

Alana Calhoun Ludington  
High School Ludington,  
Michigan Tuvalu, Water and  
Sanitation

## **Restructuring Septic Systems in Tuvalu**

Tuvalu, formerly known as the Ellice Islands, is a part of the Polynesia area of Oceania, located in the Pacific Ocean with an approximate population of 11,508 people (The World Population). Tuvalu is nine different islands and atolls stretching over a distance of about 360 miles (Thought Co., 2019). Of the islands and atolls, the nation's capital, Funafuti, has over half the country's population, with about 6,000 residents (World Population Review, 2020). Together, these nine pieces of land make up Tuvalu's total area of around 10 square miles. This area is just about twice the size of the famous United States airport, LAX. Due to the limited availability of land, agriculture is mainly coconut, banana, and breadfruit trees. Unlike their limited agriculture, seafood is readily available to Tuvaluans. However, this staple of Tuvalu life has become endangered due to the lack of advancement in wastewater treatments, which is polluting the nation's waters. These waste management issues might seem unimportant due to Tuvalu's small size, but the same problem impacts other countries throughout the world. About 96% of other nations with communities and coral reefs have a sewage problem (Justine E. Hausheer, 2015).

Tuvalu's family structure is slightly larger than that of an American family, with about three children per family (Index Mundi, 2018) compared to America's 1.93 (Statistia, 2019). Tuvalu has a large communal-based living structure. Tuvaluans believe the word "family" means much more than the definition most believe, which is to whom you are blood-related. They believe that during their upbringing, they can end up calling someone who is their best friend, their brother or sister. They are then immediately a part of their family. In fact, in Tuvalu, when these "siblings" begin to have children, they live together with their children and spouses.

Tuvaluan diets typically consist of three meals a day, almost all prepared in Lolo (coconut cream). Food is either roasted, boiled, or steamed. For carbohydrates, Tuvalu residents eat mostly homegrown bananas, breadfruits, plantains, and *Cyrtosperma merkusii* (also referred to as swamp taro). Other imported carbohydrates Tuvaluans eat are rice, flour, and sugar (Countries and their Cultures). The most common fat of the Tuvaluan diet is coconut (Oishimaya Sen Nag). For beverages, Tuvaluans typically drink coconut milk or imported teas. Protein in their diet consists of pork, tuna, and other oceanic life, but most seafoods are collected from the nation's lagoons and eaten either raw or cooked. Tuvalu's imported proteins are beef and other meats (Nexus Commonwealth Network). However, Tuvaluans eat about one pound of fish per day, showing that fish and seafood are essential parts of the Tuvaluan diet (Florent

Baarsch and Lan Marie Berg, 2011).

The resources in Tuvalu have improved significantly, but there is still room to grow. Tuvalu provides free and required schooling (Chris Glavin, 2017). Students can either take six years of secondary school or seven years of primary school. There is one secondary school and ten primary schools in the country. Education in the country has grown so well that Tuvalu's adult population has a 99% literacy rate (Chris Glavin, 2017). Although education is getting better for the country, health care is not so advanced. The nation has one main hospital in Funafuti that is only adequate for regular treatment, such as dental and maternity. However, additional health care is available in Fiji. Tuvalu has and continues to reform its healthcare system, making it the most cost-efficient and beneficial as possible (Pacific Prime, and The World Health Organization). Tuvalu imports about 80% of its food supplies from Fiji, making up most of the remaining 20% of food supplies in Tuvalu (Florent Baarsch and Lan Marie Berg, 2011). To keep a regular, healthy diet and income, Tuvaluans rely heavily on fishing, which costs almost nothing for the inhabitants. With humans usually eating about five pounds of food per day, the 1 pound of fish Tuvaluans consume is significant and necessary for living a life without food insecurity.

The importance of fish means that Tuvaluans rely not only on Fiji for its resources but also on other Tuvaluans. With such a communal living, almost all Tuvaluans share the island's resources, whether that be fruit and coconuts or fish harvested that day. Tuvalu's society depends on the communal living of Tuvaluans. Family relations usually consist of members having different tasks, like working, cooking, taking care of the children, and fishing. About 4,000 Tuvaluans have employment from the fishery's primary sector, including agriculture (Fishery and Aquaculture Country Profiles). This means that almost a third of Tuvalu's population is dependent on fishing for employment alone. However, nearly all the people of Tuvalu, whether for a job or not, fish; it is a necessity for their diet as well as their family's. Fishing is not only an essential part in solving food insecurities in Tuvalu due to the lack of agriculture, but is one of the main foods in which Tuvalu is self-sufficient.

