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Tuvalu, Water, and
Sanitation

The Thirst of Tuvalu: Sustainable Water Desalination In a Small Pacific Island.

A reliable supply of potable water is one of the world's biggest problems. Too many countries in the world have huge populations that struggle to get enough freshwater for their families, for drinking or basic hygiene. The reasons for lack of freshwater are varied: anywhere from drought to climate change to lack of clean water. However, this problem strikes one region of the globe particularly hard: the Pacific Islands. One of these nations is Tuvalu.

Tuvalu - the name inspires wide-open oceans, adventure, remoteness, and untouched beauty but this presumed paradise has a history of struggling with access to freshwater. In 2011, Tuvalu experienced a catastrophic drought that essentially obliterated the rainwater supplies and plunged the country into a national crisis. So many other Pacific islands are steps away from a similar predicament. In order to prevent this from happening again, we need to help Pacific Island nations such as Tuvalu develop a sustainable plan for freshwater as climate change continues to wreak havoc on the climate we rely on.

Note: Tuvalu as a nation is so small that a lot of the statistics regarding populations, immunizations, education, and others are outdated; however, they are a good reflection of the status in the recent past, therefore, the numbers may be extrapolated as being higher in the present day.

Tuvalu is a collection of nine islands in the Western Pacific region known as Oceania. It used to be a British colony and gained its independence in 1978. The capital is Vaiaku, located on Funafuti Atoll. The form of government is a constitutional monarchy with a parliament. The head of state is officially the Queen of England but is represented by Governor-General Sir Iakoba Taeia Italeli. The prime minister is chosen via the unicameral legislature; the current Prime Minister is Kausea Natano. Tuvalu consists of five coral atolls and four reef islands. The islands are only about 13-16' above sea level and have about 100-125" of rainfall yearly. The temperature is constant at 80-85 degrees Fahrenheit degrees yearly. Tuvalu is Polynesian, so it's culture is similar to the islands around it; the language is very similar to Samoan, as well. The population of Tuvalu is about 11,508 (c. 2018) and almost the entire population lives on the Funafuti Atoll. Thus the density is 1,060.6 people per square mile over 9.9 square miles, fairly dense for a small island nation ("Tuvalu", *World Bank*). Additionally, Funafuti is the only island with reliable electricity. 62.4% of Tuvaluans live in urban areas while 37.6% live in rural areas. The life expectancy is 64.7 for males and 69.2 for females. 86.03% of children attend school in Tuvalu. All schools also teach English in their classrooms. (CountryProfile, *World Bank*). Most farms in Tuvalu are extremely small: only about 1 acre or less; for context, the average farm we see in Iowa is about 350 acres ("Tuvalu" *Encyclopedia Britannica*). The soil in Tuvalu is loose and porous, so special fertilizers and mulches are used for the tropical crops they grow ("Tuvalu - Agriculture" *Encyclopedia of the*

Nations). Most farms grow plants like "coconut palms... breadfruit trees, pandanus, taro, and bananas" ("Tuvalu" *Encyclopedia Britannica*). Tuvaluan farms also raise pigs and chickens, and "seabirds, fish, and shellfish are caught for food" ("Tuvalu" *Encyclopedia Britannica*). However, the islands are heavily dependent on imports for almost everything else. The nation's GDP is \$42,587,778.472 with a \$5,430 GDP per capita ("Tuvalu", *World Bank*). There are only 1.003 metric tons of CO2 emissions per capita, as well ("Tuvalu", *World Bank*).

The average Tuvaluan family consists of six people; children, starting at 7 years old, are required to attend school for at least another 7 years. The minimum wage for workers in Tuvalu is \$81.25 biweekly but can be up to \$3-9,000 for skilled labor ("Tuvalu - Working Conditions", *Encyclopedia of the Nations*). The Tuvaluan diet is essentially the subsistence crops, seafood, and animals that are grown, hunted, and raised by the majority of Tuvalu's citizens: these are taro, breadfruit, plantains, fish, crayfish, pork, chicken, spinach, and coconut ("Customs", *Tuvalu*). Healthcare in Tuvalu is nationalized and free for everyone: 82% of children received diphtheria, tetanus, and pertussis vaccines; "polio, 92%; measles, 94%; and tuberculosis, 88%. About 49% of children under one had been immunized for hepatitis B in 1995" ("Tuvalu - Health", *Encyclopedia of the Nations*).

The major barrier Tuvaluans face now is access to freshwater. 30 years ago, 100% of the population had access to potable freshwater, but now, especially after the major drought of 2011, this number has dropped drastically ("Tuvalu - Health", *Encyclopedia of the Nations*). This problem has been exacerbated over time because of anthropological climate change, especially the rising sea levels contaminating water sources and more frequent and deadlier droughts. Climate change also leads to less land for cultivation and harsher climates, allowing for diminished crop yields. However, before the islands sink, due to climate change-related rising sea levels, the water supplies will be contaminated, creating massive drought: the foremost issue for Tuvaluans has now become access to clean drinking water.

In 2011, the country faced a huge water crisis, unparalleled in the history of Tuvalu; the country declared a national emergency over the disaster, and water supplies were critically low for months. Potable water had to be imported from New Zealand and Australia to help with the crisis ("Tuvalu Declares Emergency over Water Shortage.", *BBC News*). The country had relied so much on rainwater collection that when the major drought struck, the whole nation had to depend on imported bottled water *for months*; Water was rationed at 40 liters per family per day, hardly enough for the average six-person household ("Red Cross Responds to Water Crisis in Drought-Stricken Tuvalu.", *IFRC*). Since 2011, the increased effects of climate change have produced more long-term droughts and encroaching sea levels have contaminated the little groundwater reserves available.

