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Ensuring Food Security in Yemen through Urban Agriculture and Drip Irrigation

Thirty-three years of corrupt policy has left Yemen in a dire situation; an economy on the verge of collapse and an unstable centralized government have led to unsustainable agricultural practices causing water scarcity and civil unrest. Since the Republic of Yemen was formed in 1990 there have been deep divisions between the tribal north and the urbanized south, fighting between the two cultural groups has killed hundreds of people and displaced hundreds of thousands more. Displaced families rely on the new government, established in February of 2012, for most basic needs, including education, food and water security.

The Common Country Assessment (CCA) lists water scarcity as one of the four underlying reasons for slow development in Yemen. Urban Yemenis pay high prices for food while farmers pump water endlessly and use all methods possible to irrigate their crops. In order for Yemen to begin to develop farmers must be given the knowledge and resources to irrigate their crops efficiently.

There are no permanent bodies of freshwater in the Republic of Yemen. Most water comes from groundwater resources or rainfall during the biannual monsoon season. The rains from monsoons create temporary rivers in dry beds, and temporarily result in lush greenery. Climatically, Yemen has three separate regions. The coast, along the Red Sea, is the hottest region. Temperatures range from 21 to 40 degrees Celsius, and humidity is constantly high. In contrast, the desert region of the east and north are dry year round. Temperatures here are also high, ranging from 25 to 37 degrees Celsius. The central highlands have the most temperate climate, they are home to Sana'a, Yemen's capital, and temperatures here range from 5 to 25 degrees Celsius (CultureGrams).

There are 9,300 hectares of agricultural land in Sana'a that produce more than 37,500 tons of vegetables including leek, coriander, radish, onions and tomatoes (Hoekstra). The land is also used to grow grains, forage, fruits and *qat*, a narcotic drug that is common in Yemen. Many staples, mainly rice and wheat, are imported. Other staples such as vegetables and lamb are raised and sold internally. The main meal of the day is lunch; it generally consists of a meat with cooked vegetables and rice or bread. However, recent rises in food costs have forced many Yemenis, especially those living in cities, to adopt a vegetarian diet. With no way to grow their own vegetables they often spend two thirds of their income on food (World Bank). Due to the high cost of vegetables some urban Yemenis have been forced to scavenge for food scraps left around a *suq*, or central market. Most Yemenis cannot afford enough food to sufficiently feed their whole families, which are commonly as large as eight to ten people spanning many generations.

Meanwhile, Yemen continues to struggle with education, health, and nutrition. The right to education is guaranteed to all citizens in Yemen's constitution, yet only half of the population is literate (CIA). Primary education is required between the ages of six and fifteen, and provided free of charge by the government. However, in 2005 only 81 percent of the school age population was enrolled in school. Health care systems also require government support as the current health care system in Yemen lacks supplies and facilities. Despite attempts to change the quality of health care by Yemen's Ministry of Health unsanitary water and poor hygiene continue to cause sickness and death without any improvements in sight (CultureGrams). In addition, many Yemeni children suffer from malnutrition due to inadequate food access.

Yemen's economy struggles with unemployment and depleting natural resources-which make up most of the nation's income. Only two or three members of each family work, yet unemployment was at 35 percent in 2003, among the highest percentage globally (CIA). Oil revenue accounts for 25 percent of the Gross Domestic Product (GDP) and is by far the largest influence of the economy. However, Yemen's oil resources are depleting (CIA). In 2006 a reform program was introduced to diversify the economy and in 2010 the International Monetary Fund approved a three year, $370 million program to strengthen the economy. The agricultural sector currently accounts for only 10 percent of Yemen's GDP, while 40 percent of the working population is employed in this sector (FAO).

Ten million Yemenis are food insecure, about 44 percent of the population (OCHA). Due to a weak domestic economy farmers must export a significant portion of their yields to make a profit. In fact, approximately 47 percent of income from exports is attributed to food products (CIA). Urban Yemenis are not able to pay for the costs of production and have very few options for producing their own food, causing a disconnection between rural production centers and the concentrated urban populations.

Urban Yemenis are particularly disadvantaged because they depend on rural farmers to keep prices low through trade and qat production. Forty percent of existing agricultural water is used to grow qat (IFPRI). Qat chewing results in a feeling a fullness that could only otherwise be gained by eating, some families have added qat as a part of their daily diet because it is readily available and often cheaper than food crops. However, it is important to recognize that chewing qat is a cultural practice with ninety percent of Yemeni men chewing qat regularly (Nasser).

