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Israel: Planning for Long Term Stability through Water Conservation and Improved Irrigation

Israel, a small country located on the Mediterranean Sea, has faced constant turmoil regarding territory and resources since its formation. In November of 1948, the United Nations General Assembly created Israel by voting to divide Palestine into a Jewish State and an Arab State, with Jerusalem remaining under an "international regime" (BBC News). While the Jews immediately agreed to the creation of their own sovereign state, the Arab nations opposed the resolution. The Arab nations referred to the creation of the State of Israel as "'al-Nakba,' the catastrophe" (BBC News).

While the creation of a sovereign Jewish homeland was popular with many Western and European countries, it created a unique problem within the Middle East that continues today. The creation of Israel encouraged immigration and population growth in an area already stretching its natural resources. "By the year 2020 Israel's population is expected to grow by about one third, to 8.5 million. This will cause huge increases in demand for agricultural produce and products, and urban use of land and water will also increase enormously" (Fedler). With Israel's population increasing, Israel must manage water scarcity and adapt farming practices to reduced water supply with improved irrigation technology and conservation practices.

The lack of clean water for Israel has led to a decrease in jobs, specifically in the agricultural sector. Although over the past twenty years Israel has made strides to develop their agricultural infrastructure, they are still lagging behind other Middle Eastern Countries. Since the 1960's, Felder argued, Israel has seen a sharp decrease in agricultural production because of the decrease in water available to produce a plentiful yield. During the 1960's, agriculture represented over 30 percent of exports**.** Today agricultural exports accounts for only four percent of exports and 2.4 percent of Israel's overall Gross Domestic Product (Fedler). The decrease in agriculture production has led to an increase in poverty rates. A typical Israeli family of four has an average income around $19,000 (Omer-Man). The high cost of goods and living expenses drove over 430,000 protesters to the streets in September of this year demanding the government lower the costs of everyday necessities (Sherwood). Approximately 23 percent of Israelis live under the poverty line of $7.50 per person per day ("Israel" CIA). In the coming years, Israel will have to create a solution to stretch its already limited water resources for the growing population.

However, Israel has the educational infrastructure in place to develop technology to create water security. The country has one of the best educational systems in the Middle East with public, religious and private schools ("The Education System"). According to the CIA World Factbook, the literacy rate within Israel is remarkably high with over 97% of people over the age of fifteen are able read and write proficiently. Over 95 percent of women are literate ("Israel" CIA).

Like many other countries, as the Center for Strategic and International Studies explained, Israel's depleting water supply is caused by "using water as though it will never run out" (Clear Gold). The lack of water within Israel has contributed to rising food prices. As water resources within the country continue to diminish, Israel has had to revert to importing the majority of their food, increasing the

already high food prices. By not focusing on developing improved irrigation technologies and water conservation practices, the government is ensuring little to no agricultural growth or economic stability in the future. The Center for Strategic and International Studies furthered that if the process of irresponsible water practices continues, "It will undermine the strength of governments that tout their control over water as a political success. Preventing crisis will require all the political will, governance skill and leadership that Middle Eastern governments can muster" (Clear Gold).

The government has not taken enough steps to help improve irrigation technology, and as a result is facing dire consequences. Israeli farmers typically use wasteful irrigation systems that continuously spray crops with water, in an effort to insure a high yield. "The situation has developed into a crisis so severe that it is feared that by the next summer it may be difficult to adequately supply municipal and household water requirements. . . The [water] deficit has also lead to the qualitative deterioration of potable aquifer water resources that have, in part, become either of brackish quality or otherwise become polluted" ("Israel's Chronic Water Problem").

