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Yemen, Sustainable Farming Practices

Yemen: Floating Gardens, the Sustainable Solution

Water insecurity is the lack of reliable access to sufficient, safe, and affordable water. This affects water that is used for drinking, agriculture, sanitation, and hygiene. Not only does this affect water usage and consumption, but it also affects the health, livelihoods, and ecosystems in a country. Yemen is a country that is well below the poverty line, while also facing extreme drought, water insecurity, and a civil war. These problems make it difficult to feed families in the country. “According to the Ministry of Agriculture and Irrigation of the unrecognized Houthi government, the total direct damages and losses of the agricultural sector in Yemen since the beginning of the war amount to about 111 billion dollars” (Thamer). Based on research, sustainable agricultural solutions that mitigate food insecurity in Yemen, given its water insecurity, include drip irrigation and fertigation, cascade check dams, and floating gardens.

According to the article titled “Yemen,” published by the United States Census Bureau, Yemen has a population of 35.3 million people. However, among the 35.3 million people, 84.7% live in urban areas and 15.3% in rural areas (Burrowes). Yemen has a wide variety of geography, including coastal plains, highlands, and deserts. Unfortunately, Yemen has no permanent waterways; however, it does have temporary, often violent, waterways called wadis that form during the rainy season. There’s also a very hot, humid climate, with temperatures reaching 100 degrees Fahrenheit with little to no water; the mountain areas have a relatively wetter, cooler climate (Burrowes). Yemen is currently experiencing a civil war and has a divided government and leaders. According to an article titled “Yemen,” published by the Australian Government Department of Foreign Affairs and Trade, states, “On 7 April 2022 it was announced a new President, Dr. Rasheed al-Alimi, would lead the international 'recognised' Yemen Government. The new government was called the Presidential Leadership Council (PLC) and consisted of eight members, selected by the GCC. Yemen is now divided between the Houthis in the north and the PLC, which controls much of the south and east of the country, operating from the city of Aden.” This civil war was caused by failed political transitions after the 2011 Arab Spring, which removed President Ali Abdullah Saleh, but it didn’t address large economic and security issues. This has resulted in Yemen’s population struggling to make a living and grow crops.

According to the latest national agricultural survey, the total amount of land suitable for growing crops in Yemen amounts to 1.6 million hectares, which accounts for 2% of the whole country. The agricultural holders in Yemen are 1,180,105, which averages out to 1.36 hectares per holder, which amounts to 3.34 acres (Family Farming Knowledge Platform). This is equivalent to 2 and a half American football fields, which equals 1.32 acres each. Based on the size of the farmlands, families are able to cultivate them by themselves. According to an article titled “Yemen,” published by the U.S. Department of Agriculture, the top 10 major exports in Yemen are wheat, food preparations, sugar, ethanol, planting seeds, condiments and sauces, and rice, with wheat being their most efficient crop in crop production. In 2025, Yemen exported 65,550 tons of wheat and brought in $14.76 million in US dollars. However, wheat isn’t

Yemen's largest export - crude oil is. Annually, the exports of crude oil bring in roughly two billion US dollars, but in 2022, they were prevented from exporting crude oil because of targeted drone and missile attacks on oil terminals from the Iranian-backed Houthi militia. According to an article titled "Yemen Suffers $2 Billion Revenue Loss From Halted Oil Exports Amid Houthi Assaults," published by The Medialine states, "Yemeni Prime Minister Ahmed Awad bin Mubarak revealed Tuesday that Yemen has faced a loss exceeding $2 billion in revenue due to halted oil exports. This financial blow came as a result of the Houthi faction's targeted assaults on the nation's export facilities." The loss of revenue from crude oil exports has negatively affected the country, as that was one of its main sources of income, and without it, many families are struggling to sustain themselves.

