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## **A Shriveled Up World**

Access to clean water is an opportunity that, unfortunately, isn't granted to every person worldwide. In reality, it is considered a privilege to have, and if one does have access; consider themselves lucky. The access to clean drinking water was defined as a human rights issue by the United Nations in 2010. Due to a large percentage of people without access to clean water, the demand for change became prominent. The act of ensuring freshwater is considered the most essential and basic need for humanity [2]. When the world wide water scarcity was first recognized, a large percentage of first world countries committed to developing solutions to help countries who were less fortunate. New methods of freshwater transportation, and sanitation procedures were evaluated and deemed necessary. Although the issue was recognized to be extremely expensive, the steps that needed to be taken were essential for the sake of the global community.

One of the first steps in forming a solution to the water scarcity issue was recognizing the human right to water. For decades, underdeveloped countries were overlooked and ignored by those who were capable of forming solutions. Despite an individual's background, anyone in a perfect world should have direct access to clean and safe water. However, this conception of a "perfect world" will never become a reality if current trends continue at the rates they are occurring. With no assistance in regulations, and implementation of new water ways and treatment systems, communities have no other choice but to utilize the water sources that are available. These water sources typically are contaminated with large concentrations of pollutants that are damaging to human health. According to the World Health Organization (WHO) records of infectious disease outbreaks in 132 countries (from 1998 to 2001). Water borne diseases are at the top of the list, with cholera as the next most frequent disease, followed by acute diarrhea, legionellosis, and typhoid fever [5]. Unfortunately, as the global population continues to grow exponentially, the distribution of water is strained and there are millions of people worldwide without access to safe drinking water. Excess population growth, industrial development coupled with improving living standards have caused an unprecedented need for freshwater all over the world [2]. Not only do humans use water to drink, but water is used for several essential purposes including, cooking, washing, personal hygiene, recreational use, irrigation, and industrial use. Unfortunately given the reality of the earth, only a fraction of the world's water is accessible, so there are hundreds of countries that are left dry. Only three percent of the world's water is considered fresh water. With such a low percentage, hundreds of countries are left in the dust with no capability to access safe water for their people. In total there are nearly 1.1 billion people on this planet that lack access to clean water. This scarcity leads to detrimental effects on both the social and economic sides of the spectrum. However, if the world shifted towards solutions on the water crisis, society could help pull these struggling countries out of economic predicaments and help to boost economic growth and lower poverty rates.

When looking at a world map, the correlation between underdeveloped countries and access to clean water becomes very defined. Countries with strong sources of economic growth and improved technology are responsible for a majority of the world's water usage. On the other hand, countries with little access to technology and development are facing dangerous scenarios of water shortage. A large portion of the world's freshwater is actually taken from the ground where it is found in large bodies called aquifers. Even though groundwater can be utilized to provide countries with freshwater, they are also at risk of being pre contaminated. These aquifers can become polluted from surface water that has been contaminated by anthropogenic sources. Groundwater quality which relates closely to human health has become as important as its quantity due to the demand for safe water [3]. With the use of pumping technology, whether it is completed at significant rates, or at smaller paces like wells, people are able to gain another source of freshwater. One of the major issues though, is finding a source from an aquifer that isn't polluted. More often than not, there has been an entry of contaminants from nearby sources that are facing unregulated effluent dumping. Contaminants from different sources should be treated and protected in different ways, and, therefore, it is quite important to understand the origins of the contaminants [3]. Not only does this effluent release contaminants from the water it is directly entering, the water also flows into other sources making the pollutant hard to trace and treat properly. The results of water quality assessment suggest that half of the groundwater samples collected are of medium quality thus require pretreatment before human consumption [3]. In order to prevent this problem. Water must be properly treated immediately after it is contaminated in order to prevent the spread. Groundwater has been a huge access point for large communities, but the source is finite and is about to reach its end. With the aquifers being drained, it is important that society salvages the water that is available. If contamination continues, one of the world's largest sources of water will be nearly useless for those who are unable to properly treat it.