Farmers grow qat because it is profitable and can be sold locally and in international markets. Food crops such as dates, grapes and tomatoes are all exported for profit as well. Once farmers have earned their cost of production from export crops they are able to sell food within Yemen at lower prices. The dependence on international markets is illustrated by the sudden rise in domestic tomato prices when trade with Saudi Arabia slowed. Yemeni farmers depend on exporting tomatoes for profit, when trade slows they are forced to increase local prices (Najmaldeen). Many farmers have quit, or turned to qat because of the instability of foreign markets and the domestic agricultural industry.

The Yemeni government has not been very involved in agriculture, with it representing only 2 to 3 percent of the national budget. Many farmers have built their own pumps for irrigation water, causing rapid depletion of groundwater resources. In May of 2005 there were 70 rigs and 1000 wells that had government permits to pump from groundwater resources. But, the Food and Agriculture Organization, or FAO, estimated that 52,000 to 55,000 wells were being used to pump water in Yemen (FAO). The illegal pumping combined with the instable government has stressed the groundwater resources to historic lows.

To further exacerbate the issue there is lack of natural fresh water in the region. Yemen has an arid desert climate; although this cannot be changed, current water management practices exacerbate the issue. Qat requires larger amounts of water and nutrients to grow compared to food crops. Land used to grow qat will become unusable due to soil degradation (Vldar); which is especially concerning because only 7 percent of Yemen can be used for crop production (FAO). The natural land and water challenges force farmers to use any means possible to grow their crops.

Many Yemeni farmers use expensive trucked water to irrigate their crops, with up to one third of their income for drinking water alone. The prices will only rise as groundwater resources deplete and surface water reservoirs run dry earlier in the year. The system of trucked water has turned water into a commodity. As the price of irrigation rises food costs will go up, forcing Yemenis to spend a larger portion of their income on water. As a result they will have less to pay for food. This imbalance will magnify the number of food insecure people in Yemen.

Between 1998 and 2004, the production of cereals decreased by 0.6 percent per year while withdrawals from groundwater resources increased by 41 percent, exemplifying poor water management (FAO). The change has been attributed to an increase in qat demand and production. The statistics from the last twenty years have shown that despite a growing population and increased water use, Yemeni farmers are still failing to produce enough food, or even as much as they did in previous years. This deterioration of the agriculture industry has already led to food insecurity for many Yemenis and more families will be added to the group if the situation is not rectified. In addition to being food insecure, they may not be able to afford the cost of water, the two substances most essential to life.

Inefficient irrigation practices aggravate the problem with irrigation efficiency between 35 and 45 percent. Localized irrigation systems programs have been successful where they have been introduced, but they are costly. Yemen's unstable government could not afford the technology without foreign aid. Between 1994 and 2004, the total water management area increased by about 41 percent. Irrigation methods that completely depend on groundwater have declined recently, because groundwater resources are disappearing. The Irrigation Improvement Project was created in 2000 to increase the amount of land irrigated by rainwater and relieve stress on groundwater reserves. Large dams and diversions were built in the *wadis,* or temporary rivers, to ensure that water would be present year round. In 2001, 217,541 hectares of land were irrigated from these rainwater reserves. However, in 2002 the area irrigated from rain water was less than half of the previous year (FAO). The project includes long term maintenance plans to ensure that these new diversions remain maintained and well managed. However, fighting between the United States and Al Qaeda has caused serious damage to homes and property in the southern region, jeopardizing the already fragile infrastructure.

The population of Yemen is one of the fastest growing in the world, at around 3 percent growth each year, increasing the need for water. The total population is expected to double to forty million in the next twenty three years, putting pressure on Yemen's agriculture industry to increase production (UNDP). As of 2010, 32 percent of Yemen's population lived in urban areas, and that number is growing by 4.6 percent each year (CIA). The urban population is the most susceptible to volatile food prices because of the instability of urban markets. A strategy often adopted to combat hunger and malnutrition in cities is urban agriculture. For urban agriculture to be feasible irrigation water will be needed in Yemen's cities. Unfortunately, the fast growing, and moving population of Yemen makes it difficult to develop a sustainable plan because the country will require significantly more water than it has in the past, just to meet basic needs in the future.

The Food and Agriculture Organization, or FAO, described changing the way we think about water as the first step in developing an efficient plan for using water, saying, "Instead of a narrow focus on rivers and groundwater, view rain as the ultimate source of water that can be managed." In the past, the tribal communities in Yemen relied heavily on rain water for agricultural use. But the water demands of modern agriculture have caused a shift to groundwater resources as the primary source for agricultural water. Using rainwater as a primary source of water would provide relief to the rapidly depleting groundwater resources.

