural students continue into upper secondary education. He also highlights that education is "beneficial for rural Chinese communities to help raise their agricultural production, alongside exploring... their off-farm labor market opportunities." Rural families play a large part in supplying food through farming, yet experience inequality in education and the labor market. More food could be produced if rural families were provided equal opportunities.

Water is essential to agriculture, and agriculture is essential to food security. Water is used to support both crops and livestock. About 70% of the world's freshwater consumption is for irrigation in agriculture, and water use is expected to grow twenty-one percent by 2050 (Rosegrant). Agriculture is especially important to China's food security and economy. Much of its population grows its own food, and the country was #1 among U.S. agricultural export markets in 2020 (USDA). 70% of water being used for agricultural purposes leaves only 30% for use between industrial and residential sectors, so it is essential to conserve water when possible.

Irrigation in China may be inefficient. There are many ways to irrigate: types of irrigation include drip, spray, furrow, and flood. Flood irrigation involves diverting a body of water into an area to submerge crops. It requires the use of levees to keep water in and decreases in elevation to keep the water flowing. This method is effective for rice, one of China's biggest crops, as rice does well when watered substantially. It may also appeal to poorer Chinese farmers because it is relatively inexpensive. However, flooding is arguably the most inefficient approach to irrigation. It does not allow for the precise application of water, and 20% of the water used is lost to evaporation. This lost water could be utilized if a more water-efficient irrigation system is used.

China's government has been working on the South-to-North Water Diversion Project since 2002 (Water Technology). Its goal is to connect the country's four main rivers and transport water anywhere. Water diversion at this scale has never been attempted (Cho). The idea of borrowing water from the South to supply the dry North was originally proposed in the mid-twentieth century (Water Technology). It is expected to surpass the cost of the Three Gorges Dam—another Chinese water project and the largest hydroelectric power plant in the world (Water Technology). The Chinese government-owned newspaper China Daily reports that two of the project's three lines are in operation, water hardness in Beijing has decreased, and 40 major cities now depend on water from the South. Britt Crow-Miller, an Assistant Professor in Portland State University's Department of Geography, sees the project through a notably environmentally conscious lens. She argues that the project is a "band aid approach" that "violates [a] core principle of sustainability" because moving water only treats the effects of China's scarce water resources, and allows the issue to worsen for future generations.

Developing communities in other nations are using renewable electricity to power their irrigation. In a YouTube video titled "Solar-powered irrigation," Virginia Wango, an African community member,

presents how farmers in Kenya have reduced their irrigation expenses. According to Wango, farmers save money when they replace the burning of diesel fuel with solar energy because the running costs of solar panels are low. She says “it takes some investment at the start, but it means the farmer has low-cost drip irrigation in the farm.” Renewable energy has given these farmers low-cost access to drip irrigation—the most expensive and efficient method. In drip irrigation, pipes with small holes drop water directly onto the roots of crops. Only 5% of the water used is lost to evaporation. Avoiding the combustion of fossil fuels also reduces pollutants and one’s ecological footprint. However, not all areas receive the same amount of solar energy, and as Wango states, solar panels require a high initial investment. Kenyan farmers have demonstrated that renewable technologies can play a part in reforming agriculture for the modern world. These technologies’ lower long-term cost can help impoverished farmers, and their minimal impact on the environment makes them sustainable.

China could free up its water resources by minimizing water loss in its industries. The majority of the world’s freshwater is used for irrigation in agriculture. Less water will be necessary to support crops if efficient irrigation methods are implemented. Not only will this free up water to be used for more food production—more water will be available for consumption. Having more water for use by other industries will also promote economic growth. In his article “Water and Hunger”, agricultural economist Materne Maetz asserts that “agriculture will have to adapt as it will face increasing competition for water from other sectors.” Maetz’s prediction is especially true for China. The country is still experiencing rapid development, and more water will be necessary to support its growing industries.

It is evident that sustainable practices are often the expensive option. To implement efficient irrigation, China’s government must make it accessible to the country’s less privileged farmers. It can achieve this by covering the installation and maintenance costs of water-efficient irrigation systems. Systems that apply water to crops precisely (like drip and spray) can replace systems that apply water in large quantities (like flood and furrow) when possible. Reducing water scarcity for farmers will allow them to produce more food.

Possible pushback to these changes could be that traditional irrigation methods are connected to China’s cultural identity. Terraced rice farms are a symbol of Asian agriculture and can be connected with China’s history. They have been in use for thousands of years: rice paddies (a form of flood irrigation) have been used in China since as early as 8000 BP (Britannica). These ancient irrigation technologies may have been important for China’s early farmers. Others may argue that changing irrigation isn’t possible with crops that perform the best when submerged in water. Nevertheless, even flood irrigation can adapt. A publication by the University of California illustrates recirculating tailwater recovery systems. Tailwater recovery systems divert water at the bottom or ‘end’ of a terraced system back to the top. The water then flows over crops again. Reusing water reduces the total amount necessary. Consequently, less water is lost, and farms do not suffer as much from water shortages. Keeping water in the farm area also lessens the amount of agricultural chemicals that reach public water supplies.

For the Chinese government to implement these solutions, it must be able to offset the costs of new irrigation technologies and convince farmers to adopt new techniques. Fortunately, cleaner agricultural methods may yield economic benefits in other sectors. For example, if more farms reuse water with

tailwater recovery systems, agricultural pollution is less likely to reach public water supplies. With cleaner waters, China would see economic growth. Its tourism and recreation industries would expand, and businesses in areas adjacent to water would benefit from the increased customer traffic. To persuade farmers, the government could address issues of inequality in rural education. Improving rural schools will strengthen the relationship between rural farming citizens and the government as well as help make known to farmers the long-term financial and environmental benefits of sustainable irrigation. Better rural schools will also bring more opportunities to rural families and increase their access to food.

China is water-deficient. Its already small water resources will be stressed even more as the country develops. Growing industries have been consuming and polluting water, but the government has the opportunity to work with citizens to conserve it. Studies show that water can be conserved in irrigation, the biggest strain on freshwater resources. If China's government provides its farms with water-efficient irrigation systems, more water will be available for food production, and public health will improve.

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