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Impact of Water Irrigation Systems on Society

"Agricultural water takes up to 70% of total available water worldwide" (Olowoyeye and Kanwar). Water irrigation systems have an essential role in the future of humanity. They help conserve water and efficiently feed our growing population. These irrigation methods have evolved since our earliest signs of humanity. Water irrigation systems provide solutions for many of the problems Earth faces today while simultaneously creating new ones.

There are multiple ancient irrigation systems throughout the course of humanity that are represented in a variety of ways. "The earliest archeological evidence of irrigation in farming dates to about 6000 B.C."(Sojka et al.). These irrigation systems initially began as the waters from the Nile were rerouted to farmland. Eventually, they evolutionized to the construction of dams and canals. This still brought the issue of flooding and insufficient watering in some areas. To combat this unpredictability a variety of versions were developed in turn making a diverse of ways to irrigate plants. Although there is archaeological evidence dating back to 6000 b.c. (Sojka). There are different depictions illustrating ancient irrigation systems and their significance in different parts of the world. "The earliest pictorial representation of irrigation is from Egypt around 3100 B.C."(Sojka et al.). The water irrigation systems in the Middle East, particularly the Aflaj system, have ancient origins dating back thousands of years. The origins of the Aflaj system can be traced back to Iran, later spreading to other countries like China and

India. The Aflaj system channels water over arid otherwise known as dry lands, irrigating farms and supplying households with water. Constructed and maintained entirely from earthly materials such as rock and mud by tribal laborers known as the Muqannis (*"The Traditional Aflaj Irrigation System for the Sustainable Management of Water in Oman*."). This system in particular consists of deep wells and redirected underground springs that go into tunnels and channels. Over the centuries, Middle Eastern governments have recognized the importance of these ancient waterways, rebuilding and repairing Aflaj systems to maintain their functionality and continue to feed the mouths of their people. The system created a way for sustainable water management practices that have become a part of Middle Eastern culture and history. The Mormon pioneers played a revolutionary role in developing already existing irrigation systems and agriculture in America. "Modern irrigation technology probably began with the Mormon settlement"(Sojka et al.). Facing the challenge of limited rainfall in Utah, the pioneers created irrigation systems to not only survive but thrive in the desert environment. The Mormon Church played a notable role in organizing and coordinating the creation of irrigation systems. Led by Brigham Young, an American religious leader. They were the first of the Anglo-Saxon race, inhabitants of what is now known as England in the Middle Ages, to successfully implement irrigation techniques when settling in the Salt Lake Valley in 1847 (Hooton). Through a combination of strong leadership, community, and religious principles, the Mormon pioneers transformed the desert landscape into fertile agricultural land creating vegetation for the West. By 1865, the Mormon pioneers had constructed extensive irrigation infrastructure, diverting water to 1.5 million acres of farmland and building over 1,000 miles of canals (Hooton). Advancements in water irrigation systems have been revolutionized by the integration of technology, creating efficiency and reducing water waste.

Even thousands of years later new advancements are being made, continuing to modernize the irrigation systems of today. Smart irrigation controllers and sensors have come into play to optimize water use by adjusting irrigation schedules based on plant water needs, as opposed to traditional fixed schedules. Climate-based controllers utilize local weather data, such as evapotranspiration rates, to adjust irrigation schedules("Smart Irrigation Technology: Controllers and Sensors - Oklahoma State University."). Evapotranspiration is the loss of water from the soil both by evaporation from the soil surface and by transpiration from the leaves of the plants growing on it("Evapotranspiration and the Water Cycle Completed."). This utilization of data and soil moisture to determine the irrigation requirements of the vegetation minimizes water consumption while maintaining plants healthy. Soil moisture-based controllers, on the other hand, rely solely on sensors placed within the roots of the plant to determine water needs("Smart Irrigation Technology: Controllers and Sensors - Oklahoma State University."). These sensors measure soil water content and activate irrigation when the moisture levels reach below a certain threshold("Smart Irrigation Technology: Controllers and Sensors - Oklahoma State University."). Studies have shown that both types of smart controllers significantly reduce the unnecessary use of water while maintaining healthy crops("Smart Irrigation Technology: Controllers and Sensors - Oklahoma State University."). Incorporating smart irrigation technology not only benefits agriculture but also proves effective for water conservation.

