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Mid-East to West Coast: Implementing Israeli Water Conservation Strategies in California

Tel Aviv and San Francisco, though halfway around the world from each other, share more than expected. Both are liberal cities with a booming LGBT population, both are known homes of countless successful start-ups, and both enjoy spectacular westward sunsets over their coastlines. But the most unifying factor between Tel Aviv and San Francisco actually lies in the two cities' natural dearth of water. With similar populations that now far surpass what their natural water supplies can sustain, Tel Aviv has managed to fix its water problem while San Francisco still finds itself in a drought-induced state of emergency. Time is running out for California, and before faucets start to run dry, the state must find a solution to its water problem. In the midst of its worst water shortage to date, California should focus on implementing water conservation strategies that have previously succeeded in the state of Israel. By using how Israel largely solved its own water shortage through methods like desalination, advanced irrigation, and water reclamation, California can begin to supply itself with the amount of water it so desperately needs. Similar climates and patterns of population growth in both California and Israel further support the ability to implement these Middle Eastern systems on the American West Coast.

The parallels between Israel and California's water issues begin with each region's physical landscape. Before either state was considerably populated, both were already experiencing hints of water shortage. Long before the Western settlement of California that focused water so solely on human interest, Native Americans still ran into their fair share of

water troubles. Though the population was much smaller than it is today and thus consumed less water, archaeologists believe that in about 1000 C.E. a drier-than-usual climate forced the Paiute tribe to migrate from Southeastern California to the wetter Owens Valley and set up early forms of agriculture (Hundley 20). This water-fueled adaptation toward agriculture was entirely necessary to support the Native American population that could no longer rely on a hunter-gatherer system. Even as Native Americans began using agriculture, however, they resisted exploiting California's water supply by continuing to view nature as "something to be manipulated, yet always within the context of maintaining their symbiotic relationship with nature" (Hundley xiii).

The beginning of the end of California's water supply was set off in 1849. The Gold Rush brought self-interest, and thus debilitating exploitation, to California's long history of drought. A booming population and, not to mention, extreme exploitation of the environment brought overuse of water to an entirely new level in late 1800's California (Hundley 66). By this time, the Native American population had been decimated along with their value of symbiosis with nature. Because the Gold Rush attracted so many people in such a short period of time, most Californians congregated in environmentally-unconscious metropolitan areas an entire generation before city-living became prominent in the rest of the country (Hundley 122). From a population of only 300 in 1846, San Francisco quickly rose to a city of 56,000 in just 14 years. By 1900, there were over 340,000 people living there (Hundley 122). City governments throughout California bought up all the resources they could, using up all the water in their municipality and quickly turning to reliance on further and further areas to provide for their

city's needs (Hundley 122). Thankfully, this unsustainable behavior was recognized and addressed as the nationwide rush to the west slowed.

The year 1902 saw the creation of The Reclamation Service that sought to "[make] the desert bloom," but ultimately lost momentum as the century progressed (Hundley 204). This was only the beginning of countless government programs focused on the water problem that was exacerbated by California's suddenly enormous population. In the 1960's, California enacted the famously large and expensive State Water Project that allowed for even more overuse of water because of the newfound ease of transporting it throughout the state (Hundley 204). By the middle of the twentieth century, increased desire for personal claim to water, property, and its benefits had inflated California's natural lack of water, making the drought far more serious than when the state was first settled simply because the demand for water grew so high so quickly.

Today, California implements many strategies to limit the amount of water it uses, but the variance of water provided from a dry year to a wet year is too great to stabilize maintenance of the environment. Most of California's strategy relies on consumers simply using less water, an unrealistic and fickle method. For example, even if residents this year manage to shrink their water usage by the mandated 25% from 2013's levels, even greater problems still exist in water management in agriculture ("How Water is Used in California: Agricultural"). From 1967 until 2010, only 5% less water was being used on farms ("How Water is Used in California: Agricultural"). Furthermore, this seemingly negligible amount of conservation still had large negative effects on farm productivity. University of California Davis economists have claimed that $856 million in potential crop revenue will be lost in 2015 due to farmers' lack of access to enough water ("How Water is Used in California: Agricultural"). To provide an incentive for

farmers to use less water, the State Water Efficiency and Enhancement Program (SWEEP) provides grants to farmers who use environmentally sustainable irrigation systems ("How Water is Used in California: Agricultural"). This is a step in the right direction, but so far barely over half of California's farms use precision irrigation techniques that prevent excessive water loss ("How Water is Used in California: Agricultural"). Preventing overuse of water through mandating these precision techniques would allow farms to use the water that they do have to its fullest potential.