Countries throughout the world emit greenhouse gases, causing the atmosphere to increase in temperature. This temperature rise, in turn, causes bleaching of the coral reefs in the nation's waters. Unfortunately, adding to this problem is Tuvalu's lack of advanced wastewater treatment. The current waste treatment leads to sewage spills, increasing algal blooms that cause a stop to "[T]he coral's algae counterpart from growing food for itself and the coral." The NOAA National Ocean Service Education also says that "Coral reefs support more species per unit area than any other marine environment." The importance of coral reefs to marine life shows that the coral impacted, in turn, impacts sea life and its ability to survive in Tuvalu.

Tuvalu's waste management consists mainly of bottomless septic tanks and pit toilets. These management sources cause wastewater to sink into the ground water or leak into lagoons or the ocean (Florent Baarsch

and Lan Marie Berg, 2011). Many of these systems, especially those with a dry well connected to the septic tank system, impact the oceans. Seawater penetrates the tank bottoms during high tide, and the pollutants of the sewage and wastewater then seep out and pollute oceans during low tide. Dry wells are very susceptible to this and can overflow easily during the high tide or storms (RNZ News, 2004). This leakage of waste causes algal blooms, creating reduced fish reserves, impacting Tuvaluans' food availability (Stephanie De Marco, 2019). Not only do these algal blooms affect the amount of fish in the lagoons [due to the decrease in oxygen from the algae, it can cause fish to die] and oceans surrounding Tuvalu, but it impacts the quality of the fish consumed. Fish can eat the algae in the blooms because the toxin domoic produced by the algae is not toxic to the fish. When fish do survive the algae bloom and have consumed the toxin, humans that eat the fish then consume the toxin domoic. This is harmful to those humans and can cause damage to the brain, like memory loss, or can even lead to death (Stephanie De Marco, 2019). In fact, according to Economics of Liquid Waste Management in Funafuti, Tuvalu by Padma Lal, Kalesoma Saloa, and Falealili Uili, "[T]he human health costs of key water-borne diseases directly attributed to liquid waste management accounts for about 80% of this cost." Tuvalu is an impoverished country with each person, on average, making \$4,760 each year. Tuvaluans between the ages of 15 and 35 are 39% unemployed (Annie Kate Raglow, 2020). In Tuvaluan culture, people of this age range are responsible for taking care of their parents and families. The average salary and unemployment rate show that the poor wastewater management leads to more expenses to provide Tuvalu's already poor residents and families' health care. Without a steady income, it is almost impossible to get what the whole family needs to survive, let alone healthcare that may be necessary if someone contracts a water-borne disease.

These inadequate waste management systems leading to low fish quality and human health problems impact Tuvaluans' dietary nutrition. The stunted growth rate for children under 5 in Tuvalu is 10%, less than the average of other developing countries at 25% (World Bank through the Global Nutrition Report, 2020). Professor of the Johns Bloomberg School Of Public Health Jean Humphry said that a lack of food is not the only reason for stunting. The bacteria and germs from a specific environment causes, "[C]hildren's bodies [to] divert energy and nutrients away from growth and brain development to prioritize infection-fighting survival." Consuming less nutrition would make these infections even harder to fight off than with the right nutrients. One significant problem that causes infections and severe difficulty in Tuvalu is anemia (Food and Agriculture Organization of the United Nations). This condition is caused by a lack of iron, which is likely from the decreased nutrients in seafood, resulting from poor wastewater treatment. This decrease of nutrients, most likely including iron, results from an increase in waste due to inadequate waste management systems, which then create algal blooms. These growing algal blooms absorb nutrients in the water that would have gone to fish, including iron (Freshwater Agriculture Extension, 2019) According to Paula Martinac, "A 3-ounce serving of the following [clams, oysters, octopus, mussels, and cuttlefish] satisfies 75 to 150 percent of a man's daily requirement for iron and at least a third of a woman's needs." So, Tuvaluans should be getting enough nutrients through seafood resources Tuvalu is surrounded by, or at least enough not to get anemia or other conditions and become unable to fight them off. Malnutrition in Tuvalu, even though not large compared to other countries, should be non-existent. If there is a change in waste management, Tuvalu's anemia cases would likely

decrease due to the increased nutritional quality of seafood surrounding the nation. Better waste management systems are the solution to malnutrition's unnecessary problem in Tuvalu.