The present status of this challenge for Tuvalu is now unsustainable. If a long term solution is not reached soon, Tuvalu will run out of drinking water far before the islands sink into the ocean, rendering them uninhabitable for the residents ("Rising Sea Levels Are Threatening This Pacific Paradise." *CNN*). The truth is that lack of water doesn't discriminate between rural and urban, rich or

poor, young or old; without drinking water, people cannot live. Given that many Tuvaluan families rely on sustenance farming for food, the lack of water extends beyond drinking and hygiene; rising sea levels render farmland useless and if the water is too highly saturated with minerals, it cannot be used to grow crops (“Rising Sea Levels Are Threatening This Pacific Paradise.” *CNN*).

The best solution to this problem is as follows: one solar-powered reverse osmosis filter per 200 people along with solar distillation on roofs, in fields, and in the ocean. In a small country like Tuvalu there is so little land, that huge desalination plants on shorelines, like those in Middle Eastern countries, wouldn't work. The reverse osmosis filters would be the best because of the small population. Also, since there is so much sun and heat in the Pacific Islands, solar distillation balloons and pipes would be the best for irrigation and water that doesn't necessarily have to be drinkable. Solar distillation wouldn't produce enough water for a whole family to use whereas neighborhood reverse osmosis tanks would.

The reverse osmosis tanks work by pushing saltwater through a membrane and cleaning out the particles from the water that we don't want. They are only about 40 square meters per tank (“Solutions: Solar-Powered Desalination Plug & Play - Sustainable Water.”, *Elemental Water Makers*) and they would provide water for 200 people - about 33 families. All power for the desalination RO tanks would come from solar power, so generators used for lights and radios wouldn't be compromised. In fact, the widespread use of solar power would decrease the use of generators and dependence on imported fossil fuel. Solar distillation would work by having buoys or fiber/plexiglass tanks on the shore that hold water while the sun distills out water through condensation. These would feed into collector tanks on the side and provide extra water for irrigation or other tasks outside the home. The tanks would be provided by nonprofit organizations or reverse osmosis desalinators groups such as Elemental Water or Applied Membranes.

A lot of the money would have to come from donations, but there are many philanthropic and social work organizations that work towards global betterment including the Bill and Melinda Gates Foundation and The United Nations Foundation. They would certainly fund a project like this. Organizations like UNICEF, Red Cross, the UN, or other environmentally conscious bodies are also capable of heading massive projects like this. Additionally, research institutes such as the Water Desalination Grant Program or the Desalination and Water Purification Research Program, are available to fund efforts like these and have done so in the past (Reclamation, Bureau of). Other countries can provide aid as well: the governments of New Zealand, Australia, and the United States, as well as Red Cross, provided Tuvalu with access to freshwater during their 2011 water crisis (“Tuvalu Water Crisis Highlights Global Concerns”), and they would be a resource now as well. Money is easier to give to another country than material goods like bottled water.

The people of Tuvalu would play an integral role in the success of this project. Tuvaluan culture places emphasis on togetherness, kindness, and hospitality so this project would flourish by tapping into this cultural resource and involving the locals from the beginning. They should feel that it belongs to them and have a sense of ownership. Tuvalu's local revenue can be used to fund this initiative as well to gain more ownership. Educating locals as to how this process works is key as they would need to allow us into their country and their homes to place these reverse osmosis tanks and solar distillation pipes in their

houses and farms. The government and local organizations would have to help with the placement of these devices and also in communicating with the locals. They would have to develop a trained team to keep the project going after installation.

This project is very sustainable as these kinds of desalination machines can last for a long time and have been successfully used in other island nations like the Philippines and British Virgin Islands (“Solutions: Solar-Powered Desalination Plug & Play - Sustainable Water.”, *Elemental Water Makers*). The devices are large enough and effective enough to power water for 200 people at a time and will produce 11 cubic meters (11,000 liters) of water. Given that the average person requires at least 50 liters of water a day (Basic Water Requirements), they will be able to meet demand.

Critics of desalination say it requires too much power from the country and doesn't create enough water. However, using these reverse osmosis tanks, one tank will give enough freshwater for 200 people and being solar powered, requires no extra power from the Tuvalu power systems.

Tuvalu is a beautiful nation, rich with culture, tradition, and history. It harbors biodiversity and is a piece of Polynesian life that cannot be lost. However, Tuvalu, along with other island nations like it, are at a huge risk of losing everything due to inexorable climate change. Contrary to popular belief they will become uninhabitable not because of being submerged underwater, but because they will run out of freshwater supplies long before that happens. Climate change will inevitably cause another major dry spell that could be much more disastrous than that of 2011. Thus, Tuvalu is in dire need of a sustainable solution to the lack of freshwater. The best solution is desalination. One reverse osmosis desalination unit would provide freshwater enough for over 30 Tuvaluan families a day. The solar power used to power these units is renewable and plentiful in island nations resting on the equator. Solar distillation on shorelines will provide more water for other uses, such as irrigation.

As an island nation, Tuvalu embodies the line from Coleridge's *The Rime of the Ancient Mariner* “Water water everywhere / nor any drop to drink”. We as humans have an obligation to help each other in times of crisis; we need to provide resources to nations that need them in order to fulfill our duties as fellow citizens of the globe.

The time to act was yesterday but we need to do something now and quickly.

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