Jennifer Young

GLOA 495

WATER SCARCITY IN THE MIDDLE EAST

After research and field work in my internship at Waterhealtheducator.com, I have discovered that availability of resources is at the heart of many conflicts that are usually attributed to other causes, such as religion or politics. In this paper, I investigate how humans are exacerbating the problem of our world's finite water supply. I present an investigation of this issue in the Middle Eastern countries of Iran, Iraq, and the Occupied Palestinian Territories. I also put forward an explanation for the real reason behind the conflict between Israel, Jordan, and the Occupied Palestinian Territories. I show how a variety of factors including population, agriculture, sanitation, climate, and political upheaval all contribute to a pre-existing, natural water scarcity in these nations. My argument is that humans are intensifying water scarcity through unsustainable population growth, unsustainable agricultural methods, irresponsible sanitation practices, and disregard for natural regional climate. All nations, particularly those in this water-scarce region of the Middle East, need to adopt more sustainable water consumption habits in order to prevent the world's finite water supply from running out in the future.

This investigation is directly related to my work with Waterhealtheducator.com. As part of my work with Waterhealtheducator.com, I researched issues related to water, such as democracy, infrastructure, gender, privatization, and human rights, with a regional focus on the Middle East. The paper's focus on water availability in an underdeveloped region of the world reflects the objectives and educational efforts of this organization. Waterhealtheducator.com is an independent nonprofit organization with the main objective of raising awareness about water health and water quality issues throughout the world. Through lectures and provision of

materials, the organization reaches out to a variety of ages from kindergarten through university level to educate on water-related topics ranging from pollution, globalization, sanitation, and water scarcity, as well as others.