At various points during the past five years, the Israeli government has been accused of diverting water from shared aquifers with Palestine. Donatella Rovera, Amnesty International's researcher on Israel and the Occupied Palestinian Territories, explained,

> Israel uses more than 80 percent of the water from the Mountain Aquifer [which is shared with Palestine]. . . Israel allows the Palestinians access to only a fraction of the shared water resources, which lie mostly in the occupied West Bank, while the unlawful Israeli settlements there receive virtually unlimited supplies. (Israel Rations Palestinians to Trickle of Water)

Over the past ten years, there has been an increase in demand for drinking water and a decrease in supply. Aburawa, a writer for *Al Jazeera*, argued, the demand for drinking water led Israeli officers in July of 2011, to demolish water wells, tankers, and pumps in a Palestinian settlement**.** This was the fifth depletion of water resources in Palestinian villages by Israeli officials in the past year (Aburawa). Clearly, the issue of water rights in Israel has grown worse over the past decade, and without any plans for innovative agriculture practices, the fight over water resources will continue to escalate, creating more violence, and less food stability within the region.

Not only does Israel need to develop innovative infrastructure to combat water scarcity, they must factor in climate change and the effects of pollution on their rapidly depleting water supplies. "Water scarcity is an issue exacerbated by demographic pressures, climate change and pollution," said Ignacio Saiz, director of Center for Economic and Social Rights (Arsenault). Climate change is a significant factor in water security. The article "Israel: Don't Make the Desert Bloom" explains Israel's water quality varies from extremely low salinity from the Upper Jordan River, to very high salinity from groundwater sources in the south. Global climate change has affected the length of rain showers Israel receives. Instead of longer rain showers, the country receives shorter, more intense showers which force the rain to run into the sea, rather than replenish the aquifers. More intense rain storms also mean longer droughts ("Israel: Don't Make the Desert Bloom"). Like Yemen, Israel has water wells that are so dry, oil drilling equipment is needed to drill for water, which often times turns up nothing (Clear Gold). Human and animal pollutions from farming and industry practices lead to an increase in minerals or bacteria in watersheds, which eventually end up in drinking wells. "Due to unbalanced exploitation and return flow from irrigation, an increase in the salinity of the groundwater has occurred in many wells" ("Israel's Chronic Water Problem"). Clearly, addressing pollutants' effects on water practices is necessary to create a solution for Israel's water shortage.

Israel, unlike any of its neighboring countries facing water shortages, is posed with a unique advantage. The country has "plenty of scientists, an entrepreneurial culture and a desperate shortage of fresh water"

(Water Technology). Israel must take steps to manage water scarcity and adapt farming practices to reduced water supplies to ensure water security by implementing integrating drip irrigation, aquaponics, and desalination to combat the rapidly depleting water resources.

One of the world's largest "blue-tech" firms began on a kibbutz, which is a community in Israel focused on agriculture, in the Negev Desert. The article "Water Technology: Striking the Stone", explained drip irrigation was created when one agronomist discovered that a cracked pipe in a large tree fed droplets directly to its roots, maximizing the amount of water the roots received in the desert. In 1965, after years of experimentation, Netafim was launched, patenting "drip irrigation" ("Water Technology: Striking the Stone").

The article "Low Volume Irrigation" further describes drip irrigation, also known as micro-sprinklers, low volume irrigation, or trickle irrigation. Using a polyethylene pipe connected to a small drip emitter, drip irrigation systems release water in a constant slow drip on the plant ("Low Volume Irrigation"). Drip emitters can be purchased in different sizes, in order to customize the water flow available to plants. This means farmers can change the flow of water based on the geographical location or climate of the farm, and the type of plant.

> In agriculture, the wide scale adoption of low volume irrigation systems (e.g. drip, micro-sprinklers) and automation has increased the average efficiency to 90% as compared to 64% for furrow irrigation. As a result, the average requirement of water per unit of land area has decreased from 8,700 cum/ha in 1975 to the current application rate of 5,500 cum/ha. At the same time agricultural output has increased twelve fold, while total water consumption by the sector has remained almost constant. ("Israel's Chronic Water Problem")

According to Zhuwakinyu, the United Nations Food and Agriculture Organization launched a drip irrigation project in Israel earlier this year for 200 poor sustenance farmers, who could no longer afford typical bucket irrigation. After harvest, the UN's Food and Agriculture Organization checked back with the 200 farmers. They reported that moving from bucket to drip irrigation increased both their yield and income by 150% and 200%; in addition they used 60% less water (Zhuwakinyu). Another article confirmed these reports stating, "These systems are typically low cost, easy to operate and relatively maintenance free" ("Low Volume Irrigation"). Israel could offer incentives for drip irrigation systems for farmers, in order to improve irrigation technologies, increase agricultural growth, and minimize water waste.

