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Libya, Factor Two: Water Scarcity

Education and Irrigation Uniting Libyan Communities

Hundreds of thousands of Libyan men, women, and children are suffering from a country-wide food security crisis. Food security is characterized by four factors that affect an individual's proximity to a diverse, nutritional diet. These four factors are availability, accessability, utilization, and stability. Libya, a violence-riddled country suffering from numerous safety and food crises, is lacking in all four of these food stability requirements. To reduce the number of Libyan citizens affected by food insecurity, short-term solutions must be implemented to conserve what little water the people possess, and the community must be educated on sustainable agricultural practices to ensure agricultural growth.

While the sizable African country has a prosperous oil export, its agricultural industry is floundering, as Libya is settled on arid, unfertile land. Before the genesis of Libya's civil war, over 80% of Libya's food goods were imported, because over 90% of Libyan land is desert (CNN Library). The country has been in a state of political and economic unrest, due to the increase in radical Islamist population and the frequent flow of migrant travelers fleeing from or imprisoned within Libya. Over 430,000 Libyans are affected by displacement and insecurity, as the Government of National Accord stations itself across the country to confront extremist groups battling for control and power over this African Nation (Libya). Civil unrest and population reduction have induced a 3.4% decrease in agricultural food production. This decrease in production creates a large employment barrier, due to loss of industry. Now, according to the Food and Agriculture Organization (FAO), over 1.3 million Libyans are in need of altruistic assistance, including the need for food and water security (FAO GIEWS Country Brief on Libya). The average family wage is approximately $170 per month, and in 2004, 30% of the Libyan population was unemployed (Worldmark Encyclopedia of Nations). Poor living conditions are commonplace, especially in the crowded, urban areas. Food is also not easily accessible, especially among those below the poverty line, which encompasses over 40% of the Libyan population (The National).

In 2015, approximately six percent of the population suffered from food insecurity. That number has more than doubled, jumping 11% in 2017 (World Food Programme). Libya is divided into three distinct sectors: Tripolitania to the west, eastward Cyrenaica, and Fezzan to the south. Each region has exceptionally different climates. They are characterized as possessing, "five distinct ecological zones in this region… each with different combinations of pastoralism and agriculture" (Libya).

The most fertile region lies within Cyrenaica, the coastal region located at high elevation. There are limited areas of coastal plains and plateaus in this region that produce crops such as barley, wheat, grapes, potatoes, olives, dates, oranges, and almonds (World Food Programme). Most crops grown in this region do not require heavy amounts of irrigation. Tripolitania is split; some of the land is protected from the powerful sun due to the mountainous Jabal Nafusa, but the more populated urban areas require heavy irrigation to grow the crops required for survival (Libya). The most impoverished groups, usually those living in the heavily populated Tripolitania region, have the highest insecurity rate. As a result, the most vulnerable of citizens are forced to decrease nonfood spending, such as forgoing health care and educational development, or even stable housing facilities (World Food Programme). Farming families own small areas of land, but studies show that, "less than five percent of the country receives enough rainfall for settled agriculture" (Kaushink). Libya relies mostly on imports and irrigation systems to provide stable food production not only to the native population, but also to provide for livestock and

crops (Bourdain). How do such devastating statistics affect the typical Libyan family?

There are no independent in-country agricultural developments allowed, so all workers must be members of a labor union. Each household holds approximately six people: a mother, a father, their married sons and their wives, and unmarried daughters. Mothers are usually in charge of domestic affairs, including raising the children. Libya has a patriarchal society; children born in-country are only considered Libyan citizens if they are born to Libyan fathers. According to Gender Concerns International, "[Women's] rights and freedoms suffered under increasing civil rights restrictions by the Gaddafi regime." Healthcare is severely underfunded, and seventeen of Libya's ninety-seven hospitals have closed due to insufficient funds (Libya). Regarding education, "Unicef estimates Libya's total number of schoolchildren this year is about 1.2 million, and around 279,000 will miss classes" (The National). A study conducted in 2017 within Libyan schools stated there was, "sufficient and poor quality of drinking water…facilities in 54 per cent of the assessed schools" (Water and Sanitation Facilities in Libyan Schools). Such obstacles create employment barriers for those individuals feeding families and livestock.