Farms also have a responsibility to reuse their water. California reports that it often reuses water, but in rather rudimentary, low-tech ways. The most cited way of reusing freshwater is diverting it into the California Delta, which prevents the entrance of salt water that can contaminate freshwater supplies and habitats ("How Water is Used in California: Agricultural"). While this is entirely valid, it is just a first step in water reuse. Claiming that California's reuse of water is advanced is also faulted when one of the main methods of reuse cited is "flood-irrigated rice fields [that] serve as critical habitat[s] for many species of migratory birds that fly through California" ("How Water is Used in California: Agricultural"). Neither of these methods are effective or widespread enough to be the main ways in which California reuses its water.

California needs to rethink its water management in order to provide for such a large ecosystem. In 2006, 9% of California's water went to urban use, 31% to agricultural use, and 58% to the environment. In 2007, however, urban and agricultural needs used 13% and 48% of California's water supply, respectively, while the environment was allotted only a mere 37% – significantly less than it received during the wetter year of 2006 ("How Water is Used in California: Environmental"). Such variance of water put into the environment year-to-year is

clearly detrimental to California's ecosystems. Even though each year California is able to meet the needs of its citizens and industries, its environment suffers. Just one way that great yearly change has poorly affected California's environment is seen in the fact that "one quarter of California's native freshwater fish species are listed as endangered or threatened" ("How Water is Used in California: Environmental"). California needs more advanced methods of water conservation in order to comprehensively provide for all ecosystems within itself.

Israel also has its own long history of water shortage, and with a similar climate and population growth, has tried many similar methods to California in order to solve its water crisis. Like California, the Middle East is a generally arid climate that is vulnerable to seasonal rainfall and droughts (Blum, et al. 6). Rainfall in Israel is extremely unpredictable, and yearly droughts make standardizing water systems difficult. Examples of Israel's fickle environment can be seen as early as the Bible, when Joseph anticipated seven years of rain followed by another seven years of drought (Amster viii). Because of outdated techniques and poor land management in response to unpredictable rainfall, farmers in the early to mid-twentieth century used to waste large amounts of water and damage the land they were farming (Blum 6). Changing governments in first the Ottoman Empire, British Mandated Palestine, and now Israel have also made consistent agricultural practices difficult to standardize and land management a complete nightmare (Blum 7). Water managers of newly independent Israel in 1948 even overestimated the nation's amount of renewable resources in regards to water, causing programs to use more water than was sustainable (Tal and Rebbo 26). Though this mistake has been corrected, the tendency for Israel's fast-growing population to settle in small, fertile, coastal areas made for

easy overexploitation of rapidly developed land (Blum 6). Simply put, the land of Israel was not ready for such an influx of people, and subsequently their water supplied suffered.

Despite the land of Israel innately not having enough water to support the number of people living there, the nation was able to implement three inexpensive, efficient, and effective methods to supply itself with enough water. Desalination, advanced irrigation, and water reclamation are well-known worldwide, but cutting-edge technology has allowed Israel to implement these methods on a large scale and cost-effectively produce massive amounts of drinkable water. Big-picture desalination has been on the table since the 1960s in Israel (Tal and Rebbo 33). Starting originally with just brackish groundwater, the Sabha desalination facility in Eilat eventually was able to treat 24,000 cubic meters of water a day at the price of just ninety cents a cubic meter (Tal and Rebbo 33). Since then, a facility in Ashkelon opened in 2005 at a cost of only 52 cents per cubic meter (Tal and Rebbo 34). By 2013, Israel was desalinating the equivalent of one eighth of its natural water supply, providing itself with at least 14% more water than would have been possible just using its freshwater resources (Tal and Rebbo 26-27). MIT Technology Review shows Israel's impressive progress by stating that "by 2016, when additional plants will be running, some 50 percent of the country's water is expected to come from desalination" (Talbot). Advances in technology and energy efficiency of desalination equipment has lowered the price of desalination plants, making them more feasible for widespread implementation (Tal and Rebbo 33). Israel Desalination Enterprises (IDE), Israel's most successful desalination corporation, combats the usual problem of cost with highly effective reverse osmosis desalination that implements many significant engineering advancements that allow their plants to spend less money and have a smaller effect on the