Due to Tuvalu's geography, only about 15.09 feet above sea level, the country is very susceptible to cyclones. For example, in January 2020, Tuvalu was hit by Cyclone Tino. This cyclone alone caused severe damage to over half the Tuvalu population. Damages to resources such as trees of coconuts, bananas, and breadfruit have increased food insecurity (RNZ News, 2020). The deterioration of resources creates a need for more imports, which costs more money for the Tuvaluans. Instead of having food readily available, like bananas on trees, residents now need to buy carbohydrates and other food that they did not before. Bread for 1-2 people a day costs about \$1.27. Although it may not seem like a lot, again, the average Tuvaluan makes about \$4,760 per year (Nexus Commonwealth Network). There is also a 39% unemployment rate of Tuvaluans 15 to 35 (Annie Kate Raglow, 2020). Just for 1-2 people having bread (carbohydrates) for each day of the year, it costs about \$463.55. For the average family of 3, this would cost \$695.33, and a family of four would pay about \$927.10, or more (Expatistan, 2009). For the average family, this is almost 15% of their income. This 15% of their income is only for the portion of carbohydrates needed for a balanced diet each day, not including protein and fat required for the human body to function correctly. Not helping with a lack of resources, the lack of advanced wastewater treatment causes the unavailability of fish to increase during natural disasters. The unavailability of fish is due to a cyclone's ability to further damage these waste systems, contaminating the water more than before. Therefore, cyclones cause an increase in food insecurity in the nation as well as financial insecurity. Service sectors of Tuvalu create about 69% of the country's GDP; these include animal husbandry, craft production (such as weaving, boat and motor maintenance, net mending, and home building and repair), as well as bureaucratic and commercial bodies (Geddes, W. H and Barrie MacDonald). Agriculture accounts for about 71% of the remaining 31% of the GDP value for the country. Natural disasters, such as Cyclone Tino, hurt the one major self-sufficient part of the country's GDP, agriculture (Nexus Commonwealth Network). Although agriculture may not be readily available after times of crisis, fishing is. Fishing accounts for 17% of the country's GDP, so if waste management systems were taken care of, it would dramatically help Tuvalu's economy (Nexus Commonwealth Network). With destroyed agriculture, having better waste management is essential. The coral reefs will be better protected and less susceptible during crisis times, creating the availability of fish and seafood to ease food insecurity and economic instability by saving money.

Due to the inadequate waste management systems, contamination of drinking water is also a problem in Tuvalu. Contamination also increases through natural disasters like Cyclone Tino. To obtain drinking water, Tuvalu has two types of sources. One is ferro cement storage tanks. These are big tanks connected to pieces of roofing sheets that collect rainwater for households to use. Although some Tuvaluans have these tanks, most use well water because it is more affordable (Integrated Water Resources Management program's Diagnostic Reports, 2007). Well water is from underground aquifers reached by digging or drilling into the ground. The water then is collected through containers, by hand, or by a pump (Julie Keating, 2014). As Tuvalu's population grows, wells are being pumped from deeper depths, which causes

the aquifers to drown in salt. This can lead to microbiological microorganisms and nitrate contamination, and cause illnesses to those consuming this water (Microbiological Water Pollution, 2020). This drinking water pollution is hard to prevent due to rising sea levels, natural disasters, and the unpredictable population; however, sewage contaminating the water wells from poor waste management is avoidable, yet is not being avoided.

Although wastewater management is a complex issue, it needs to be solved for Tuvaluans to receive a higher amount of nutritional food and water as well as create economic ease. It can be solved with higher governmental intervention, new technological introductions (keeping in mind economic and ecological value), and an education element concerning the new developments. For any action to occur with new technological advancements for wastewater treatment, government intervention needs to occur. Without government enforcement of waste policies, many may not want to accept the newness to this area of their lives and would not want change. For example, a greener way to take care of waste, like a composting toilet, might seem like a downgrade from their flushable toilets. However, it is the opposite, and compost toilets have numerous benefits over their present septic systems. The legislation will force residents to adapt to new advancements to keep the water sanitary, leading to uncontaminated fish as reliable food sources.