Due to the average low income per household, the average diet is basic and usually consists of dried beans, grains, and soaked chickpeas, and relies heavily on agricultural imports. Land size for the average farmer is eleven hectares, often broken up "into small, contiguous plots" (US Library of Congress). However, not all farmland can be utilized properly. According to the FAO, "security concerns prevented [farmers] from purchasing seeds, particularly for crops." Overirrigation damages farmland, and exorbitant gas prices impede farmer's agricultural progress (FAO GIEWS Country Brief on Libya). Throughout history, irrigation triumphs and downfalls have greatly influenced Libya's agricultural industry.

In the mid-20th century, large underground water reserves were discovered while miners were digging for oil. Libya's ruler, Muhamar Gaddafi, decided to embark upon "the largest civil engineering project in the world" (Maroun). The Great Manmade River is an avant-garde, complex series of pipes that carries water from the Nubian Sandstone Aquifer to provide water for the Libyan population. The Nubian Sandstone Aquifier is an ancient, cavernous underground reservoir that remained undiscovered for hundreds of years (Water Resources Programme). Gaddafi planned to make the arid, unfertile Libyan land, "as green as the flag of the Libyan Jamahiriya" (Maroun). The irrigation system utilized four sizable water basins from all around the country: the Kufra, the Sirte, the Murzuk, and the Hamadah. The first and largest stage of this construction aimed to provide over "2,000,000 cubic meters of water per day to Benghazi, the second-largest city in Libya, as well as Sirte… Gaddafi's stronghold" (Maroun). Approximately 80% of the liquid transferred through this pipeline was to be used for agricultural purposes (Encyclopaedia Brittanica). Throughout the five stages, water flowed to areas of the country that had previously suffered agriculturally. Construction began in 1984 and concluded in 2005. The system produced changed Libya's agricultural network entirely.

This unparalleled irrigation system doubled the amount of usable farmland, which soared from 700 hectares to 1600 hectares. Libyan farm owner numbers skyrocketed, jumping from 117 to 305. Libya was not solely reliant on imported materials and products, but instead became practically self-sufficient, a luxury the Libyan people had never experienced. Heavily water-reliant crops, such as lettuce and corn, were grown sustainably in the non-coastal region of the country for the first time. The people were not

perpetually, unquenchably thirsty for the first time in their lives. Then, in 2011, Gaddafi was overthrown and assassinated by rebel groups. All irrigation construction came to a grinding halt. The Libyan Civil War continued for six years, until a cease-fire was implemented in 2017. During the gruesome battles and devastating bombings, one of two Libyan water pipeline facilities was destroyed, severely impeding any future irrigational growth, and devastating areas of Libya that now do not have enough water to develop the land. Originally, land developed for irrigation exceeded 465,000 hectares, but a mere 240,000 hectares of land are currently in use, resulting in a food shortage spanning from the densely populated urban areas to rural farms deep within the desert (Maroun). The Civil War left its ugly mark not only on the surface of the land but also in the pockets of the people. Sufficient funds are not available to resume the lengthy construction efficiently enough to provide for the people in the short term. In addition to these devastating water security statistics, costly desalination plants located along the Mediterranean are also closing.

Libyan coastal agricultural regions heavily rely on desalination plants to remove salt from the Mediterranean water and the soil around it. These plants utilized "Hyflux's Kristal™ ultrafiltration pretreatment membrane and process technology in the production of desalinated water" (Holmes). In other words, Libya supplies large sums of money to utilize desalination technology in-country. Ahmed Leyas, manager of the Derna Water Treatment Plant, stated that "compelling conditions" forced workers to leave the plant, causing a decrease of industry, and therefore a loss of employment. Soil desalination research has also decreased (Housam). Now, not only is the irrigation pipeline decreasing in efficiency, but sea water desalination production is as well. However, the livestock industry is surprisingly prosperous, though other integral crop imports are limited.

