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Sudan, Factor 2: Water Scarcity

Sudan: Solar Water for the Sudanese

Sudan, with a population of almost 38 million people, is one of the largest countries in Africa. Having access to necessities is more important than ever. However, families have found that being self-sufficient increases their chance of survival. They have accomplished this by establishing family living compounds, maintaining subsistence farms, delegating household duties to the women and children, and placing the men in the fields. By creating subsistence farms, maintaining a viable way of life has become possible. Factors contributing to this impoverished life include an unclean water supply, or no access to water at all, and crop failure. The Sudanese government has done little to regulate the input and outtake of the Nile River basin, the most important water supply in Sudan, and average poor families depend on runoff or wells to obtain water for their families and crops. Regulations placed by the government in the future could include a spill-ban, limiting the amount and type of waste dumped into the water supplies by major industries and municipalities, or a tax for these industries and cities if they continue to dispose of waste improperly. Creating regulations on contaminants dumped in the water would be especially beneficial during the dry season. Families rely on the closest source of water to them and would benefit from regulated or prohibited waste dumping. During the dry season, it is not uncommon to face a drought lasting between three and four months: "From January to March, the country is under the influence of the dry northeasterlies. There is practically no rainfall countrywide except for a small area in northwestern Sudan in where the winds have passed over the Mediterranean bringing occasional light rains" ("Sudan-climate"). The little water received, in some areas totaling as little as 2.5 inches in the four months, quickly seeps into the dry earth or trickles into small streams and pools ("Sudan-climate"). These small but essential sources of water have been known to be contaminated and have since led to waterborne illnesses including hepatitis A and E and typhoid fever. Furthermore, without proper access to water, the daily high temperatures can lead to dehydration. While the sun is inescapable, it can be tamed. A solar-powered filtration system and vacuum pump could be the answer to the water problems in Sudan. Using this solar energy to provide water to farms and power auto-filtering wells and basins, the Sudanese people can obtain the essentials at little annual cost. This will help families at home and in the fields; better health and proper irrigation of crops can go a long way to help families better survive when resources run low.

The family composition in Sudan consists of immediate relatives as well as extended family. The oldest male of the family leads, and each male after leads by age. These men maintain the family's subsistence farm, a plot of land less than five acres that produces only enough food for their family. Subsistence farms share the water they have collected for their homes with the fields, and depend on rain during the few short months it may storm. Unfortunately, this water collected by family members is often from contaminated stagnant pools. The chemicals and bacteria in this water transfer to the soil and plants, killing plants prematurely and stripping soil of fertility. Lack of nutrients in the soil from over-farming has forced farmers to recycle land, rather than rotate to a healthier plot every five or so years. This has caused multiple crops to fail over a long period of time and has shrunk their market for crops that can be planted. Hardy and farmable crops include sorghum, cotton, and peanuts; these plants can thrive in any soil and depend on very little water, making them the best crops to be grown in a drought-stricken country. These crops are some of the most commonly found and grown in Sudan, and are some of the most common exports for this region of Africa. However, the sun makes growing many common crops hard, if not impossible. The dry soil and roots draw water in quickly, making plant hydration another issue. The poor quality of the water used is due to contamination by harsh industries, like petroleum

refineries, and is responsible for many crop failures. The government has not set strict regulations for the removal of waste from factories into rivers and major water sources. Future regulations should be proposed collectively, with the United Nations and the Sudanese people able to vote to protect their own resources. The Nile River, one of the main sources of water for the entire country, has left the Sudanese people in a sort of drought for over twenty years, because the contaminated water should not be used. People that do drink the contaminated water are more likely to develop harmful diseases, risking death due to lack of proper healthcare. The viable resources this country once had continue to shrink, and soon, nothing will be left. Despite the rivers massive coverage, including the underground Nile River Basin, the people of Sudan are struggling and need a permanent, high quality solution.