Water irrigation systems have a profound impact on poor countries, notably in regions dependent on lakes for food security and water sustainability. "Climate change, population pressure, and the unstructured withdrawal of water for irrigation have been reported as the primary reasons for the drying of the lake by 90% between 1960 to 2000"(Olowoyeye and Kanwar). Water irrigation systems have contributed to a shortage of water in Lake Chad, a

critical water resource shared by over 30 million people in Africa (Olowoyeye and Kanwar). In the 1960s, Lake Chad supplied water for irrigation and fishing, but its irrigation capacity has decreased by 90% since the beginning of the 1970s (Olowoyeye and Kanwar). Population growth and increased animal production have further strained the lake's resources, leading to conflicts between farmers and herders. Wastewater irrigation systems can contribute to disease, lack of hygiene, and lack of drinkable water in several ways. The use of wastewater in agriculture often leads to poor hygiene practices, as farmers may come into direct contact with contaminated water and soil while cultivating their crops. This can result in the spread of infectious diseases and significant health issues in communities. Urbanization and population growth increase the demand for water for irrigation purposes, leading to competition for scarce water resources. This competition can further strain water availability for drinking purposes, exacerbating the lack of drinkable water in urban areas. Lakes serve as crucial sources of water for agriculture; supporting crop and livestock farming while sustaining a diverse number of ecosystems. However, other challenges such as climate change and territorial controversies threaten further the sustainability of many lakes globally. As in Africa, managing regional and global water bodies poses significant challenges, as many of their lakes are shared between multiple countries. For example, Lake Chad is shared by four African countries, Cameroon, Chad, Niger, and Nigeria(Olowoyeye and Kanwar). The lake's water has been spread scarcely because of the aforementioned poor water management and climate change. The shrinking of Lake Chad's surface area has had consequential effects on domestic and agricultural use. Collaboration between countries is crucial to effectively manage water levels and address concerns, allowing for the implementation of conservation plans. Efforts to address the decline in Lake Chad's water quantity and quality include innovative water management strategies such as

implementing water harvesting measures, like wastewater irrigation systems. This as a result will restore Lake Chad and ensure long-term food and water security in the region. Overall, addressing the decline of Lake Chad requires governmental efforts, innovative strategies, and collaboration to ensure a sustainable water supply for agriculture and meet the food challenges of the region.

The challenge of providing food security for the continually growing population while preserving the environment and simultaneously its citizen's health is one of the largest issues faced in our century. Agriculture is threatened by issues like water scarcity and pollution. To combat these issues treated wastewater has surged as a solution to enhance sustainability. Wastewater treatment has been implemented in various water-strained countries like China and Ethiopia, but both issues and benefits have risen (Kama et al.). Wastewater works as an effective method to supplement freshwater in irrigation systems: it improves soil and crop yields when proper management of water resources and wastewater treatment are set in place. The issues arise when the wastewater is not correctly sanitized. Unhygienic wastewater leaves soil and crops with salinization or wrong Ph levels, human waste, and metals. These invasive pollutants create issues in food safety and public health. These impurities most commonly contract populations with Cholera and Typhoid (Kama et al.). “Cholera is an acute diarrhoeal disease that can kill within hours if left untreated”(“Cholera - Vibrio Cholerae Infection.”). Typhoid fever is a life-threatening infection caused by the bacterium *Salmonella* Typhi (“Typhoid.”).

So, despite its common adoption, the treatment and regulations have yet to be placed into any enforcement due to capitalization. Wastewater irrigation systems provide an effective solution to address water scarcity and promote agriculture, but regulations and rules must be addressed to optimize benefits while simultaneously reducing the risks. As the global population

increases and water sources decrease these methods are crucial to ensuring food security and sustainability. While wastewater irrigation may provide benefits such as improved livelihoods and increased crop growth, it also carries the risk of transmitting diseases to consumers of its products. The rapid urbanization and population growth create a demand for irrigation water, leading to the increased use of wastewater in agriculture. This further highlights the scarcity of water resources in urban areas, creating more challenges for water management. Appropriate handling of vegetables grown in wastewater-irrigated fields is crucial to minimize contamination and reduce the spread of diseases. Overall, while wastewater irrigation may offer some benefits, it presents significant health concerns.