While the country is floundering regarding the imbalance of imports versus crops grown locally, the livestock industry is self-sufficient, and substantial amounts of fertile coastal land have been set aside strictly for the raising of livestock. Water is sent to scattered patches of these crops and pastures through irrigation systems to cater to the arable desert land, and coastal desalination plants. However, inefficiency is increasing, as are costs. This solution worked in the short-term, but imports are dwindling, as the Libyan government does not have sufficient funds to pay their agricultural partners. A study conducted by Reuters shows that imports located in Benghazi have fallen by over 60%, and prices for produce such as tomatoes or fresh juice have increased by 10%. A European trade source stated that shipping large quantities of goods is, "not worth the hassle at the moment" (Saul). Not only are the agriculture industries lacking support from foreign relations, but are also losing the support of the community.

The one to five-hectare irrigated farms Libyan families possessed would allow a small amount of subsistence farming to benefit the small, rural nomadic groups. Women, though often disregarded in society, had a purpose and a home in the agricultural world. In fact, "[from] 2005-2007, about two thirds of the agricultural workforce were women (WFP, FAO, 2011)." However, due to the lack of community involvement in irrigation and water management, and the farms that were created as a result, there is "no detailed information available about irrigators in general and about how many women may actually practice irrigation in particular" (FAO GIEWS Country Brief on Libya). As the country became self sufficient, "cultivation has been changing from subsistence farming to highly mechanized operations," eliminating many smallholder farms that were supplying their communities with necessary

nutrients, while tending the land and properly managing their water sources (Libya-Agriculture). Currently, obtaining stable employment is difficult, as thousands of immigrants who formerly offered a source of cheap labor are now held in large detention centers around the country. This creates a sizable barrier to employment because employers do not want to pay above basic pay to work at their place of business. Another factor affecting stable employment regards safety and security. Many families flee their homelands to move to densely populated urban areas for shelter and safety. They abandon their jobs and their stable water supply in the process.

Over 75% of Libyan citizens live in urban areas without access to stable food sources, a phenomenon otherwise known as food deserts (Leonahart). Large portions of the country also live without steady water supply, especially the regions with the highest concentration of individuals. To provide food security for a growing population, short-term solutions must be implemented to educate the community on how to properly manage their scarce water sources. The long-term solution to this problem is for Libyan officials is to slowly work to rebuild the damaged parts of the complicated irrigation system, but this is no small undertaking.

The Great Manmade River was a massive undertaking economically and politically. As previously stated, building the pipeline the first time took over twenty years and is estimated to have cost around $25 billion (Libya-Agriculture). The task of rebuilding the complex irrigation system is expensive and dangerous due to the sporadic outbreaks of hostilities throughout the country. Although conditions are improving, a cease-fire does not mean all fighting halted immediately. In July of 2018, "an armed attack was carried out by terrorist groups on the Tazirbu site causing havoc, looting, killing and terrorising families, children and the workers who ensure the supply of water to cities." Large water facilities, the workers, and their families who work to provide clean water sources to cities are being terrorized or even destroyed (AfricaNews). Conditions may be dangerous, but the Libyan people are struggling, reduced to an existence without basic healthcare, education, and housing. They should not have to live without proper nourishment as well. Reliable, water-conscious, short-term solutions must be implemented to assist these agriculturally unstable communities, giving them the opportunity to take their food stability back into their own hands. Three steps must be implemented to increase food and water security in Libya: partnership, education, and implementation.

Institutions and universities including Pennsylvania State University and the University of Vermont fund organizations such as WAgN, or Women's Agricultural Network, to partner with large universities all around the globe. These scientists, engineers, and students will conduct important research in partnership with the University of Libya, while educating women and men on providing sustainable solutions to pressing agricultural issues. These issues include soil studies, crop production, and especially crucial water management. Incorporating the local people will set a precedent of independent subsistence farmers distributing locally grown produce into their communities. Programs such as WAgN aim to better not only the planet, but also education opportunities around the world, aiming "to develop the foreign university's capacity by expanding their program" (Behring). These organizations study the factors that affect food security in specific areas and across the globe.