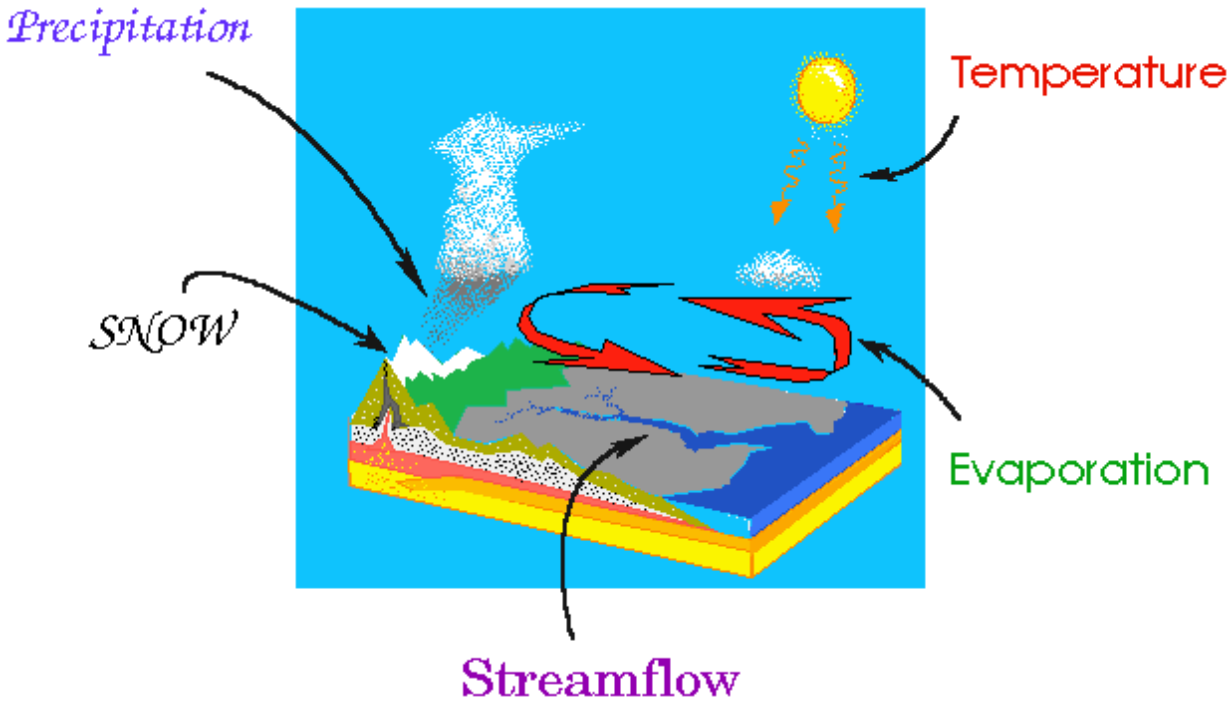
EXPLANATION OF WATER SUPPLY AND THE HYDROLOGIC CYCLE

"The existence of life, whether human, animal, avian, reptilian, amphibian, plant, or microbe, depends on water" (Frumkin 488). All members of the biosphere, all of Earth's organisms interacting with the physical environment, require water as one of their basic needs (Frumkin 488). Humans cannot survive without water for more than several days and yet, as a species, we have grown to take water's presence for granted (Frumkin 488). While water is a basic need, it has also come to be viewed as a human right. Yet, the world's water is not distributed equally across its geography. Humans have developed societies around water sources but many cultures have also sprung up in areas that are naturally water scarce. Of the 1,357,000,000 cubic kilometers of water in Earth's freshwater, saltwater and atmospheric sources, (Corps of Engineers - Portland District) less than 1% is accessible, usable freshwater (Frumkin 488). The other 99% is either locked in the ice caps of the Arctic and Antarctic (2%) or virtually useless to us as it is saltwater (97%) (Frumkin 488). Though we do not have all of the water available to us at once, all water is in a constant cycle, even the salty ocean water and frozen ice caps. Some of it cycles more quickly through the cycle than the rest of it but it all makes it through the cycle. The water cycles through evaporation, condensation, precipitation, interception, infiltration, percolation, transpiration, runoff, and storage (see Table I). It evaporates from the oceans, precipitates on land and back onto the oceans, gets absorbed into the soil, infiltrates to the underground aquifers, and runs back to the oceans. This cycle is known as the hydrologic cycle. There is plenty of water and all of it gets the chance to cycle through. The small supply of usable

supply of water that humanity has at its disposal is used for three main purposes: agriculture, industry, and municipal. When we extract the groundwater faster than it can be replenished by the water cycle, we break the balance of the water cycle, preventing the supply of freshwater from being replenished. This leads to water scarcity (Frumkin 488-491).

(For table source see: http://www.nwrfc.noaa.gov/info/water_cycle/hydrology.cgi)

TABLE I



DEFINITION OF WATER SCARCITY AND WATER STRESS

In investigation about water availability and scarcity, it is important to define the varying degrees of availability on a scale. According to the textbook *Environmental Health*, water stress is defined as "a water supply at or below 1,700 cubic meters per year" (Frumkin 491). Water scarcity is defined as "a water supply at or below 1,000 cubic meters per person per year" (Frumkin 492). A nation's water availability is dependent upon the rate at which available

freshwater is used. Freshwater can be divided into two main sources, surface water and ground water (Frumkin 490). In *Blue Gold*, a documentary, which I watched and wrote an abstract for Waterhealtheducator.com, the scientists delve into the concept that water, may not be a renewable resource, as was the previously widely accepted conclusion. Maude Barlow and Tony Clarke, the activists in the documentary and authors of a book by the same name, show that the rate that humanity is using its freshwater resources is unsustainable. Previously, it was widely accepted knowledge that only resources that have a finite supply are considered nonrenewable resources and water was therefore not lumped into this category. However, excessive water extraction is depleting our underground aquifers faster than they can be replenished by the water cycle (Blue Gold). "When a resource is extracted faster than it can be renewed then eventually supplies will not meet demand" (Frumkin 491).