The family sizes in Yemen are relatively large. According to Jacquelyn Y Taylor and Teresa G Holtrop from the National Library of Medicine, "The average size of a family in Yemen is 7.4 members." The housing in Yemen varies based on the geography in which they reside. The housing ranges from mudbrick tower houses in the highland urban centers and round or square clay-covered huts in the coastal areas. The mudbrick tower houses are made by making mud bricks out of a "builder mix" made of mud or clay, water, and straw or plant fibers, which helps keep the bricks together to prevent cracking. The mixture is then pressed into rectangular molds and left in the sun to dry for several days. They are then stacked and glued together using a wet mud mixture. The bottom of the walls is made very thick to support the weight, and they get thinner as they go higher. Wooden beams are often added to add strength, and the foundations are usually made out of stone. The round or square cover huts are built by laying down a case of stones and placing branches, wooden sticks, or palm ribs vertically in the ground, weaving smaller branches between them to form a frame similar to a basket. They can use small mud bricks stacked together to form a square hut. The same "builder mix" is used and is pressed and applied onto the wall frame or bricks. The "builder mix" is applied regularly to the hut to keep it strong.

The most common job in Yemen is working in agriculture, but because of the war, many are struggling to find work and support themselves and their families. According to an article titled "Generating New Employment Opportunities in Yemen," published by SANA'A, the Center for Strategic Studies states, "Before the current conflict, much of the country's working population was engaged in unskilled labor, working in rural agriculture or informally employed in small businesses. More recently, the ongoing conflict has destroyed normal commerce and left millions of Yemenis without a means of supporting themselves or their families." Much of the population has no source of income because they can't find jobs and because of the extreme drought the country faces. The minimum wage is set at YER 21,000 per month, which equals 85 USD per month (Yemen Payroll and Benefits Guide). The income level and lack of jobs caused by the conflict put many families below the poverty line and unable to live a sustainable life.

Much of the Yemen population lacks access to health care because of the recent conflicts, which have caused a shortage of facilities, and the collapsed economy makes healthcare extremely unaffordable (Delivering Essential Healthcare In Yemen). Not only does the war cause healthcare to be unaffordable, but it also makes many parts of Yemen unable to be traveled. According to an article

written by Ahmen Salem, published by the National Library of Medicine, states, “Consequently, more than half of the population lacked access to basic healthcare, with rural areas being most affected due to geographical barriers and a shortage of facilities.” Not only is the conflict affecting healthcare, but it’s also affecting children’s education. The 2022 UN-brokered truce resulted in reduced hostilities and civilian casualties, but it failed to protect children’s right to education, leaving millions of children out of school. According to Dag-Inge Ulstein, published by the International Parliamentary Network for Education, states, “Ten years after the conflict began the impact on children’s learning and wellbeing is severe. Today over 4.5 million children in Yemen are out of school, a massive 39% of the country’s school-age population.” So, not only are families below the poverty line, but their children are also behind in education, which results in the country being set back further.

Many families also lack access to water and basic sanitation services. It’s estimated that 17.8 million people lack access to safe water and adequate sanitation services in Yemen, with the water network reaching less than 30% of the population. The lack of access to clean water has caused major health outbreaks, including cholera (The Water Situation in Yemen). With the current conflict, much of the Yemeni population lacks access to power, with most of the population enduring power outages 12 to 23 hours a day (Al-Sakkaf). This makes it extremely difficult for families to use necessities like a stove, phone services, and agricultural solutions. However, according to Nadia Al- Sakkaf from the Wilson center states, “The good news is that ABT’s research found that 44 percent of Yemenis already access electricity through renewable energy sources – mainly solar.” With the lack of power also comes the lack of internet, which puts phones at a very high cost. Poor infrastructure supporting 3G/4G ICT networks left 40 percent of Yemen’s population without access to mobile services and over 70 percent of the population without access to regular internet services (Democratizing Development in Yemen: Beyond Food Aid). Not only do people have limited access to electricity and phones, but because of the conflict, many have limited access to roads and local markets, leaving many families unable to obtain food for their families. This also makes it difficult for families to make an income if people aren’t able to access the market (Yemen, IFAD).

According to an article titled “A Packet of Rice For a Family of Nine: Why Yemenis are Starving,” published by Middle East Eye, a typical diet for families in Yemen consists of bread and tea for breakfast and dinner. Lunch consists of rice or aseed, which is a traditional Yemeni dish made of wheat, salad, and water. This is a real-life example of what a family of nine eats on a day-to-day basis in Yemen - this provides only around 500 calories per person each day. This is less than a quarter of what is needed for a balanced, healthy diet. Many families are facing food insecurity due to water scarcity and being unable to travel, due to the current conflict. The families get food from relief programs, gather ingredients from outside, or grow their own. They cook food by using a Tannur, which is a clay oven, and they also boil and grill other foods. According to an article titled “Families Resort to Cooking Tree Leaves to Survive as Famine Looms Over Yemen,” published by the World Food Program USA states, “Throughout this year, the United Nations World Food Programme (WFP) has increased assistance to all famine risk areas in Yemen, but as the economy keeps deteriorating, families are struggling to survive. Abdullatif receives monthly food assistance from WFP – a food basket of staples including flour, pulses, oil, sugar, and salt. That is the only food they have. Abdullatif has resorted to eating leaves from a tree called Halas to feed