The Nile River stretches the length of Sudan and splits to create the White Nile and Blue Nile, which lead into South Sudan. These rivers snake through the eastern half of Sudan, though the northeastern portion is the largely uninhabited Nubian Desert, which has an average day time temperature of 105.4 degrees Fahrenheit (“Nubian Desert”). The water from the Nile River does not seep into the desert soil enough to create a fertile crop bed, making this land useless for farming. The Nile provides access to water for all of northern, eastern, and southern Sudan, but women and children must travel up to ten miles or more a day to retrieve the water. For territories in the west, the essential trek is much longer and treacherous. Voice Of America, a world renowned media group, said, “According to the United Nations, one person uses nearly 400 liters of water per day, in the world's wealthiest countries. In large cities like Darfur, 400 liters of water is shared by 20 people” (Schlein). This statistic proves the need for a reliable water source and a system available for the whole country. For both convenience and necessity, families buy water from treatment facilities where they know the water is safe to drink. It is expensive but clean and allows them more time at home and in the fields. Water is not faucet-ready like in developed countries and must be passed through extensive filtration devices to be usable. Therefore, the people of Sudan must buy their water in plastic gallon containers and tanks. Prices of this water rose consistently throughout 2015 due to the rising prices within water treatment facilities. With these escalating costs, providing families with clean water has become a second priority. Families can no longer afford water, a necessary part of daily life, so they must return to the polluted community watering holes and muck-filled streams skirting the village. These watering holes are known to be filled with many waterborne diseases and infections, resulting from unsafe waste disposal by large industrial factories. John Lesko, a professor at Saginaw Valley State University in Michigan, said, “Serious health problems are caused by diseases carried in the water supply; only about 64% of the nation's rural dwellers and 78% of its city dwellers have access to improved water sources. The water on the nation's coasts is also polluted by industrial by-products, oil, and sewage. Sudan's cities produce about 1.1 million tons of solid waste per year” (Lesko). Still, the twelve percent without access to clean, filtered water make up much of the agricultural population.

Some effects of the contaminated water on human health include typhoid fever which, if untreated, can stay dormant for up to twenty-five days or more, all the while attacking the immune system. While it is only potentially life-threatening to those who do not have access to healthcare, it kills almost a quarter of all Sudanese that contract the virus. Similarly, hepatitis A and E, transferred through fecal-oral contact or unsanitary water supply, can cause acute liver failure, fatigue, and vomiting. Hepatitis symptoms are usually mild, with most people recovering in three to six months. However, ‘most people’ have access to health care. The most common diseases treated in Sudanese health clinics are, or are in relation to, waterborne illnesses. One of the deadliest illnesses contracted from water is most common in the lower region of Sudan. It is considered one of the most stubborn afflictions in the south, and is known as *Dracunculus medinensis*, or Guinea worm (“Biology”). This disease has been all but defeated almost everywhere else. Last year, 80 percent of the world's cases were reported in southern Sudan (guinea-worm disease). People can contract it by drinking water containing flea larvae. The larvae can lay dormant in the body for 100 days before beginning to reproduce. The infection remains unnoticeable for up to a year, and the mature worms eat their way through the human body. These worms only emerge after they have bored

holes in the skin, usually through the top of the foot. It can cause temporary paralysis in its victims from the excruciating pain. The worms are treatable, but Sudan has only roughly 3 doctors per every 500,000 people (“Physicians per 1000 People”). It is considered one of the unhealthiest nations in the world, because of the number of untreatable epidemics identified in the past twenty years. The majority of these epidemics come from the water, the most important aspect of an environment. Also, with the average daily temperature of around 85 degrees Fahrenheit, dehydration sets in quickly, leaving people searching and settling for anything liquid to quench their thirst. The sun is an unforgiving force and can cause dehydration in less than an hour under extreme conditions (Brinks). Dehydration is treatable in the United States, and in other well-developed countries, simply through inserting an intravenous line and restoring enzymes and minerals to healthy levels. In countries as underdeveloped as Sudan, finding adequate healthcare services is not such a convenience. Some of the most common infections are also some of the deadliest. Many farm families are affected by these diseases because of their proximity to contaminated water supplies and lack of access to healthcare and major cities. The farms located near the cities and quality water supplies tend to succeed and their caretakers have better health, leaving a major healthcare gap within select regions. Farming families are directly affected by the lack of quality water and inadequate healthcare.

Even though commercial farms located near cities are few, agriculture-related jobs make up over half of the job market in Sudan. However, fewer than one third of the working farms in Sudan rely on irrigated agriculture, commonly found on large plantations or commercial farms; this system provides constant water to fields, and stores water in a reservoir in case of a drought. This system and its maintenance is costly. Crops of irrigated agriculture contribute to about 64% of the Gross Domestic Product reported (“Agriculture’s Sectors”). However, commercial farms are capable of producing enough food for the entire Sudanese population five times over; that is if agriculture exports stopped altogether and water sources were properly managed. Other small commercial and private farms depend on conventional or mechanical rainfed farming. By doing so, farmers can save money by not maintaining an irrigation system, but run the risk of not having enough water if a drought occurs. Droughts often last up to four months due to extreme sun exposure and lack of consistent and reliable rainfall. A recent study done by American Energy Independence states that one hundred square yards of sunshine provides as much energy in one to two days as an average family uses in an entire month (“America’s Solar Energy”). The average Sudanese family can use this energy much longer. Harnessing the sun's energy for vast regions such as war-torn Darfur, itself is the size of France, is costly. But, the country's ministry of energy and mining believes that advances in solar technology will lower the costs (Lavallee). In Sudan, the sun shines an average 300 full days per year, or 7,200 hours. By utilizing these UV rays, a solar-powered vacuum pump and water filtration device could be less costly.