The article "Low Volume Irrigation" reports that in a recent study from the Texas Department of Agriculture, the Lower Colorado River Authority and Netafirm, drip irrigation system implemented in rice fields were remarkably efficient. The study concluded that irrigation systems typically cost around $500 per acre, and usually last 15 years **(**"Low Volume Irrigation").

> The benefit is overall savings in water cost, assuming that conventional water use is 5.25 acre feet per acre of farmed land and a market price of $0.07 per pound of rice. If the savings in water and the increase in yield reflect the best experimental results (80 percent water reduction, 10 percent increase in yield), the total benefits could be as much as $4.78 per dollar of investment. ("Sub Surface Drip Irrigation for Rice")

Drip irrigation systems allow for farmers to increase yield and production, save money, earn more profit, and reduce the water they use, all without purchasing additional land. Furthermore, drip irrigation systems completely eliminate chemical runoffs from fields, which improves the water quality in the surrounding watershed ("Sub Surface Drip Irrigation for Rice"). Marlow reported Netafirm currently has drip irrigation systems installed on a few citrus farms in Israel**.** The company stated that they are currently

experimenting with a "smart field, complete with sensors that communicate with a centralized system and maintain an ideal balance of nutrients and water" (Marlow). Israel should look at further integrating drip irrigation into farming practices by offering financial incentives, such as tax breaks and grants to farmers. In the long run this will save the farmers money and increase overall crop production, which will help decrease poverty, as well conserve water resources for future generations.

Aquaponics is another process that should be implemented to help manage water scarcity and adapt farming practices to reduced water supplies. There are two types of aquaponic systems: fresh water and salt water. Both systems combine aquaculture and hydroponics. In aquaponics both fish and plants live together in a soilless system. The fish waste serves as natural fertilizer for the plants, and the plants provide a natural breathing filter for the fish (About Aquaponics). The only water added to the system is enough to replenish what evaporates over time; the system uses 80 to 90 percent less water than what traditional field planting requires ("What Is Aquaponics?"). Not only are aquaponic systems efficient, but they also produces no environmental waste because the water is recycled through the system, cleaned by both the fish and the plants.

Salt water aquaponics is a relatively new system that does not conduct nitrification ("Saltwater"). Nitrification is the process in which ammonia, produced by excretion from fish, is converted to nitrites and nitrates (Cordaro and Jacob). Although this process occurs naturally in the wild, it must be completed in aquaponics with the help of plants and a filter. Salt water aquaponics systems are much more efficient than freshwater systems in coastal countries like Israel because of the availability of salt water and the lack of electricity in rural areas.

A leading Australian aquaculture scientist, Dr. Amir Neori, explained that with a salt water aquaponics system, families could produce crops native to salt water such as sea weed. Dr. Neori explained that every ton of fish produces nearly seven tons of plant material, such as kale or lettuce in fresh water, or edible sea weed in salt water. The sea weed is also extremely rich in Omega-3, a vitamin necessary for a healthy heart and joints (Nelson and Pade Incorporated). Not only does salt water aquaponics present a nutritional benefit, it creates a solution for countries with unlimited salt water access. An article from the Aquaponics Shop explains fresh water aquaponic systems require fresh water and a constant supply of electricity to run the pump that helps with nitrification. However, salt water aquaponic systems do not need a constant supply of electricity because they do not need to conduct nitrification. As a result, salt water aquaponic systems are much more efficient in coastal cities. Aquaponic systems have been on the forefront of innovative technologies in Haiti (Aquaponics Shop). Fresh water aquaponic, as the article Aquaponics System Nears Completion states, are used by multiple Christian missionary teams, to generate a continuous yield of food for the locals. One mission team called their aquaponics system a "living Food Bank" (Aquaponics System Nears Completion). Both systems are used in Australia, where droughts have crippled the land for nearly a decade. Farmers are finding aquaponics appealing because they require 80 to 90 percent less water than traditional practices (Tortorello).