environment. Cutting out waste with simple methods like using one 16-inch diameter pipe instead of two 8-inch pipes requires less maintenance and less material (Talbot). Sorek, IDE's newest plant, embodies this ability to combine cost-effectiveness with efficiency and productivity. The plant will be able to sell water for 58 cents a cubic meter and still make a profit (Talbot). Because of this technology, desalinated water has become a staple of the Israeli water system, relieving the nation greatly of its drought anxiety.

Advanced irrigation is the second extremely vital method that Israel uses to provide its citizens with enough water. Israel's National Water Carrier is a crucial piece of technology that united the more rainy north with the entirely dry south upon its completion in 1964. A large part of the creation of the state of Israel, this advanced irrigation system made water transfer possible from the Kinneret to the Negev desert through an extremely efficient national grid (Tal and Rebbo 32). In the rainy season, the National Water Carrier stores excess water from the Sea of Galilee in underground aquifers which can be tapped into during the dry summer (Cohen 20). Filling these aquifers also prevents salt water from entering into the domestic water supply thus keeping drinkable water standards fulfilled (Cohen 20). Advanced canals, pipes, pumps, and aquifers ensure the regulated flow of water to all corners of Israel (Cohen 20). However, intentional conservation does not stop there. Since the 1970's, Israel has widely implemented drip irrigation techniques in its agriculture (Fishelson and Rymon 375). Drip irrigation forgoes the outdated practice of pressurized irrigation technology like sprinklers and hoses. Instead, it involves a series of ground-level pipes that slowly release water directly into the soil. This allows not only for far less water loss due to evaporation and runoff, but also fosters further filtering of the water as it travels through the ground at a slower rate, allowing reclaimed sewage water to be

used (Fishelson and Rymon 376). Drip irrigation also uses considerably less water as it supplies only the amount needed directly to the plant. This assurance that the plant is getting what it needs results in better yields than when pressure irrigation systems are used (Fishelson and Rymon 376). Precision drip technology, though initially more costly to install, significantly reduces the amount of water used in any agricultural situation, showing the prevalent value in Israel that while "there is a growing recognition that while water supply must continue to grow, conservation must be part of the solution as well" (Tal and Rebbo 35). Drip irrigation has allowed Israel to have a booming agricultural industry in what was previously arid desert.

Water reclamation in Israel was fueled not only by Israel's need for more water, but also its lack of space for a rapidly growing population's sewage (Tal and Rebbo 32). Running out of space to store its largely septic-dependent sewage system, Israel began recycling waste water in the 1950's (Tal and Rebbo 32). Today over three quarters of Israeli sewage is recycled into freshwater, a far higher rate than the United States' disappointing 2.4% (Tal and Rebbo 32). About one of every five gallons of Israeli water is reclaimed from sewage water, an impressive feat considering the technology to do so is yet to be widely implemented in the rest of the world (Tal and Rebbo 32). Skepticism about the cleanliness of reclaimed water has prevented the rest of the world from widespread implementation, but high water quality standards have prevented health issues from arising in Israel (Tal and Rebbo 33). Additionally, Israeli effluent water sources are used mostly in agriculture and are thus even less likely to show any signs of health risks (Tal and Rebbo 33). In fact, reclaimed water has been such a boon to Israeli agriculture that Alon Tal, founder of the Israeli Union for Environmental Defense, predicts that in response to recent consecutive drought years, Israel will increase the amount of reclaimed water it uses in

agriculture (Tal and Rebbo 33). With ever-increasing demand, this looks to be just one way Israel plans to increase its water supply even more.