Secondly, for the government to enforce legislation, leaders need to introduce new technological advancements. Some of the many different ways Tuvalu can replace bottomless septic tanks is by installing plastic septic tanks, or by using composting toilets. There are many advantages to these new technological advancements, including a dramatic ecological and financial significance from the domestic waste treatment now present in Tuvalu. Since concrete septic tanks are very costly, most Tuvaluans do not have a bottom to their concrete systems, meaning they do not have a draining field. Plastic septic tanks can replace concrete septic tanks to be more environmentally friendly (The Pink Plumber). Plastic septic tanks would also leave room financially to purchase the construction of a draining field or to replace their current dry well systems. Although a plastic septic tank has many benefits, owners need to make sure it is filled with water when they backfill the tank, so it does not collapse. It is also very close to a concrete septic tank in which it needs a draining field. It takes meticulous work to install and maintain properly; if not, the solids can back up and cause many more issues, increasing pollution. However, if Tuvalu's sewage regulation will not accept concepts such as compost toilets, then this is an excellent alternative to concrete septic tanks with no bottom. One benefit of the plastic septic tanks is they are less expensive than standard septic tanks and can range anywhere from \$500 and up depending on the tank's size. They are also not susceptible to corrosion and are water-sealed. Concrete septic tanks can crack in severe weather, unlike plastic, which can undergo harsher conditions without cracking due to the plastic's flexibility. Plastic septic tanks are also lighter and easier to install, unlike heavy cement septic tanks. They also have a less likely chance to pollute water due to the tank's all-around seal, unlike a concrete septic tank that's bottomless, causing sludge to escape.

Although plastic septic tanks are an excellent alternative to bottomless concrete septic tanks, there are even better solutions like compost toilets. There are a few negatives to using compost toilets. One is that they can not be the easiest and best for children to use because of the separation of waste. Also, residents would need permits from the government or legislation allowing these toilets. Another is needing organic

compounds for the toilets, even in the time of a natural disaster when those resources are not readily available (Louise Gaille). However, the benefits outweigh the negative impacts of the toilet. The compost toilet's primary function ultimately eliminates sewage creation (which is urine mixed with feces). There are no draining fields and a very minimal construction to compost toilets compared to septic systems, making them not vulnerable to an environmental activity like cyclones. Compost toilets would then, in turn, cause less to no pollution of water sources, creating healthy fish for times of need when other agricultural resources are not available. It also separates and prepares the waste for disposal, requiring no septic tank, leading to no runoffs of pollutants in Tuvalu's water sources. Another advantage is that, depending on which type of compost toilet, it can cost only a minimal fee of just \$100. The minimal expense is if Tuvaluans were making a toilet with a seat and two buckets to separate liquids from solids. With more complex systems, it still only costs a minimum of \$1,500 compared to conventional septic systems that, on average, cost a total of \$3,280 (Green Building Alliance). According to the Economics of Liquid Waste Management in Funafuti, Tuvalu, by Padma Lal, Kalesoma Saloa and Falealili Uili, "If all Funafuti residents were to convert to compost toilets, Tuvalu could expect to generate net benefits of approximately AUD 2 million each year, as compared with incurring at least a cost of approximately AUD 100,000 annually under other options." Advancements in waste treatment would significantly help the Tuvaluan economy, leaving more room to spend on education, health, and other areas of needed progress and improvement. Since there is a separation of the feces and urine, the two can be used in alternative ways and put back into the earth. With the urine, inhabitants can use it to water soil for plants when water is not readily available or cannot be extracted from aquifers when wells have saltwater contamination. Urine can create an equivalent of 25 pounds of fertilizer per person each year (Jean Nick, 2017). Feces, however, would need to undergo treatment before being able to be used as a fertilizer. Having treatment for feces is unnecessary, but would make the feces from the compost toilet even more eco-friendly, rather than just bringing the waste to landfills. Many compost toilets require organic compounds like wood chips, or in Tuvalu, dried coconut fiber, which luckily Tuvalu has an abundance of unless undergoing natural disasters. However, Tuvalu is in a natural disaster-prone area due to its location in the Pacific and its proximity to sea level. Luckily, there are other alternatives to using dried coconut fiber when it is not available. Using dry topsoil as its organic compound once the natural disaster is over is one (Tiffany Selvey, 2017). During a natural disaster, residents can use torn bark and greens from bushes and trees that have fallen as the toilets' organic compounds (Meg Butler, 2020). Composting toilets can be used in diverse ways, making them adaptable to almost all-natural disasters and situations Tuvalu goes through.