POPULATION

One of the main factors in water scarcity is population growth. Population growth has had a tremendous impact on water use; since 1960, the world's population has doubled. In 2011, it reached 7 billion people (Population Action International). "Projections show that by 2035, 3.6 million people will be living in regions of water stress or scarcity, as population growth causes more countries and regions to become water scarce" (Population Action International 2). The water supply in the Middle East will be particularly affected by population growth, as it is a naturally arid region. In fact, seven out of ten of the world's most water scarce countries are located in the Middle East and North Africa (MENA) (Population Action International 2). The MENA region's rate of population growth has been faster than in any other area in the last fifty years, growing 3.7 times in size from 1950 to 2000 (Roudi).

AGRICULTURE

Though Iran is a prosperous country that ranks in the high category for human development, it faces many challenges in the realm of water health (Young). Only one third of Iran's land area is suitable for farming but unequal water distribution and naturally poor soil prevent most of it from being cultivated. Despite this, agriculture is the main source of water withdrawal (United Nations Food and Agriculture Organization). The most recent statistics for Iran's water use were recorded in 2004, making an accurate analysis of present conditions difficult. However, even at that time, of the 93 trillion cubic meters of water that Iran used, 92% of that went towards agriculture. Only 6% went towards domestic consumption, and a miniscule 2% went towards industry (United Nations Food and Agriculture Organization). Iran's per capita water consumption was 1,859 cubic meters in 2010 (Population Action International). If Iran continues at this rate of water consumption, it is predicted to join the 27% of nations that will face water stress (Frumkin 491).

Iraq is in a worse situation. It ranks as a medium development country on the United Nations Country Index and its water health reflects that (International Human Development Indicators: Iraq). Iraq suffers from very unequal water distribution. That is to say that as of 2006, only 77% of the population had access to safe drinking water (United Nations Food and Agriculture Organization). That percentage is an average between urban and rural: while urban coverage is around 88%, rural coverage hovers around only 56% (United Nations Food and Agriculture Organization). One might wonder where Iraq's water goes if not to its people. According to Aquastat, Iraq consumed 66 trillion cubic meters of water in the year 2000. Of those 66 trillion cubic meters of water, 52 trillion cubic meters went towards agriculture. That is 79% of Iraq's water supply. In that same year, the water consumption per capita was 2,632 cubic

meters (United Nations Food and Agriculture Organization). Though this is somewhat higher than Iran's most recently recorded levels of per capita water consumption, it is still very close to the water stress threshold of 1,700 cubic meters per capita. It is expected that by 2025 Iraq will have, at best, 1,409 cubic meters per capita, setting it well under the water stress threshold. By 2050, it is expected to enter water scarcity, with the most generous estimates at 954 cubic meters per capita (Population Action International).

Unsustainable agricultural methods, like flood farming and overgrazing, have led to soil erosion and desertification in both countries. Iran and Iraq are both naturally very dry climates in some regions. These further exacerbate the lack of water availability throughout the countrysides. Flood farming uses immense amounts of water at one time to irrigate fields, a practice which is not very efficient because not all of the water gets absorbed into the soil but runs off instead. The water that runs off takes with it many organic compounds, like phosphates and nitrates, as well an inorganic compounds, like antibiotics, disinfectants, pesticides, fluoride and nonylphenol. These then enter the water cycle and have the potential to contaminate underground aquifers. Once an aquifer is contaminated, it is virtually impossible to clean, rendering unusable (Frumkin 490-92).

SANITATION

Another major contributor to water scarcity is actually a separate environmental problem by itself: water pollution from improper sanitation. The disposal of wastewater into freshwater surface water sources is common practice in many developing countries, particularly in the Middle East. Iran has struggled with sanitation-related pollution for some time. According to the United Nations' most recent profile on Iran's water and sanitation from 2004, 40,000 tons of waste is produced in Iran daily (United Nations). Of that, 70% percent is organic material and the

remaining 30% is dried-up or non-organic material (United Nations). According to that same report, in urban areas, individual municipalities are responsible for waste management and in the majority of rural areas; no systems for waste management are in place (United Nations). Another more recent report by the United Nations Educational, Scientific, and Cultural Fund's Water Health Institute, 0.5% of rural dwellers and 20% of urban dwellers had access to sanitation services (UNESCO-IHE). Both of these statistics support that throughout the twenty-first century, there have been serious gaps in Iran's sanitation management plan. There is very little recycling or composting: ninety percent of Iran's waste gets sent straight to a landfill (UNESCO-IHE).