One of the most recognized issues in water treatment and wastewater management is the Citarum River located in the West Java Province in Indonesia. This river is a main water source for nearly 27 million people as it lies between Jakarta and the West Java Province. It runs through the center of Indonesia and has been a main source of water for hundreds of years. Unfortunately, as the area has developed and increased in population by nearly 300% in the past 30 years, the river has been mistreated and left to deteriorate into a cesspool filled with contaminants from all different types of sources. This river has been named the dirtiest river in the world and faces extreme sources of water pollution on both an individual and industrial basis. Nearby locals have used this river to dispose of their waste and rubbish, filling the shorelines and waterways with mountains of pollution. Despite the state of the river, they believe that there is no other option to dispose of their waste, but little do they know they are only endangering themselves. Not only, is human waste a problem but industrial pollution as well. Since this area relies highly on the textile industries as a source of economic growth, there is no projection to decrease production rates. The textile industry is one of the most important subsectors of the manufacturing industry that contributes to the transformation of economies in countries [1]. With such a high dependency on this market, underdeveloped countries don't have much of a choice but to allow industries to continue production. That being said, industries will still continue to dump their effluent into the river. Chemical compounds such as lead and mercury are released into the water from the effluent at concentrations well above the allowed

regulation. These textile industries have strong negative environmental impacts, often associated with water pollution leading to a decrease in the amount of freshwater [1]. These chemicals enter waterways and cause both physical and chemical changes in the water. At the points of effluent entry there are visible changes in the color of the water. Typically one would see the water as a light brown or green, but concentrations of lead and mercury can change the color of water to resemble shades of dark purple or red, and sometimes fluorescent blues. Even though these colors are appealing to the eye, this color change represents high level concentrations of harmful chemicals. These chemicals can lead to extremely dangerous health effects like disease and can sometimes be fatal. The sources and impacts of these common classical pollutants are reasonably well understood, but designing sustainable treatment technologies for them remains a scientific challenge [5]. In cases like the Citarum River, the people surrounding the area don't have any alternatives for where they can get water, leaving them with no choice but to face the consequences of consuming and using this polluted water.

As a community with high poverty levels, and no extra income to develop sustainable solutions to the water crisis, Indonesia, as well as several other countries, look to wealthier nations for support. A lot of the countries that face a water crisis are in areas where water is scarce in the first place. Dry and arid climates lead to long periods of drought where water won't be seen for months. Therefore, countries are faced with no other option but to transport water from other sources. This can become very expensive and isn't reasonable for large populations. In areas where water is found more prominently, there are more cases of pollutants. For most cases of water contamination, pollution comes from human waste products and industrial waste. In order to clean up the industrial and human pollution, a large sacrifice has to be made economically. Both these methods require different solutions that have been proposed by the Environmental Protection Agency (EPA) and the United Nations (UN). One of the main concerns though, is how one will go about paying for the proper implementation and procedures to allow clean water for all communities. Water treatment is extremely expensive and requires a lot of maintenance and upkeep in order to ensure the facility is operating properly. A 2016 World Bank study estimated annual costs of providing water, sanitation and hygiene (WASH) services to sustainable development goal standards could reach \$114 billion, three times current investment levels [4]. Clearly, this number is absurd and is not the favorable solution for developed countries despite the desire to help the less fortunate. Not only is this number extremely high, but it will only continue to grow as the world population exponentially increases in the next few decades. In addition, because most of the population increase will occur in urban areas of developing countries, current estimates predict that 67% of the world's population will still not be connected to public sewerage systems in 2030 [5]. The rapidly increasing population leaves researchers with a large gap to overcome. An increase in population will cause current projections of budget and treatment options to be undershot. Research continuously innovates to develop efficient and cheap methods to sustain clean water for developing countries [6] since the ideal sanitation methods aren't feasible with the current income and scenario. The idea behind these solutions is to find water sources that need little treatment in terms of contamination. This ideology allows a portion of the expenses to be saved for alternative methods [6]. Tackling the global water pollution will require well thought out policies, technologies, and scientific advantages on both a large and small scale. In terms of regulations, these must be implemented on an individual country basis. Since not every community faces

the same challenges, it is nearly impossible to implement one solution for all. Factors such as industrial growth, climate, demographic, and dependency on outside sources all affect how a country obtains fresh water. Not only are factors different, but the reality of developing one standard for water quality is unreasonable. Different communities have various income and access to technology, so solutions implemented by developed countries aren't obtainable by developing countries. The economic factor is a challenge, but the treatment procedures and sanitation regulations are also issues that have proven themselves difficult to implement. One standard will not work for all, instead a collaborative method must be put into play. Pressure must come from all – investors and financial institutions, diplomats, private companies, and citizens – both impacted and not [4]. As time passes the world water scarcity issue continues to develop, yet sadly the urge to fix it remains unchanged. Even with current world leaders and climate scientists proposing methods and changes needed, the global community continues to pollute the world's water's. This will eventually cause the demise of the human race and that fact is inevitable. People can not survive without water, so you would think there would be a greater motive to create change. Clean water is only as clean as waste water management and treatment linking with global waters, thus the problems begin at locations facing numerous anthropogenic pollution.

## Resources:

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