With new technological advancements in waste treatment, there will be healthier coral and water, creating

a healthier fish environment. Healthier environments for fish also eases food scarcity during natural disasters and economic dependency on Fiji for food resources. A decrease in the percentage of water-borne illness among inhabitants is also extremely likely due to better technology reducing contamination. Lastly, this new technology will cause seafood nutritional levels, especially in iron, to increase. The malnutrition percentages should significantly decrease from the increase in nutrient-dense seafood, which is now combating conditions such as anemia. Once these concerns decrease, the nutrients can then be used for its original purpose, brain, and growth development. Overall, the new technology will allow Tuvalu society to grow in communal strength. Strength will be grown physically through higher seafood quality leading to health benefits for children and adults, as well as mentally, through Tuvalu becoming more economically independent.

Lastly, some form of education about the new waste management systems needs to be in place. Knowledge about the new technology management will ensure it is appropriately used and show the inhabitants of Tuvalu its benefits. Showing benefits to citizens would show how vital installing new technological waste management is. Education on how to install and use the new technology correctly can be done in many ways. It could be in a daily session at a local church by waste management experts. It could be by having residents watch a demonstration of the installation of whatever the new technology may be. Tuvalu could also hire a waste management expert to teach at schools or in a facility so that residents can then become familiar with the waste management field. One effect of not having educational systems would be food insecurity through the scarcity of food. Food insecurity would be caused by the continued lack of health of the fisheries, due to leakage and runoff of the inferior waste treatment technology or incorrect usage of the new technology. Another long-lasting effect would be creating an unhealthy, over-dependent relationship with other countries due to Tuvalu's reliance on those other nation's resources. However, with more government interaction, waste management technology, and education, Tuvalu can begin to depend less on imports, more on its fishing economy, and cause relief to food insecurities during natural disasters without depending on costly and scarce food supplies.

Tuvalu is just one of the many island nations in the Pacific impacted by pollution of coral reefs and ocean water due to poor waste management. Tuvalu's neighboring island, Fiji, currently has water sanitation issues due to inadequate waste management systems (Jennifer Phillip, 2020). If Tuvalu's communal, brotherly living can come together and solve this issue, it will be the leader of many other island nations, including Fiji, which decide to follow and take action. The issue of waste management seems buried beneath problems that appear to be more significant and essential; however, if this management is changed, it can cause a revolution--a revolution in decreasing food scarcity in island nations such as Tuvalu; a revolution of thriving coral reefs, oceans, and environments throughout the world; a revolution of bonds growing in a community of people working together to solve an issue that impacts each life differently. However, the most significant revolution could be building a communal bond between the nations of the world.

Works  
Cited

Baarsch, Florent, and Lan Marie Berg. "Warming Oceans and Human Waste Hit Tuvalu's Sustainable

Way of Life | Florent Baarsch and Lan Marie Berg." *The Guardian*, Guardian News and Media, 4. Mar. 2011, [www.theguardian.com/global-development/poverty-matters/2011/mar/04/tuvalu-sustainable-way-of-life-disappears](http://www.theguardian.com/global-development/poverty-matters/2011/mar/04/tuvalu-sustainable-way-of-life-disappears).