Urban growth systems take advantage of rainwater. The Community Food Security Coalition defines urban agriculture as "the growing, processing, and distributing of food and other products through intensive plant cultivation and animal husbandry in and around cities." Urban agriculture is often proposed as a means for alleviating food insecurity, but only recently has it been proposed as a system for optimizing water use. The FAO explains, "Rainwater harvesting in cities holds great potential for urban agriculture, but is as yet relatively untapped." Urban agriculture, or backyard farming, allows city residents to grow some of their own food. In addition to providing relief to water supplies, urban agriculture would increase the amount of food grown in Yemen, and subsequently reduce food insecurity.

The flexibility of urban agriculture allows each family to meet their own needs. Some urban farmers sell their produce to make a profit, reducing the portion of a family's income spent on food. Through urban agriculture training, similar to irrigation training being conducted in rural Yemen, urban families will be able to utilize the best systems for their needs. For example, rain barrels offer a simple method for catching and containing rainwater for future use as the dry climate in Yemen demands efficient use of water at all times.

In addition to rain barrels, slow release irrigation is a low cost technology that uses one third of the water used in conventional irrigation practices (FAO). Slow release irrigation slowly applies water to the root zone, which increases efficiency. Although it is labor intensive, the simplicity of the technology makes it ideal for an urban setting. Terracotta pots have been used in Northern Africa, where the climate is similar to Yemen's, for more than 4,000 years. This method takes advantage of the porous nature of terracotta. A pot is buried with a thin tube-like top left sticking out of the soil. Because plants wick moisture from the soil, water is sucked out from these pots only in the direction that it is needed. The pots can be refilled from rain barrels as needed. Covers on the pots as well as the rain barrels prevent water from evaporating.

Urban agriculture is a quick and sustainable way to reduce food and water insecurity for urban Yemenis. Implementing urban agriculture programs will reduce the strain on Yemen's existing agricultural system, and in doing so allow for reform. Efficient agricultural practices need to be implemented in all existing farms in Yemen. Irrigation is necessary to farming in Yemen due to the arid climate; however the current methods of irrigation are not sustainable. In 2004, only 0.1 percent of agricultural land was irrigated through localized irrigation methods (FAO). Drip irrigation is one method of localized irrigation that could increase irrigation efficiency in Yemen. Farmers in many countries saw a decrease in water use of 30 to 60 percent when they switched to drip irrigation (FAO).

Drip irrigation saves water and fertilizer by slowly applying water to the root zone, similar to the terracotta pot system. However, drip irrigation is not as labor intensive as the pot system making it easier to apply to large areas. In addition, drip irrigation significantly reduces erosion in fields and nutrient loss in soil, two problems that afflict the arable land in Yemen. The FAO has funded drip irrigation systems in Yemen, and they have been very successful. If drip irrigation was introduced in conjunction with the Irrigation Improvement Project the agriculture industry could prosper through water security. The largest barrier to implementing more drip irrigation projects is funding for technology and education on how to use drip irrigation.

The success of implementing new irrigation systems will depend largely on the motivation and education of farmers. In Syria farmers were reluctant to adopt new methods of irrigation because there was a lack of incentive and they were skeptical of new techniques. Foreign nations must act quickly to aid the government in implementing programs to educate and encourage urban agriculture and drip irrigation because the situation is especially bad in Yemen.

The United Nations must stay involved by providing knowledge and funding for a new agriculture initiative, but the government of Yemen needs to connect the world organizations with Yemenis. The Yemeni government must lead the effort by limiting groundwater withdrawals in addition to increasing rainwater use through the Irrigation Improvement Project and developing education programs alongside world organizations, such as the FAO. When given the appropriate resources Yemenis can be in charge of the future of agriculture in their country.

The acute nature of Yemen's water scarcity problem means that immediate and drastic attention must be given to the issue. There is no one solution. The expansion urban growth systems would maximize growing area and provide temporary and long term relief to food scarcity. Urban agriculture could relieve the strain on rural farmers allowing for drip irrigation systems to be introduced and for groundwater

pumping to be regulated to a sustainable level. Through widespread education efforts farmers in Yemen would be able to use drip irrigation systems to reduce water use to sustainable levels. Bringing the country closer to achieving the Millennium development goal to, “Halve, between 1990 and 2015, the proportion of people who suffer from hunger.” International involvement has the potential to bring the world closer to achieving another millennium development goal as well. The goal of global partnership, which focuses on globally minded efforts to achieve the other millennium development goals.

Despite years of corrupt policy, government instability and unregulated agriculture, Yemen has the potential to shift to sustainable agriculture and water use practices. Through urban agriculture and efficient irrigation, water use can be reduced to sustainable levels, lowering cost of production and increasing the availability of local and domestically grown food crops. With international support the people of Yemen can regain political stability through food security.

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