Aquaponics have been successful in both developing and developed countries. The Israeli government could offer financial incentives for both salt water and fresh water aquaponic systems to encourage corporations, families, and individuals to purchase them. In the long run, aquaponic systems will help cut back water use within the city by using water conservation practices and help alleviate the financial burden on families to purchase food.

One of the last, and easiest, solutions to managing water scarcity and adapting farming practices to reduced water supply is through desalination, which is the process of removing salt from water to make it safe to drink. Since Israel is located on the Mediterranean Sea, there are nearly unlimited salt water resources. By building more desalination plants, the country can successfully combat the water shortages. In June of 2011, the Israeli government gave its approval to build a desalination plant south of Tel Aviv.

The plant will be able to process 300 million cubic meters of water a year, which would make the plant the largest in the world (Miskin). "'Over the last several years, the water market in Israel has plunged into a deep crisis,' Prime Minister Binyamin Netanyahu warned. 'There is a gap of hundreds of millions of cubic meters of water that we need each year, and these plants that we are planning will serve to fill that gap'" (Miskin). Building desalinated water plants would provide the vast majority of water to cities. In fact, desalinated water now accounts for "65% of household water consumption in the economy" (Udasin). One of the largest barriers to creating this infrastructure is the amount of energy these plants need. Israel could follow in Australia's footsteps and offer funds to build renewable energy sources to power the desalination plants *(*Goossens). This would decrease the amount of energy used to operate a desalination plant, and encourage the production of new plants. By further investment in renewable energy technology to power desalination plants, Israel can create long term infrastructure to combat the water shortage within Israel.

While Israel has the educational potential to innovate radical water technologies, they cannot effectively implement them alone. Government officials should request the help of non-government organizations (NGO's) and aid from other foreign countries to create long term water stability. The Israeli government has neither the funds, nor the ability to jumpstart programs to implement drip irrigation and aquaponics systems or to build more desalination plants. NGO's and foreign governments should work alongside the Israeli government to insure funds for water conservation are spent correctly, and that Israeli citizens receive adequate training to run the systems. After water conservation practices have been implemented and economically develop, NGO's and foreign governments should begin to lessen their role in oversight within Israel, and allow for the citizens and the government to run their water conservation systems.

If Israel does not address proper water conservation practices in the future, they will be faced with a dire situation. Water rights are one of the main issues in the Israeli-Palestinian Peace Talks, and if water rights issues are not solved, the talks will cease to make significant progress. Slowing these Peace Talks will only contribute to the ethnic tension and violence within the region. Furthermore, if a plan is not implemented to conserve water and adapt farming practices, the availability of water resources in the region will continue to decrease, leading to a decrease in agriculture in Israel and an increase in the cost of importing food. As food prices climb, and the average family income remains the same, families will be able to afford less food, and the poverty rate will increase. If Israel does not address water rights and implement a plan to manage water scarcity and adapt farming practices to reduced water supplies with improved irrigation technologies and conservation practices, there will be a further decrease in agriculture and farming within the country.

It is essential that Israel begins to develop long term infrastructure for water conservation and adapt its farming practices to converse water. There are several ways that the country can create stability within the water markets. Alongside NGO's and foreign governments, Israel could provide incentives for drip irrigation systems, in order to reduce the amount of water wasted with traditional irrigation systems. Israel can also offer financial incentives, like tax breaks, for building aquaponic systems in the major cities, so that families can alleviate the financial burden of purchasing vegetables and herbs from the markets. The systems would also significantly reduce the amount of water used in urban areas. Finally, Israel needs to consider building more desalination plants, utilizing their most abundant resource, the Mediterranean Sea. By offering financial incentives to companies to produce renewable energy resources to power desalination plants, Israel can cut the costs of running the plants. This would allow for the increase in production of desalinated water and the further availability of water for the growing population. Only through long term investment can Israel manage water scarcity and adapt farming practices to reduced water supply with improved irrigation technology and conservation practices.

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