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 Yemen, Factor 2: Water Scarcity

Yemen: A War-Torn Country in Search of Peace

Ismail Serageldin, former Vice-president of the World Bank, knew of the growing pressure water has on war-torn countries. In August of 1995, during a meeting for the United Nations Development Programme he famously stated, “If the wars of this century were being fought over oil, the wars of the next century will be fought over water.” The lack of water availability in many countries throughout the world is growing at an alarming rate, and without immediate and effective action, the future of water accessibility and sustainable water usage rights will subside into the past. For the first time in human history, the consumption and pollution of fresh water has reached a level where water scarcity will threaten the production of goods and services vital for human survival.

1. Cultural, Geographical, and Political Impacts

Yemen is a Middle Eastern country that borders the Arabian Sea to the south east, the Red Sea to the West, and the Gulf of Aden to the South. Its neighboring countries include Oman to the East and Saudi Arabia to the North. Being a principle port country, Yemen has been devastated by a war between the allies of the Houthi rebel movement and the forces of the internationally recognized government of President Abdrabbuh Mansour Hadi (“Crisis”). By late January of 2011, many public rallies, fueled by high unemployment rates, poor economic conditions, and political corruption, revitalized the southern secession movements from the northern Yemen Arab Republic (“World”). An unfortunate effect of the secessionist war is a diminishing of precious water resources. Since the conflicts began, many war groups, including Al-Qaeda and Al-Islah, have strategically weaponized water; for example, the Islamic State (ISIS) shut down a major water channel from the Tabqa Dam to Aleppo, which the Syrian government took control of in December 2016 (Suter). Additionally, the Syrian government, hoping to eradicate 50% of the Yemenese population it viewed as unsustainable given the region's severely limited water resources, bombed the Tishrin Hydroelectric dam, calling it a win for the rebel forces of Al-Qaeda (Suter). The war affects not only the national economy and policies but also the current state of the country prevents vital resources from reaching the people in need.



Figure 1.0



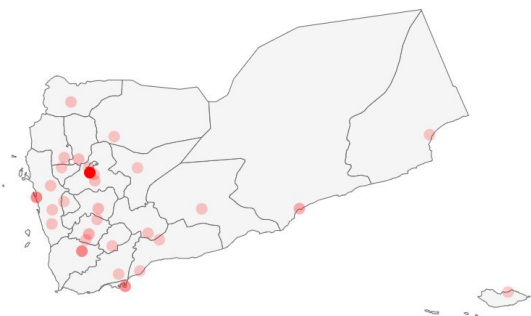
Figure 2.0

Both figures 1.0 and 2.0 show the Al-Mocha water desalination plant located in Mocha on the Western Coast of Yemen. Figure 1.0 shows the plant in November of 2013. Figure 2.0 shows the plant in 2018, just months after the bombings in October of 2017.

As the cultural war in Yemen escalates to new levels, the water crisis is exacerbated. Because the majority of Yemenese citizens rely heavily on local wells and underground water storage systems to water their crops and livestock, the water supply is an easy target for military personnel to destroy; the destruction of these local water sources has the potential to eradicate entire populations of people. A desperate need for water for many of the citizens has exponentially grown to a level where innocent people are forming alliances with Al-Qaeda, hoping that the organization will desist from destroying any more water sources. Slowly, the country is tearing itself apart with the scarcity of water being the basis of the crisis. With the demand for water increasing every day, the rebel group Houthi has targeted specific locations where water is meager. These inhuman war tactics have caused the deaths of nearly 4,000 innocent people per year (Hettle). Targeted locations' water supplies are diminishing each year; since the climate of Yemen is arid and dry, there is little to no annual rainfall to aid the replenishment of the regions' invaluable water tables. These water tables are the only way for the majority of the population to receive water. Along with the war and human factors, the geographical location, topography, and meteorological factors of Yemen exacerbate water tensions in the area and will continue to hinder the abilities of the citizens to access safe and renewable water sources for years to come.

2. Demographics

With a population of nearly 29 million people as of July 2018, the population density of Yemen is 60 people per sq km ("Population"). This density is largely the result of increasing urbanization by the struggling rural populace. With 35.8% of the population living in urban areas and that number increasing 3.76% annually, the cities are rapidly becoming overpopulated, resulting in the social and environmental ramifications of overcrowding. ("World"). Yemen's largest city, the capital Sana'a, has such a surfeit of residents that the United Press International expects Sana'a to be the first major city in the world to



experience full water scarcity ("Five"). Another problem catalyzed by extreme urbanization is the shift away from coastal communities where access to water sources is more readily available than that of inland communities. Yemen's beleaguered citizens are only populating areas where water sources are more scarce than on the coastlines. Since Yemen has no rivers, unlike its neighboring countries, it relies solely on rain and groundwater; therefore, this transition from coastal communities to urban living has a negative impact on not only the topography of the land but the economy of Yemen as a whole.