his family. They boil the leaves to soften them and make them more digestible." Because of the nine-year conflict and an economic collapse, many people are living below the poverty line and have little to no income, leading them to search for their scavenge for their food. This makes it extremely hard for families to afford food and make food because of the destroyed agriculture. This creates a major barrier for families trying to earn a living and have access to nutritious food.

A big problem in Yemen is water insecurity. In terms of water resources, Yemen is the poorest country in the world. According to an article titled "Leveraging Water for Peace: FAO's Experience in Yemen," published by the Food and Agriculture Organization of the United Nations, states, "The annual per capita share of water is a lowly 83 cubic metres compared to the absolute threshold of 500 cubic metres." Agriculture drastically contributes to this trend, with it taking up 90% of Yemen's water supply. Most of the water goes to growing qat, which is a stimulant drug and is a part of social traditions in Yemen. Climate change and the rapid population growth also put additional pressure on Yemen's limited water supply. These trends are currently worsening; groundwater resources are being used at random, and the water basins are expected to be depleted by 2030 with the current extraction rate ("Leveraging Water for Peace: FAO's Experience in Yemen").

Water insecurity greatly affects the rural population, as 70% of the population practices agriculture. If all water is lost, the results will be catastrophic, and many will be unable to raise livestock and grow crops (Gadain). Many who live in rural areas live in hard-to-reach areas and have to travel long distances to find water. In urban areas, they too are having trouble producing crops due to the lack of water. However, not being able to produce adequate crops isn't their only issue; the lack of water has caused disease outbreaks. According to an article titled "Being the Change in Yemen: Improving Integrated Water Resources Management for Food Security," published by the United Nations states, "about 14.5 million people in Yemen are without access to safe drinking water and reliable sanitation facilities. This presents the right conditions for bacterial diseases, such as cholera, to spread fast, putting large populations at high risk. This is pertinent in peri-urban slums and areas populated by internally displaced people (IDPs). This was the case when there was a cholera outbreak in 2016, which spread to 19 governorates, affecting 53,000 people." These disease outbreaks spread drastically, and without access to healthcare, many people suffer.

Water insecurity affects people differently, as men and women have different roles. The men take care of agriculture and bring in money, which puts a burden on them as to whether they'll have enough water to grow sustainable crops. The women stay home and do household chores. These chores include teaching the children, cleaning the house, and going to fetch water with the children, which puts a huge burden on them, as they have to travel long distances. Water insecurity greatly impacts the elderly, and many are malnourished or extremely vulnerable to malnutrition. This also puts them at risk for cholera, which is very dangerous for the elderly (Cholera in Yemen Killing Mostly Older People). Water insecurity affects marginalized populations as their access to safe water is restricted. This puts these populations at risk of diseases and can force these groups to pay hefty prices to get a small amount of safe water. This greatly affects the environment as agriculture and water usage have greatly depleted the groundwater faster than it can be replenished (Omolere). The lack of water causes extreme droughts, which increases the risk of

wildfires and accelerates soil erosion. The central issue of water insecurity contributes to food insecurity as water insecurity limits agricultural production.

One solution is floating gardens. Floating gardens are rafts made out of bamboo and/or water hyacinths that rise and fall with the water. The families plant vegetables or crops in the rafts, and as the raft plants decompose, they release nutrients that help feed and grow the vegetable plants and crops. Floating gardens would work hand in hand with cascade check dams; as the water rises in the wadis, the dam would stop the water flow, and the floating gardens would be able to float and gain adequate water for plant growth (Floating Gardens as a Way to Keep Farming Despite Climate Change). Floating gardens alone won't meet the needs of the population in Yemen, as the country doesn't have floods or predominant rivers that would be able to support floating gardens and provide enough crop growth, but they can be used in wadis with the help of cascade check dams that retain the water for a longer period of time. The creation of cascade check dams would also need to be included in this solution to increase the number of dams available. Now, Yemen does have a lot of registered dams, but by adding more, this solution would be able to be widespread throughout the country. The Emirates Red Crescent would be able to help support the creation of dams, as they've assisted in funding 50 small dams in Yemen in the past.