To start, a network of underground pipelines can be based out of the northern head of the Nile River. Here, just below the Egyptian border, a large filtration machine can be built to extract as many impurities as possible by treating the water with consumable amounts of chlorine (5.25%) and iodine (2%) solutions (“Purifying Water”). As the water travels down the pipe system, which is optimally along the shores of the Nile, the Blue Nile, and White Nile Rivers, it is drawn by a solar-powered vacuum-type device. This brings the filtered water to cities quicker, though supply may still be limited. Aerospace grade titanium pipes will connect the water from the Nile to major town centers and small communities in between. Each town will have a filtered well maintained by community members, properly trained through programs funded by the Sudanese government, the United Nations, and the Peace Corp. Aerospace grade titanium is the best suited material for this job because of its outstanding qualities. It boasts a high strength-to-weight ratio and is “considered a refractory metal, meaning it is extremely resistant to heat and wear. Titanium does not corrode in sea water or chlorine” (Ascione). While similar, smaller solar water systems already exist, a more developed program that is both simple and environmentally friendly would help correct the water-crisis. To aid in the construction of this system, representatives from the UN, government, and volunteers from across Sudan will work together to find the best way to proceed with construction and

educate the people of Sudan about the benefits. This includes delegating tasks and forming proper committees to make decisions about the system and the regions in which it is implemented, similar to a community board. The filtered water will also benefit farmers and their field irrigation.

Farmers, along with the citizens of local communities, will benefit from an extensive education program detailing the effects and uses of chlorine and iodine in the water. It is important that the people are well informed and can support the system. Farmers will meet with environmental scientists and plant pathologists to advise them on how to properly treat their soil and crops with this water, and how to maximize their crop production rates. The water, clean enough and treated for drinking and crops, would improve production of crops and human health, as well as encourage eventual farm expansion. To make this water accessible for the westernmost points of Sudan, a water transportation system will need to be established. A courier will be assigned from each village to drive to major cities close to them. Here, they will fill a water tank on a truck and transport it back to their villages. The water will then be held in a treated well near the center of their village for community use. Establishing ration rules will be important, and a transportation schedule will need to be drawn and voted on to ensure the community always has access to clean water and proper resources. Powering this system with solar energy will prevent possible future costs of electricity. Solar rays are also available roughly 300 days of the year, while electricity may be scarce. Many countries that have implemented a similar system have found that some residents steal system parts and sell them so they can provide for their family or add to their savings (Carnie). Local law enforcement would be responsible for patrolling the areas where the filters are located, while environmental officers would be responsible for the upkeep of the system, as well as adding the proper chlorine and iodine solutions to the filters. The training needed for the upkeep of a system like this would be taught and sponsored by the United Nations, the Sudanese government, and the Peace Corps. Establishing an effective security system would also be beneficial and would create jobs for community members. This system could include a series of alarms or cameras and a patrol rotation on foot. By setting up a system like this, and recruiting local citizens that know the area well, the police agencies will build a better relationship with their community members and better develop their inter-communal communication skills. This water system will provide adequate quality water to the neediest parts of Sudan and establish jobs for the unemployed. It will also decrease the risk of contracting a potentially fatal waterborne illness, or spreading a harmful disease to crop beds and killing an entire crop species.

The population of Sudan has struggled but survived without a consistent source of water for many years. However, without government regulation, the problem has worsened. By establishing strict laws protecting this new water source, the government would save money and be able to refer back to a set of laws the people agreed upon by voting. These regulations could include strict punishments for defacing or stealing parts of the well system, filtration machines, or pipes, and punishments for dumping harmful chemical waste into wells, large bodies of water, and established municipal water sources. Using solar power to benefit the nation of Sudan would cut costs of buying pre-filtered water from expensive factories and provide enough electricity needed to power the vacuum and filtration systems, which would be powered by solar energy. To offset the cost of this system, a "share" system will be established; the United Nations would pay for one quarter of the project, the Peace Corp, another quarter, the Sudanese government, a quarter, and the Sudanese citizens, another quarter through taxes. By paying taxes, the citizens would have a right to vote on decisions affecting their wells, local systems, and ration regulations, which would be presented by community boards, and decide what works best for their region. Decisions regarding the solar panels, set up at the site of the filtration machine, would be managed by the government, the United Nations, and the Peace Corp. By containing the UV rays that have done so much damage in the past, the people of Sudan would have access to adequate drinking water, lowering the risk of dehydration, reducing the risk of contracting potentially harmful viruses, and increasing crop production. This improved system has the potential to increase exports, allowing the economy to flourish and the agriculture industry to expand and provide resources for neighboring countries that may also be struggling. A country considered one of the driest in the world could soon restore and better manage its

natural resources to benefit the nation as a whole, and equip citizens with resources they need to survive, by depending on a filtered water system run by solar energy.

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