Many Californians, however, are skeptical of adopting all of these foreign practices without knowing for sure whether they will work in the United States. Perhaps these systems are not applicable, realistic, or affordable enough for a state to risk so much capital on. However, Israel's Mediterranean climate aligns its water situation quite similarly with that of California, and therefore Israel's water systems can be effectively implemented in the Golden State. California, though almost halfway around the world from Israel, is also considered to have a "Mediterranean climate...where higher stream flows occur in winter and spring followed by low flows during the summer" (Ball 188). Israel and California's sun exposure and rainfall are so similar because they are located along very close latitudinal lines. Israel ranges from 30°N to 33°N ("Israel Latitude and Longitude Map"), while California ranges from 32°N to 42°N ("California Latitude and Longitude Map"). Since the climates are so similar, both areas' natural shortages of water take on very like forms and thus can be alleviated with the same methods. Israel put desalination plants along its Mediterranean coast, and California has the ability to do the same along the Pacific. Even recently in 2015, San Diego County has commissioned their very first desalination plant that will be built by Israel Desalination Enterprises (IDE) ("Carlsbad Project"). Though the plant will be the largest of its kind in the West, it will only process less than a third of the water that IDE's Sorek Plant in Israel can ("Sorek Project"). This is a step in the right direction for California that needs to turn into a leap. A small first investment in desalination may be safe for the state, but ultimately widespread and macro-scale use of desalination will be what provides for such a large population. The initial investment is costly,

but overtime paying for water production will be much cheaper for California than running entirely out of water.

Skeptics also worry that Israel's current strategies are not applicable to California because the American state is so much bigger, both in population and in size, than the state of Israel. While this is true, Israel proportionally has a larger population and fewer resources. Additionally, a bigger state means more resources and a better ability to serve a larger population. First, Israel's demand for water is proportionally bigger than California's because Israel's population density is over four times larger than that of California ("Population of USA States" "Population Density (Population Per Square Kilometer)"). However, Israelis are still easily able to supply their country with enough water using modern technology. Israel's population has also grown at a faster rate than California's, which has seen only a 243% increase since 1960 ("Population in California") compared to a 390% increase in Israel ("Population in Israel"). This means that while Californians fear they will never catch up to a rapidly growing population, Israel has shown that this is nothing to worry about.

Money-wise, the amount of California's annual budget that goes toward the environment is, again, proportionally larger than Israel's when population is considered. In 2010, California spent about $144 per person per year on its environment ("California State Budget: Summary Charts" 11), while Israel only spent about $64 per person per year (Kislev 83). With this kind of extensive spending already occurring in California, surely the government can either cut down on waste or allocate a relatively small amount toward implementing Israeli technologies into the state's water industry. Clearly California has the ability to successfully integrate desalination, advanced irrigation, and reclamation into their water systems. Financially, there is enough capital

at hand – especially when the direness of the situation is considered. California also has an entire country behind it, and several other states that also depend on water in the West Coast. Surely the surrounding states of Nevada, Oregon, and Arizona have financial interest in this cause.

Desalination, advanced irrigation, and water reclamation have proven time and again to be overall faster, cheaper, and more productive than California's outdated methods of water management. Though revolutionizing the way California deals with its water is intimidating for lawmakers, environmental engineers, and citizens alike, it is ultimately the direction in which California must go in order to fix its serious drought problem. Demand-wise, Israel has fixed its water problem with a proportionally larger population that was more entrenched in drought than California. Monetarily, California is already spending more capital on outdated technology that would be better spent on methods that work. Climate-wise, the two regions share parallels that promise the success of Israeli methods in the very similar Californian environment. Implementing new technology in California would not be a risky, first-time move, but instead a relatively scaled-back repeat of how Israel was able to quickly alleviate its national thirst. As California finds itself in increasingly shallow water – it must make the choice to dive head-first into the next generation of water technology.

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