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Ethiopia, Water Scarcity

**Ethiopia: The Fog Net Water Harvester**

Can you imagine living in a country that is continually taking in refugees even though your country does not have enough water for their own citizens? A country that is trying to provide for all of the Sudan refugees that are trying to escape from terrorists and violence raging within its borders. According to the Famine Early Warning Systems Network's Integrated Phase Classification Ethiopia is a stage two country, landlocked in Eastern Africa. With Ethiopia having a scarcity of water, they run into problems with the water they have being unsanitary, causing the quality of food to be poor, negatively impacting their health. After researching, solutions were found that will help to improve the water scarcity issue in Ethiopia.

Ethiopia has a population of 105,350,020 citizens with a little under 80% of them all living in rural areas. Their current prime minister is Hailemariam Desalegn, the head of the Ethiopian Parliamentary Republic Government. They have only 15.2% of all land that is arable that can be used for farming other than the 20% of permanent pasture land. Some different crops that they produce in Ethiopia are coffee, grain, sorghum, and castor beans. Ethiopia produces 3% of all coffee beans in the world which is one of their largest exports. They also export oilseed, edible vegetables including khat, gold, flowers, live animals, raw leather, and meat products. The average farm size in Ethiopia is 1 hec which equals about 2.5 acres. When compared to the average farm size in the United States being 434 acres. The country is in a tropical zone located above the equator, landlocked with no access to a body of water.

A typical family in Ethiopia has five children per woman, or more, depending on if they live in rural areas where they use children for cheap labor. In Ethiopia there is a very high divorce rate with many single parents raising their children. Frequently the extended families stay together with many times aunts, uncles, grandparents, parents, and kids all live on the same farm together. The homes they live in are made from any material they have access to, including mud, sticks, grass, bricks, and clay. The families typically eat vegetables, spicy meats, injera bread, millet, plantains, and sorghum. The injera bread they eat is also called Teff, it is a very thin sponge that is made with simple ingredients that is rolled up, and served at all meals. They farm in big groups as a community which is where they get a majority of their food. In order to make the traditional bread Teff, they hand pick thousands of seeds, add water, and flour and then mix to make dough. They then place the dough on a heated flat surface that compresses, and cooks the bread.

In Ethiopia, 80% of the population work as farmers. Many of them farming coffee beans, as that is the largest export for the country. The average wage for workers is $35-$40 per month compared to the United States average of $3,428 per month. In Ethiopia they are working on having more education opportunities for children. They also do not have healthcare, because it would be extremely expensive. There are many health problems in the country, with many Ethiopians being very sick because of poor sanitation, and many diseases like HIV/AIDS. Only 42% of the population has access to clean water with over 58% of the population going without water or drinking unsanitary water that can potentially kill them. They do not have any eastern toilets with plumbing, but they typically have holes in the ground that they use for toilets. They have public toilets in the cities which are extremely unsanitary, and can cause many illnesses. There are millions of Ethiopians though that do not use toilets, and defecate on the roads in the cities, and anywhere they live. With, feces all over, it is possible for many to become extremely sick

from the spread of infections through the feces. Only 27.5% have electricity in the whole country. They do have telephones, roads, and local markets where they can sell their extra crops from harvest, and products. Some of the main barriers that prevent families from earning a living and having nutritious food, are extreme drought conditions, and also the shortage of water.

Ethiopia is currently in the worst drought of the last half-century. The drought is very severe leaving many without water, and dying. The scarcity of water is worsening with virtually no rain, and very little water which continues to decrease as they use up their resources. Without water, there is no food because the crops cannot grow without rain, which leads to no jobs, so families do not have income to buy food, which ultimately leads to the death of many innocent victims. Without water it affects everyone in the cities, and in rural areas. With, most of the country living in rural areas they depend on their animals, and crops to survive, and produce goods that they need to eat and sell. But without water their animals and crops die, leaving the families with no other options. So they send the women and children to walk hours to find a water source in the scorch sun. The water sources that many find most likely are unsanitary, and contaminated by feces or dead animals. This crisis is not only affecting the citizens of Ethiopia, but it also includes the thousands of refugees that continue to escape into Ethiopia from the terror in Sudan. Ethiopia is the largest refugee host in Africa, even with an already existing water shortage.