Yemen population density map. The coastlines of the West and South are the only readily available water sources for the majority of the population. With little to no water located in northeastern Yemen, the density of southwestern Yemen continues to grow. As a result of mass migration, the creation of larger, safer cities have become accustomed to Yemenese life: <http://worldpopulationreview.com/countries/yemen-population/>

3. Maritime Trade

Yemen, the second largest country in the Arabian Peninsula, covers just under 528,000 sq km, about twice the size of the state of Wyoming. Of the total surface area, Yemen has access to 0 sq km of fresh water (“World”). The only viable way to access any fresh water is to dig wells or have water transported from neighboring countries. Transporting water would be a feasible way to give people the access to fresh drinking water, but the International Maritime Bureau reports that the coasts of the Southern tip of the Arabian peninsula are at high risk of piracy: numerous vessels, including commercial shipping, have been attacked and hijacked both at anchor and while underway (“World”). As a result, shipping water and other natural resources to the country are nearly impossible. According to the UN Offices for the Coordination of Humanitarian Affairs (UNOCHA), more than half the population is currently suffering from “acute” stress due to water deprivation (Cruickshank). Furthermore, shipping water to Yemen is a costly procedure. If one cubic meter of water were to be shipped from a location near the Mediterranean Sea, it would cost double what it takes to produce the equivalent by a desalination process (Sher).

4. Increased Diplomacy

Despite the grim circumstances, the Middle East has access to both diplomatic and technological solutions that can aid the water crisis it is facing. For many regions in the Middle East, solutions for managing scarce water resources are available at the domestic and regional level (Finn). In February of 2014, the Food and Agriculture Organization of the United Nations convened the 32nd annual FAO Regional Conference for the Near East. The organization met with the governments of many Middle Eastern and East African countries to identify policies in agricultural practices and water management (Finn). With an increase in diplomacy, many foreign agencies can now focus their efforts on technological advancements to improve water quality and quantity throughout the Middle East.

5. Desalination

Yemen’s coastline and access to an abundant source of salt water designate it as a viable location for desalination plants. Desalination, or the process of removing salt from seawater, is becoming a rapidly expanding industry in the water-poor Middle East. Many countries in the Arabian Peninsula have already begun the process of building desalination plants and making the switch to a seawater-use-only policy; for example, a state-of-the-art, 200-million-dollar desalination plant was built in Haifa Bay, giving Israel, Jordan, and its neighboring countries access to over 50 million cubic meters of fresh water per year (Sher). Not only was the water plant beneficial to the economy of Israel but increasingly rapid technological advancements in water desalination are making the cost of production and transportation relatively inexpensive compared to other options. Promisingly, the cost of the multi-stage flash distillation (MSF) process that distills seawater by transforming water into steam through multiple stages of what are essentially countercurrent heat exchangers, has dropped from \$9.0/m³ in the 1960’s to \$1.0/m³ (Zhou). The efficiency and financial feasibility continue to increase with new advancements in technology, such as reverse osmosis. Reverse osmosis (RO) is a water purification technology that uses a semipermeable membrane to remove ions, molecules, and larger particles from drinking water, and with this new method, costs of desalination have fallen to less than \$0.6/m³ (Zhou). Continuing improvements to the desalination process and production of safe drinking water are steps in the right direction; however, desalination plants are not the best and most affordable way to produce safe drinking water.

6. Improved Technology and Education

Desalination costs are and will remain higher than other viable alternatives for providing fresh water to Yemen. With a debt of over \$1.5 billion (“World”) and in the middle of a violent civil dispute, the country is in need of simpler, tamper-safe solution. One easy to use and accessible resource is Waterseers. A waterseer is a device placed 6 feet into the ground. The top of the lower chamber is placed at ground level where spinning fan blades collect moisture in the air. The moisture then condenses and falls in the collection chamber where, during cooler nights, a waterseer can collect up to 37 liters of water in a 24 hour time period. The small device was patented by the VICI labs in the US, and the National Peace Corps Association is currently targeting worldwide use of the device by early 2018 (Spinks).

However, technological advancements such as desalination plants, Waterseers, and even fog catchers are only possible because of the strong education systems found in first world countries who develop and patent products such as these. The education system in Yemen is one of the worse in the world; for example, Yemen is ranked 177/195 on the education index and the average person only has a three-year education. Furthermore, financial resources are dwindling and many school buildings have been destroyed by the ongoing war (Moheyddeen). Organizations such as the United Nations Children's Fund have created long-term goals to rebuild the broken country. As of August 2016, over 2,000 schools were either completely damaged or partially damaged by airstrikes and shelling (“Yemen”). A financially stable, higher education system in Yemen has the potential to turn the country into a self-sufficient and safe country that creates an environment suitable for children to grow and learn.

Since its independence, Yemen has been a barren wasteland torn apart by war and drought. Political direction is lacking and government funds are dwindling. The only hope for the future of water conservation is to provide cheap and efficient alternatives to wells and pumps. Even creating a water collector that can provide water for one person per day is enough to make a change in the country; additionally, the only way to get Yemen, as a whole, self-sufficient again is to provide the country with diplomatic services that will aid in peace and ease civil disputes over water. Only then can organizations such as the World Bank, UNICEF, UPI, and UNOCHA enter the country and rebuild the infrastructure, creating opportunities to save and produce water. Immediate solutions to Yemen’s water crisis would start with technology such as Waterseers, and ultimately, when the country has become politically and economically stable, Yemen can promote the production of desalination plants and water shipments. Water is the most critical resource issue of the twenty-first century. A nation’s water is a principle measure of its prosperity and future prospects; therefore, the potential to restore the country of Yemen lies in solutions that will assist in the relief of not only a tumultuous government caused by war but an impoverished nation plagued by drought.

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