Bank, World. *Tuvalu Nutrition Profile*. 11 May 2020,

[globalnutritionreport.org/resources/nutrition-profiles/oceania/polynesia/tuvalu/](http://globalnutritionreport.org/resources/nutrition-profiles/oceania/polynesia/tuvalu/)

Butler, Meg. *How to Compost Bark*. 20 July 2020,

[www.gardenguides.com/116428-compost-bark.html](http://www.gardenguides.com/116428-compost-bark.html)

"Composting Toilets." *Green Building Alliance*,

[www.go-gba.org/resources/green-building-methods/composting-toilets/](http://www.go-gba.org/resources/green-building-methods/composting-toilets/)

"Corals." *NOAA National Ocean Service Education: Corals*, 2020,

[oceanservice.noaa.gov/education/kits/corals/coral07\\_importance.html](http://oceanservice.noaa.gov/education/kits/corals/coral07_importance.html)

"Cost of Living in Tuvalu." *Expatistan, Cost of Living Comparisons*, [www.expatistan.com/cost-of-living/country/tuvalu](http://www.expatistan.com/cost-of-living/country/tuvalu).

Fishery and Aquaculture Country Profiles. Tuvalu (2014). Country Profile Fact Sheets. In: FAO Fisheries

and Aquaculture Department [online]. Rome. Updated 2016. [Cited 9 April 2020]. [http://www.fao.org/tempref/FI/DOCUMENT/fcp/en/FI\\_CP\\_TV.pdf](http://www.fao.org/tempref/FI/DOCUMENT/fcp/en/FI_CP_TV.pdf).

Food Security and Nutrition Country Profile (2014). Country Profile Fact Sheets. In: FAO Food Security and Nutrition Department [online]. [Cited 27 August 2020]

[www.fao.org/fileadmin/templates/rap/files/nutrition\\_profiles/DI\\_Profile\\_-\\_Tuvalu\\_280714.pdf](http://www.fao.org/fileadmin/templates/rap/files/nutrition_profiles/DI_Profile_-_Tuvalu_280714.pdf).



Freshwater-Aquaculture. "If Algae Produce Oxygen in a Pond, How Can Having Too Much Algae Cause an Oxygen Depletion?" *Freshwater Aquaculture*, 26 Aug. 2019, [freshwater-aquaculture.extension.org/if-algae-produce-oxygen-in-a-pond-how-can-having-too-much-algae-cause-an-oxygen-depletion/](http://freshwater-aquaculture.extension.org/if-algae-produce-oxygen-in-a-pond-how-can-having-too-much-algae-cause-an-oxygen-depletion/).

Gaille, Louise Gaille. "12 Composting Toilets Pros and Cons." *Vittana.org*, [vittana.org/12-composting-toilets-pros-and-cons](http://vittana.org/12-composting-toilets-pros-and-cons).

MacDonald, Barrie, and W.H Geddes. "TUVALU." *Encyclopedia of the Nations*, [www.nationsencyclopedia.com/Asia-and-Oceania/Tuvalu.html](http://www.nationsencyclopedia.com/Asia-and-Oceania/Tuvalu.html).

Glavin, Chris. "Education in Tuvalu." *Education in Tuvalu | K12 Academics*, 13 Feb. 2017, [www.k12academics.com/Education%20Worldwide/education-tuvalu](http://www.k12academics.com/Education%20Worldwide/education-tuvalu).

Hausheer, Justine E., et al. "Sewage Pollution: A Significant Threat to Coral Reefs." *Cool Green Science*, 17 Aug. 2015, [blog.nature.org/science/2015/06/08/sewage-pollution-great-threat-coral-reefs/](http://blog.nature.org/science/2015/06/08/sewage-pollution-great-threat-coral-reefs/).

Keating, Julie. "What Is Well Water And What Are The Advantages and Disadvantages To Use?" *Drinking Water Journal – Leading Clean Water Online Magazine*, 19 Aug. 2014, [drinkingwaterjournal.com/well-water/what-is-well-water-and-what-are-the-advantages-and-disadvantages-to-use/](http://drinkingwaterjournal.com/well-water/what-is-well-water-and-what-are-the-advantages-and-disadvantages-to-use/).

Lal, Padma, et al. "Economics of Liquid Waste Management in Funafuti, Tuvalu ." IWP-Pacific Technical Report (International Waters Project), vol. 36, 2006, <http://www.pacificwater.org/userfiles/file/IWRM/Toolboxes/financing%20IWRM/LIQUID%20MANAGEMENT-TUVALU.pdf>.