Sanitation is also an issue in the Occupied Palestinian Territories of the West Bank and Gaza Strip. These territories suffer from severe water scarcity because a majority of the water from their underground aquifers gets diverted to Israel. In fact, 87% of the water from the mountain aquifer in the West Bank and 82% of the water from the aquifer under Gaza Strip go to Israel (Palestinian Hydrology Group). Palestinians suffer from very poor sanitation services because water is so scarce. 69% of Palestinians in the West Bank still rely on septic tanks for sanitation. Only four towns have sewerage treatment plants, resulting in poor effluent quality and the majority of wastewater being discharged raw into the environment. To be precise, 350 locations discharged 25 million cubic meters of sewerage into freshwater sources (World Bank). This not only impacts the freshwater sources but also groundwater sources because the effluent that gets discharged passes through the water cycle and into the underground aquifers. In Gaza, a similar situation persists. According to the World Bank's 2009 report, "sanitation services in Gaza are also in crisis". Most sewage and other waste get discharged directly into the lagoons and the sea; sewage plants only work intermittently (World Bank Report 30). Houses not

connected to the sewerage network often discharge their waste into cesspits and due to the dismal economic situation at present; these pits are not being emptied properly (World Bank Report 30). In 2007, the problem became so severe that a temporary sewerage storage site overflowed and its back-up basin malfunctioned, causing a deadly sewage flood, which endangered human and environmental health (World Bank). The underground reservoir is virtually unusable because it has been so badly polluted from sewage seepage. There are 16 sewage outlets, which run directly into the Jordan Sea, releasing 70,0000- 80,000 m^3 of untreated wastewater. This is more than 50% of the total wastewater (World Bank).

CLIMATE

Iraq also suffers from other problems that impact its water health. This is because the two main water arteries, the Tigris and the Euphrates, have a large yearly fluctuation. This large fluctuation in annual water discharge results in an alternation between disastrous floods and severe droughts. For example, in the early 1960s, Iraq suffered a severe drought when the two rivers only put out 30 cubic kilometers of water combined. However, in the mid 1970s, levels in both rivers reached over 84 cubic kilometers. The Tigris River has been known to rise at a rate of 30 centimeters per hour. Many villages and towns in the south have been built on high embankments to avoid being submerged, though flooding still occurs often. Levees break often as well, flooding the farmland, making agriculture impossible and spreading pesticides, animal manure, organic compounds and other kinds of agricultural run-off throughout the countryside. This reduces the water quality, making the water undrinkable due to all of the chemicals and bacteria that enter the drinking water (United Nations Food and Agriculture Organization).

Drought is the other effect of the sporadic unpredictability of these two rivers. During drought, water is already very scarce. Iraq's arid climate provides that it regularly experiences

drought. It is for this reason that finding sustainable water management systems is important. Some systems are already in place to do this; in 1992, the Third River (aka Saddam River) was constructed to increase water transport efficiency, reduce waterlogging, and improve water quality. Other waterways have also been built for the same objectives. (United Nations Food and Agriculture Organization)