When developing this plan, it's important to keep in mind that people in Yemen have their own way of farming and have many cultural traditions in place that are passed from generation to generation. Some of these traditions are rituals and community events that occur based on the agricultural season and are very important to the Yemeni population when working in agriculture (Agricultural Terraces in Yemen). For this solution, the Water Law No. 41 would also need to be put in place, as it protects water from depletion, pollution and manages and rationalizes the use of water resources (President of the Republic). This law is essential to the plan as it protects the water the floating gardens use. By making sure these water sources are protected, farmers and families can see the most success and crop growth using the floating gardens. Not only do we need policies, but the families also need access to information on how to successfully use floating gardens to their highest potential.

Organizations like the FAO and the United Nations will help lead this project as they have the resources and knowledge to make adequate decisions and form policies that protect and support floating gardens. According to an article titled "Leveraging Water for Peace: FAO's Experience in Yemen," published by the Food and Agriculture Organization of the United Nations, states, "Yemen requires robust water information systems which will inform policy formulation and decisions. Such information systems would include a database with all water information. FAO has broad experience in this area and supports countries with a similar context. This will be critical for use in water policies development and decision making." Ideally, these organizations leading the project should see great success. The communities will play a large role in this plan, as the families and farmers will be the ones taking care of the floating gardens. The FAO also has the experience and resources to help support families and give them information on how to correctly use the floating gardens and see success. With the FAO and other

organizations helping families and farmers, there will be little to no government involvement, as their main concern is the current conflict, and they're not staying up to date with policies, and don't have the money to help support this plan. Not only can the FAO help manage this plan, but they can also fund this project, as they're currently helping fund floating gardens in Bangladesh. The World Bank can also help support and fund floating gardens, as it often supports sustainable agricultural projects. Floating gardens can be sustainable as they're low-cost, water-efficient farming processes that use local bio-waste and aquatic plants. It also provides sustainable livelihoods and manage water scarcity by making it less severe.

The floating garden project in Bangladesh has been found highly successful. Farmers are generating four times the income they would receive from traditional farming practices. Not only are they getting more income to help their families live a better life, but they are also gaining more food, which helps the issue of malnutrition. Another positive of the use of floating gardens in Bangladesh is that the material costs are low, with the materials being natural resources that are easily accessible. This allows for families from different economic statuses to use the floating gardens and be successful. With the proper funding, guidance, and action, Yemen can see results similar to this too.

After reviewing this solution, greater crop production and Yemen's need for more sustainable farming practices would be achieved. Yemen would need to use dams in wadis to block off water during the rainy season, so families in agriculture can implement floating gardens. If the dams are able to be placed and farmers near the wadis utilize floating gardens correctly, they can expect to see great results in food and water insecurity at little cost. The dams and floating gardens maximize the space in the area, as the floating gardens are in the wadis and won't take up any extra space on the land, so farmers can still use old farming practices if they choose. This solution will boost the economy of Yemen by allowing families and farmers to provide for their families and sell their products in markets near them, reducing the amount of travel they would have to do. Floating gardens offer the most benefits and the least amount of weaknesses, as it's inexpensive and sustainable for families to take care of. Yemen will be able to receive funding from organizations like the World Bank, FAO, Emirates Red Crescent, and International Development Agencies. Yemen will need large outside assistance, especially because of drought, water scarcity, and the lack of leadership and government amidst the current conflict.

Yemen is a country that's below the poverty line and needs support from other countries and organizations to solve the problem of sustainable farming with water insecurity, while also dealing with constant conflict because of the civil war happening within the country. Implementing floating gardens and other solutions will improve generational farming practices for the people of Yemen. It will also positively impact the population by improving profits and bringing families above the poverty line, while also improving crop production and restoring groundwater. The floating gardens will add diversity to the current crops Yemen is producing, while also growing the economy. Water insecurity, causing unsustainable farming practices, is a major issue in Yemen that needs to be fixed in order to increase profit, food, and crop production for families in Yemen.

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