The factor affecting the Libyan population the most is availability; crops are unable to be grown due to

a lack of short-term, sustainable solutions tailored to Libya's unique water crisis to provide enough food to feed the thousands of individuals suffering from food insecurity. Irrigation systems that waste precious water resources clearly have no place in Libyan agriculture. Partnering with Libyan citizens, students and experts can study the factors that affect food availability and irrigation efficiency: soil quality, water quality, efficient production, proper management, and a steady workforce. Meanwhile, program participants can implement sustainable systems while educating one of Libya's most underused resources: women. Americans and Libyans could work hand in hand to create effective and sustainable agricultural resources. Possible solutions include: implementing urban farming systems, establishing economical and effective trade routes, or studying salt levels in the water and soil to discover cheaper ways to extract the mineral while incorporating local farmers, especially female farmers, to create self-sustainable farming systems. One cheap, water-conscious, and effective system is called buried clay pot irrigation.

Buried clay pot irrigation utilizes permeable, glassless clay pots placed at certain intervals to conserve what little water comes into the area. This simple irrigation system only requires the exact amount of water the plant needs to survive, and the rest is saved for the plant's future demands. It is considered "as much as ten times better than conventional surface irrigation" (Bainbridge). Clay pots can be filled by hand or through irrigation systems. Buried clay pot irrigation, or pitcher irrigation, can also limit the amount of salt that enters the plant's system. A study conducted by the G B Pant University of Agriculture and Technology states that, "Distribution of salt and moisture from salt solution released by [the] pitcher would depend on many factors such as salt-water concentration, pot porosity, and soil parameters (Vasudaven)." The same study also proves that the saline levels in water decrease when moving in a downwards motion through the pot (Bainbridge). An irrigation system that can filter out amounts of saline while watering crops in a cost-efficient manner is just one of many food security solutions that could be implemented.

The World Food Programme is currently stationed in Libya, providing rationed amounts of food to those in need of assistance. In struggling regions, each household receives two bundles holding "enough to feed five people for one month." These packs provide over 70% of the daily nutrients consumed by the family (World Food Programme). Increasing the program's food supply through donations would increase the quantity of food per household. The World Food Programme's success stems from in-country partnerships with organizations such as the Shahik Tahir Al-Zawi Charity Organization (STACO). STACO strives to restore Libyan schools and facilities (Alaharthy). Humanitarian medical groups, such as the Medical Volunteer Abroad Program, could go oversees to provide medical care for those struggling from disease. Heat-resistant C-4 crops could be utilized to create a more resilient yield. Settled political groups could form in-country to stabilize Libya's foreign affairs.

The government must be urged to fund agricultural progress. Libya's regenerated government is led by newly elected officials, who often appear uncertain of their political decisions. Protests outside of the General National Congress building, where major political decisions are made (Smith). The imperative key to success is advocacy on behalf of the citizens: advocacy for WagN, advocacy for water-conscious irrigation, and advocacy for local agricultural growth. All solutions listed will improve some aspect of Libya's food security crisis.

President Dwight D. Eisenhower said, “If you cannot find the solution to a problem, enlarge it.” When implementing agricultural systems while considering strictly hypothetical situations, the solution seems simple. However, when undertaking an agricultural production to sustain a community, the undertaker must provide available, accessible food to the community. It is the provider’s job to feed the area while protecting the Earth and its resources. In Libya, those natural stewards must properly manage the floundering, unstable water sources. The solution to this water crisis has three pillars: partnership, education, and implementation. Implementing subsistence farms and teaching the community how to sustainably manage their land in a water-conscious manner will provide the country with a certain amount of local industry. Incorporating women will give an oppressed aspect of society a sense of fulfillment; these strong women can help farm to feed their communities. Buried clay pot irrigation utilizes the scarce water supply in the most efficient and cost-effective manner. Available, accessible food that can be properly utilized will satisfy the nourishment need within the community. Stable employment statistics will increase due to the increase in industry, and will ensure that each man, woman, and child will have enough to drink. If these steps are implemented, food insecurity will decrease in Libya.

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