In order to slow down the number of deaths in Ethiopia due to water scarcity, and poor sanitation they need to create solutions. One solution to increase the amount of water available in Ethiopia is drilling wells. In Ethiopia it may be hundreds of miles to find a large water source, but right under all of these farms there is water. This will be the least expensive solution, and it would be extremely convenient for these families if they had a well in their community to collect water from. This water would be clean, and not exposed to human waste, being sanitary for consumption. Transportation of the water could possibly be heavy for the woman, and children to carry large amounts of water back to their farms, but at the least they would have access to a reliable water source. The wells themselves would not require any technology after they were built in order to access the water, making it very easy for citizens to get clean water for 20 years. Along with drilling wells comes some expenses. These expenses include getting the equipment to Ethiopia and also educating workers on how to operate the equipment safely. This would add around $6,000 to the budget according to Living Water Wells. Another challenge of drilling wells would be the high number of wells needed across the country which would be a reason this solution needs a large about of money to be put into action with our goal of providing for the entire country. There are tons of organizations with their mission to drill wells in all of Africa such as, Life Today, Blood:Water, Water1st International, Drop of Water, Water.org, and so many more with the same end goal for everyone to have access to clean water. Seeing all of the organizations drilling wells there would be a chance of partnering with all of the International NGOs taking on Ethiopia together. The financing would not be as big of a problem because most organizations have their own sponsors that fund them. Together this solution can be tackled, but alone it would be difficult. Well drilling is just one of the solutions for the Ethiopian population to gain access to sanitary water.

The next solution is a very innovative idea that makes the accessibility of water available almost everywhere, and is being used in other countries like Ethiopia. Through research there is a net from Aquallonis in Germany, that some countries use such as Morocco and Chile to harvest water from fog. According to Aquallonis, the CloudFisher works using a “3D mesh for the highest yields, also using a robust plastic grid it can withstand winds up to 75 mph and has a flexible trough which moves with the net in the wind so there is no loss of water” (Aquallonis FAQ & Prices). There are four nets that are approximately 4.5 meters by 3 meters wide, so the nets all together would take up 12 meters in width. When there are clouds, fog, and wind in the air, the mesh catches the moisture, then the water rolls down

the net into the trough. There would be an average of 328 gallons of water everyday that would be collected in the filtering storage tank, and can be used to irrigate plants or for the community to drink. Ethiopia is a mountainous area, which would be the perfect place to set up nets with clouds, fog, and wind accessible to be harvested into water. With using the nets, the community would have to go and collect the water out of the tank which would be heavy for them to carry large amounts of water back to their farms. This solution would cost around $12,175 to have the whole fog harvester system installed for a community. Using the nets would be a natural way of getting water to the citizens, harvesting clean, sanitary water in an environmentally safe way. In research, a set of these nets can produce enough water for 800 people, which would be very beneficial to try in Ethiopia.

Along with the nets and wells, there would be hippo rollers, which are plastic drums that they fill with water, and roll with the control of a steel handle. The drum holds 24 gallons which would weigh 90 kg (200 lbs) if they carried it, but with the design of the roller it would feel like they are only pushing 10 kg (22 lbs). New features on the hippo rollers are the bearings for the handle, also the o-ring for big cap, and a smaller cap which can be replaced with an ordinary soda cap. The reason why they added a small cap is so that small farmers can more easily irrigate their crops. Additionally, families can wash their hands without opening the big cap, and possibly contaminate the water. The rollers also do not need any maintenance, and will last for 5-10 years. The hippo roller come at a cost of $125, but typically would be shared between a few families making it more affordable for the families. Being able to use the hippo rollers would make it very convenient to transport a large amount of water at one time. They would save time, and trips back to the tanks and wells, along with making it easy for Ethiopians of any age to collect water further reducing work related injuries.

The next solution that will have a lasting impact on the generations to come is the idea of planting trees to build the hydrological cycle (water cycle) in Ethiopia. According to Rosamond Hutt, this idea has been put to action in Pakistan, where they planted 350,000 hectares of trees (1,350 square miles). In Ethiopia the amount of forestation is very low. For the past 100 years Ethiopians have been harvesting the trees to make room for crops, animal pastures, and using it as fuel. The species that would be planted would be fast, and slow growing trees. Increasing the biodiversity in the environment. Also keeping in mind that if there was to be an invasive species that killed a species of trees, not all of the trees would die that were planted because there would be more than one variety of trees. The project would also keep in mind what trees are going to need to be able to survive in drought conditions. One species that would be planted is called *Juniperus Procera*, commonly called the African pencil cedar. This tree is slow growing, and can last for a few hundred years, according to “Juniperus Procera,” the trees are used during the “traditional orthodox ceremony of Meskel,” an annual religious holiday celebrated in Ethiopia each September. Another tree that would be planted is the *Schrebera Alata,* which is a fast growing tree that is fragrant and produces fruits. Both tree are strong hardwoods which could be used to build homes, and make things for the home, such as tables, bowls, and flooring. The reason why planting trees is an important solution for the drought is because of the amount of water trees transpire into the atmosphere. Venkatraman states that in order for trees to transpire they need “to have sunlight as their energy source”. Trees on average transpire 50 gallons of water every day per tree. Imagine having over 10,000,000 trees transpiring 50 gallons of water everyday into the atmosphere. That is 500,000,000 gallons of water that would be transpired into the atmosphere. When a tree transpires it is taking the water from the leaves, and turning it into water vapor which collects in the atmosphere. In Ethiopia they have no rain which means that parts of the water cycle is not working together, but with more trees, there will be more water vapor to create clouds, which will make the chances of rain much higher. So the more trees that Ethiopia has, the more opportunities there is for rain, and it would be a start to restoring Ethiopia’s water cycle.