Marco, Stephanie De. "Everything You Need to Know about Toxic Algae Blooms." *Los Angeles Times*, Los Angeles Times, 14 Aug. 2019, [www.latimes.com/environment/story/2019-08-14/everything-you-need-to-know-about-toxic-algae-blooms](http://www.latimes.com/environment/story/2019-08-14/everything-you-need-to-know-about-toxic-algae-blooms).

Nag, Oishimaya Sen. "The Culture Of Tuvalu." *WorldAtlas*, WorldAtlas, 12 Dec.

2018,

[www.worldatlas.com/articles/the-culture-of-tuvalu.html](http://www.worldatlas.com/articles/the-culture-of-tuvalu.html)

Nick, Jean. "How Organic Farming Protects and Conserves Clean Water." *Nature's Path*, Nature's Path,

13 Mar. 2018,

[www.naturespath.com/en-us/blog/how-organic-farming-protects-and-conserves-clean-water/](http://www.naturespath.com/en-us/blog/how-organic-farming-protects-and-conserves-clean-water/).

"Microbiological Water Pollution." *Water Pollution*, 7 Jan.

2020,

[www.water-pollution.org.uk/microbiological-water-pollution/](http://www.water-pollution.org.uk/microbiological-water-pollution/)

"Our Work." *World Health Organization*, World Health Organization,

[www.who.int/tuvalu/our-work](http://www.who.int/tuvalu/our-work)

Philipp, Jennifer. *10 Facts About Sanitation in Fiji*. 18 Jan.

2020,

[borgenproject.org/10-facts-about-sanitation-in-fiji/](http://borgenproject.org/10-facts-about-sanitation-in-fiji/)

"Plastic vs. Concrete Septic Tanks." *The Pink Plumber*,

[thepinkplumber.com/news/the-pros-and-cons-of-plastic-and-concrete-septic-tanks](http://thepinkplumber.com/news/the-pros-and-cons-of-plastic-and-concrete-septic-tanks)

"Population, Total." *Data*,

2018,

[data.worldbank.org/indicator/sp.pop.totl](http://data.worldbank.org/indicator/sp.pop.totl).

Project, Borgen. "Poverty in Tuvalu: An Example for Other Countries." *The Borgen Project*, Borgen

Project,

[https://borgenproject.org/Wp-Content/Uploads/The\\_Borgen\\_Project\\_Logo\\_small.Jpg](https://borgenproject.org/Wp-Content/Uploads/The_Borgen_Project_Logo_small.Jpg), 1 June 2020, [borgenproject.org/poverty-in-tuvalu/](http://borgenproject.org/poverty-in-tuvalu/).

RNZ News. "Post-Cyclone: World Bank Backs Emergency Support for Tuvalu." *RNZ*, RNZ, 7 Feb. 2020, [www.rnz.co.nz/international/pacific-news/409001/post-cyclone-world-bank-backs-emergency-support-for-tuvalu](http://www.rnz.co.nz/international/pacific-news/409001/post-cyclone-world-bank-backs-emergency-support-for-tuvalu).

RNZ News. "Tuvalu Blames Sewage Problem on Climate Change." *RNZ*, RNZ, 9 Nov. 2004,

[www.rnz.co.nz/international/pacific-news/151609/tuvalu-blames-sewage-problem-on-climate-change](http://www.rnz.co.nz/international/pacific-news/151609/tuvalu-blames-sewage-problem-on-climate-change).

Selvey, Tiffany. *Adding Topsoil to a Compost Pile*. 21 Nov. 2017,

[homeguides.sfgate.com/adding-topsoil-compost-pile-80056.html](http://homeguides.sfgate.com/adding-topsoil-compost-pile-80056.html)

"Tuvalu." *Countries and Their Cultures*,

[www.everyculture.com/To-Z/Tuvalu.html](http://www.everyculture.com/To-Z/Tuvalu.html)

"Tuvalu Country Profile: Country Information." *Commonwealth of Nations*,

[www.commonwealthofnations.org/country/tuvalu/](http://www.commonwealthofnations.org/country/tuvalu/).

"Tuvalu Health Insurance." *Tuvalu Health Insurance - Pacific Prime*,

[www.pacificprime.com/country/australasia/tuvalu-health-insurance-pacific-prime/](http://www.pacificprime.com/country/australasia/tuvalu-health-insurance-pacific-prime/)