Proper management of water resources and wastewater treatment is essential. “Better access to health care education, nutritious food, water, and sanitation”(Gashaye). Wastewater irrigation systems increase the economy and decrease malnutrition by providing a reliable water supply for farmers. This is crucial in urban areas, where it's often the only available water source. This enables year-round crop cultivation and improves crop growth with its nutrient content. Additionally, wastewater utilization in agriculture. Similarly seen in Ethiopia, contributes significantly to food production, supplying fresh vegetables at low prices to nearby cities (Gashaye). For many poor farm households, wastewater farming is essential for livelihoods, providing a substantial portion of annual household income and food supply. This practice not only serves as supplementary income but also ensures better access to nutritious food, thereby fighting malnutrition seen in developing countries.

Wastewater irrigation systems have addressed various issues engulfing today such as malnutrition, climate change, and food insecurity. Meaning despite its issues, irrigation systems have provided us with a long-term solution for long-term problems. Water irrigation systems

have more pros than cons regarding their impact on the environment, our communities, and agriculture; when done correctly. They have only been adopted in 3rd world countries that have no alternative. Yet with climate change consistently creating more issues, other parts of the world will take in similar practices. Water irrigation systems serve the well-being of all humans and living organisms.

Works Cited

"Cholera - Vibrio Cholerae Infection." *Centers for Disease Control and Prevention*, 27 Aug. 2023, www.cdc.gov/cholera/general/index.html#:~:text=Cholera%20is%20an%20acute%2C%20diarrheal,143%2C000%20people%20die%20from%20it.

"Evapotranspiration and the Water Cycle Completed." *Evapotranspiration and the Water Cycle | U.S. Geological Survey*, www.usgs.gov/special-topics/water-science-school/science/evapotranspiration-and-water-cycle#:~:text=Evapotranspiration%20includes%20water%20evaporation%20into,to%20the%20atmosphere%20via%20plants. Accessed 1 Apr. 2024.

Gashaye, Dejen. "Wastewater-irrigated urban vegetable farming in Ethiopia: A review on their potential contamination and health effects." *Cogent Food & Agriculture*, vol. 6, no. 1, 2020. *ProQuest*, https://www.proquest.com/scholarly-journals/wastewater-irrigated-urban-vegetable-farming/docview/2480198567/se-2, doi:https://doi.org/10.1080/23311932.2020.1772629.

Hooton, Leroy W. Jr. "Pioneers of '47–Pioneer Irrigators." *Pioneers of '47-Pioneer Irrigators*, www.slcdocs.com/utilities/NewsEvents/news1999/news7221999.htm. Accessed 29 Mar. 2024.

Kama, Rakhwe, et al. "Water Availability and Status of Wastewater Treatment and

"Agriculture Reuse in China: A Review." *Agronomy*, vol. 13, no. 5, 2023, pp. 1187. *ProQuest*, https://www.proquest.com/scholarly-journals/water-availability-status-wastewater-treatment/docview/2819263647/se-2, doi:https://doi.org/10.3390/agronomy13051187.

Olowoyeye, Oluwatuyi S., and Kanwar, Rameshwar S. "Water and Food Sustainability in the Riparian Countries of Lake Chad in Africa." *Sustainability*, vol. 15, no. 13, 2023, pp. 10009. *ProQuest*, https://www.proquest.com/scholarly-journals/water-food-sustainability-riparian-countries-lake/docview/2836446248/se-2, doi:https://doi.org/10.3390/su151310009.

"Smart Irrigation Technology: Controllers and Sensors - Oklahoma State University." *Smart Irrigation Technology: Controllers and Sensors | Oklahoma State University*, 1 Feb. 2017, extension.okstate.edu/fact-sheets/smart-irrigation-technology-controllers-and-sensors.html#:~:text=Smart%20irrigation%20technology%20uses%20weather,maintaining%20plant%20health%20and%20quality.

Sojka, R.E., et al. "Irrigation: An Historical Perspective." *NWISRL Publications*, Marcel Dekker, Inc., 1 Jan. 1970, eprints.nwisrl.ars.usda.gov/id/eprint/815/.

"The Traditional Aflaj Irrigation System for the Sustainable Management of Water in Oman."www.ideassonline.org/public/pdf/AflajIrrigationSystem2021-ENG.pdf. Accessed 29 Mar. 2024.

"Typhoid." *World Health Organization*, World Health Organization, www.who.int/news-room/fact-sheets/detail/typhoid. Accessed 1 Apr. 2024.