This solution is by far the most expensive due to to the amount of trees needed to build back the forest, and being able to make an impact on the water cycle. The trees would cost anywhere from $200-$450 per tree, which is needed for this project because the tree would need to be established enough that it could survive without the need of much maintenance. In Pakistan they planted one billion trees which would be extremely costly for this project to buy from a distributor, also getting no economic benefits out of it. But the project would also include establishing a huge nursery to plant the trees, and have the citizens work at the factory to earn a living, also it would help build the Ethiopian economy. With the workers getting paid they will turn around, and be able to buy things which would increase the money flow through the economy. Along with the huge amount of money being spent on the trees the Ethiopian economy would boom with over three billion dollars being put into the industry. This project is going to be extremely expensive with most likely four billions dollars needed to build the facility, purchase the trees, and pay the workers. But will be extremely rewarding being able to help build the Ethiopians economy. Also, this would be a very good thing for the citizens to have a job that is going to give them money, which will be food on their tables, to survive through these challenging times in the country.

With all of the solutions, they would meet the needs of most citizens if there was to be a lot of wells drilled across Ethiopia, also a lot of nets put up - while using the hippo rollers, and building a nursery for the trees that will be planted. The wells would take the least amount of money, and need a large amount of quantities to reach everyone in the country. The net sights would be able to help a large number of citizens, and would be more expensive than the wells, but would never run out of water to harvest compared to the wells that will dry out over 20 years. Part of both of these solutions would be the hippo rollers which is part of transporting the water from the wells or tanks to their homes. There is also the idea of building a nursery or trees that will be planted to restore the water cycle, and Ethiopia's economy, but at a huge cost. The solution that has the least amount of weaknesses, and most benefits would be the fog harvesting nets with the hippo rollers. This is the solution that would be recommended for the country to put into use to help their water scarcity issue. Ethiopia could get funding through many international non-governmental organizations which deal with many issues, including water scarcity. They also could get help from their allies such as the United States which is a huge supporter of helping build Ethiopia, Germany which has a friendship treaty, and is one of there big importers of coffee. Turkey which has excellent relations with Ethiopia, Malaysia a huge trade partner and investor, and also India which is a big investor in Ethiopia. In addition they could have the World Health Organization help donate or send their resources to ensure the water filters are safe for citizens. Ethiopia is a country that deserves to be helped out, especially for their generosity in supporting the Sudan refugees.

The community members, educated professionals, and missionaries would be in charge of helping to install the nets. They would get funding to pay Ethiopians that are trained, and have them install the nets around the county, which would be able to build the economy increasing the flow of money. While the government would be in charge of getting all of the materials shipped in for the nets, and getting money from the allies, and International NGOs. The community members would also be in charge of contacting officials if the system is broken or needs a repair. The International NGOs, and allies are in charge of funding the project, and spreading the word through media, to possibly get more supporters. With, getting the project known through media, there would be possibility that other companies or individuals would want to help provide money or resources for the nets. Some policies that would have to be put in place would be related to where the nets would be located, and trying to place them where all citizens would have access to the water. With placing the nets where people will be in range of water they would also keep in mind where the mountains are. In the mountains the nets would be at a higher altitude, and have access to more fog, and clouds to harvest maximum water amounts. The citizens would also have a policy that they would have to contact the government or a certified official if the filtering system needed work on or if the nets had anything wrong with them. There would also have to be a policy that would identify

rules regarding the hippo rollers, and how they must be used, and not abused when using the government's property. They would have to remember that when placing these nets there is only a 15.2% of arable land for farming, so care would be taken not place these nets on land that could be used for farming. They would have to place them on non-arable land like mountains or areas that would not be invading local farms. They would have the citizens help keep up on the nets also having churches from around the world help out. There would be churches and missionaries that would help sustain this project where members would come to Ethiopia, and help Ethiopians build the nets, and contribute in building the local economies backup.

In conclusion, Ethiopia is a country that needs help from others to solve their water scarcity issue, and to continually care for refugees that continue to pour into its borders. Ethiopia is a country that deserves help from others with all that they do for the refugees fleeing from terror. Putting up these nets will positively impact the lives of many Ethiopians, and is one way that should be put in place to provide sanitary water for all. The hippo rollers will definitely help make water even more accessible for everyone no matter the age or strength of the person. Water scarcity in Ethiopia is a severe issue that needs to be addressed to stop people from dying from unsanitary water, and lack of any water.

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