Throughout history, water has served as a source of conflict in the Middle East but the Jordan River has suffered from water overextraction due to the high volume of people who live in the surrounding religiously significant cities. Today, the nations of Israel, Jordan, and the Occupied Palestinian Territories vie for access to water in this parched region. In the media, the conflict between these three nations is portrayed as one of social origins, that religion is the main source of conflict. However, the real reason behind the conflict in this region is lack of sufficient water. Religion has become a scapegoat for dry climate. It now serves as justification for one nation withholding access to water. Israel claimed territorial control over the region in 1967 and thus, has had control over the majority of water sources since then. Jordan and the Palestinian Territories have limited access to water supplies from their own underground aquifers because Israel's national water authority, Mekorot, diverts much of the supply to the cities and farms of Israel. "Israelis enjoy water parks, cultivate the water-demanding banana plant, and irrigate miles of agriculture while Palestinians must purchase West Bank water that in reality comes from the land underneath their feet" (Young). The difference in religion- Israel is a Jewish majority nation, Palestine is Muslim majority, and Jordan is mixed between Muslims and Christians- has become a motivation behind Israelis keeping water from Jordanians and Palestinians. Jordanians and Palestinians have to pay to get the water that they're technically already entitled to.

POLITICAL FACTORS

Water scarcity can be induced by political upheaval within a nation's borders. This situation occurred in Iraq during the U.S. War on Terror. The United States made a concerted effort to unseat Saddam Hussein when he was in power as Iraq's president. In 2003, the U.S. military bombed Iraq from March to May. In a personal interview, one of my classmates, Hashim Alameen, gave a first hand account of what it was like to grow up in Baghdad, Iraq under Saddam's reign and what his experience was during the American bombardment before his family evacuated the country. Hashim explained that before the war, provision of water and other utility services was. The water from the tap was drinkable and of good quality. It was not until the days leading up to the bombardment that there were any water shortages. He recalls him and his family members trying to save water in bottles and cups before the bombing started because they had heard rumors that Americans were going to launch an attack. Hashim stated during the first two months of the bombardment, electricity didn't work at all and water was cut off from time to time; to have sufficient drinking water his family had to buy bottled water. During and after the bombardment because the Iraqis began importing bottled water out of fear that the American military was going to bomb Iraq's water plants. Telecommunication infrastructure was bombed during the war so phone and Internet service was not available. He remembers that there were sewage problems but said that it didn't affect water quality. Hashim explained that water shortages and sanitation problems much worse in the south of Iraq, even before the war. This was because President Hussein dried the rivers in that area by creating dams to redirect water flow to other areas and thus, cut the water supply to that area. Farmers suffered and families suffered because there was not enough drinking water and not enough water to farm. Crops died. Hashim's family left Iraq in 2006. The American government dissolved the Iraqi army, captured Saddam Hussein after he hid for 8 months, and set up an Iraqi government.

When the Americans knocked over the Saddam statue, Hashim said that Iraqis knew that that symbolized the end of Saddam's reign.

CONCLUSION

The above investigation is a reflection of the kind of work that I have done with waterhealtheducator.com. An examination of the water cycle and the planet's needs for water renewal show that nature has definite limits and is very delicate. Human action like overextraction from underground aquifers at an overzealous rate is damaging the natural hydrologic cycle to the point that we risk turning water into a finite resource. Population growth and increasing regional population growth rates, as in the MENA region, are probably the two most impactful contributors to water scarcity. However, other factors are contributing to water scarcity in the Middle East as well. Agriculture is a major draw on water and in Iran and Iraq in particular. Poorly developed sanitation systems impact water quality, which in turn, impact water scarcity. Iran and the Occupied Palestinian Territories of Gaza and the West Bank suffer from this problem in particular. One of the main reasons why the Middle East is such a vulnerable region is because the majority of the climate is very dry and arid. Iraq suffers from natural cyclic droughts and floods and disturbance of the water table exacerbates desertification. In Jordan, Israel, and the Occupied Palestinian Territories, drought has led to conflict, which has in turn become a matter of politics. However, this relationship can also go the inverse direction; political conflict can worsen water scarcity, as was the case in Iraq during the U.S. War on Terror. I conclude that all of the aforementioned factors, population, agriculture, sanitation, climate, and politics are major reasons behind a growing water scarcity issue in the Middle East, particularly in Iran, Iraq, Jordan, Israel, and Occupied Palestine.

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