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Ethiopia: Dry Urine Diverting Toilets to Battle Famine, Disease, and Contamination

The amplitude of his chest slowly declines as each breath weakens. The boy is bone by now, a sitting skeleton beneath stretched flesh. His lips grow dry, no longer familiar with the texture of neither food nor water. He cries often, but no one hears. Instead, he lies in an unset bed, alone, praying for death to end this hell while millions around the world throw the scraps of food and the droplets of water away that would save this boy's life. But he will never see those scraps and he will never drink those drops. This boy will never feel satisfied. Instead, he will live out his days wondering what he did to deserve this kind of life.

This kind of life is a reality for far too many in Ethiopia today. A land flooding with culture, family, and hardship, Ethiopia is amongst the poorest countries in our world. The majority of the population lives in rural areas where, as a male dominated society, men are expected to farm while women cook and watch over the children. Ethiopians are extremely hard workers, averaging 80 hours a week but only bringing in about \$123 a year ("Ethiopia Facts"). Living in a small, two-room house Ethiopians utilize one room for food storage and the other for living. Usually seven children along with the parents live in one home with relatives nearby. Beyond this, transportation is all by foot. Men and women walk miles to find water and work, if they are lucky. Those children fortunate enough to attend school also walk miles to get an education. A person averages one change of clothes and some educated children are offered a uniform. A meaningful, passionate life is lived out by most every Ethiopian, however, not without a multitude of obstacles ("Ethiopia").

Though a great deal of nations struggle with finding access to clean water, Ethiopia is one country that is suffering far beyond the others. Ethiopia is currently one of Africa's poorest countries, with over 80 % of the nation's people living below the poverty line. A slim 11% of the people have access to adequate sanitation services, and the recent global rise in food prices coupled with the lack of seasonal rains has led the country to the brink of famine ("Ethiopia"). At this point in time, ten million of the 77 million people living in Ethiopia are at risk of starvation. Ethiopia also faces serious shortages of clean water and has severe sanitation issues throughout the country. Because of this, preventable disease accounts for over 60 % of all health problems in the country with thousands of serious illnesses and deaths caused by malaria. Diarrheal diseases are common as people have no choice but to drink contaminated water due to the insufficient availability of toilets ("Ethiopia Facts"). However, even the 17 % of Ethiopians fortunate enough to have access to clean water still suffer from these same afflictions due to the swarming of insects towards waste sites ("Ethiopia").

In just the past 20 years, the reoccurring drought has caused a multitude of issues for the people of this country. The lack of rain, food shortages, and famine have infiltrated the land. During these droughts, water-related diseases are widespread. Small springs and ponds dry up, and remaining sources of water are contaminated by both human and animal waste. When the small periods of rain arrive, this unsanitary water is washed around the land and then used by mosquitos as a breeding location ("Ethiopia" *water*). With drought leaving water sources scarce and contaminated, most people are not able to bathe regularly causing infections and scabies to arise in large amounts. Beyond this, hand-washing is cut back in an effort to conserve water. This desperate act only causes for more diarrheal and water-related diseases to be spread, both of which are leading causes of death among children ("Global").

However, this string of issues does not stop at clean water. Because the sanitation is so poor, insects create a detrimental health issue. Ethiopia is home to a multitude of fly and mosquito borne diseases, such as Malaria, Leishmaniasis, Onchocerciasis, Bartonellosis, Typhoid, Myiasis, Leprosy, Dysentery, and African Trypanosomiasis. Such diseases arise rapidly in these areas due to the ongoing lack of proper waste facilities (“Ethiopia”). Many Ethiopians use pit latrines or large holes in the ground for a toilet. However, if a latrine is not available, people are forced to use their only water source for waste facilities and bathing, causing obvious and serious contamination. With no running water, the waste is left exposed for extended periods of time in both latrines and ponds. Such exposure attracts swarms of flies and mosquitos. As these insects move into villages they are attracted not only to the waste, but also to the already limited food supply of the inhabitants. Flies and mosquitos spread bacteria and disease onto the food, putting the health of the entire area at further risk (“Ethiopia”). With near famine conditions causing food to be scarce, inhabitants are left with the daily struggle of both famine and disease (“Ethiopia Facts”).

While such a problem seems insurmountable, a simple solution could benefit the people of Ethiopia and all of Africa. Flush toilets are clearly not a viable option, seeing as they use about 12,000 liters of water per person per year; an amount far greater than any Ethiopian living today could realistically make readily available. For this reason, an alternate method of waste management must be implemented to aid in solving the sanitation issue. Dry urine diverting toilets are the answer to the current obstacles in Ethiopia. As the name implies, these toilets are “dry,” meaning they neither use nor discharge water. All waste is stored in separate compartments and later recycled. More importantly, UD toilets are part of the ecosan or ecological sanitation approach to living (Samwel). Human waste is not simply discarded, but seen as a resource which can be processed, and later used by harvesting beneficial elements which human by-products contain in ample amounts (“Global”). UD toilets are inexpensive to construct and function without a central water supply or sewage system, making them the most realistic option for improving sanitation and health in Ethiopia (Samwel).

For better understanding of urine diverting toilets it is helpful to take a look inside the human anatomy. The human body is designed to store waste separately within the bladder and intestine system. Just as they are separate within the body, urine and feces also leave the body this way (“Body”). UD toilets copy this natural condition by storing urine and feces separately after they leave the body (“Global”). By storing these products separately, the feces and urine can later be used for productive purposes, primarily for agriculture (Samwel).

With a two-chamber system separating the urine from feces, UD toilets can be used for up to a year before having to empty or exchange the chamber. Once a chamber is full, the urine and feces can be used separately to aid in agriculture. Urine contains nutrients such as nitrogen, potassium, and phosphorus, all of which are essential to plant growth and development (Samwel). The daily urine from one person is enough to fertilize one square meter of farmland. Feces are also a good fertilizer due to high amounts of phosphorous, potassium, and magnesium, all which can be used as a natural fertilization method (“Global”). Though feces cannot be used as rapidly as urine, once treated with ash or lime feces can be used to improve soil structure and health (Samwel). The ash or lime is used to start the dehydration process of the feces (which can be accelerated further in warmer temperatures) in order to make the product safe for use. Treatment with these products kills the bacterial colonies which is the main attraction of insects. By killing these colonies and other pathogens, insects are no longer lured by the feces and urine (Spuhler). With Ethiopia’s history of famine and drought, access to natural fertilizers will aid in crop production and agricultural success. This success can be seen first-hand in Nepal. After experimenting with UD toilets, 60% of farmers noticed an increase in crop production and 54% noticed better taste and quality of food. The successes observed in Nepal through the UD implementations suggest that this project is feasible in the Ethiopian region. When taking into account the bases for implementation in Nepal, issues of

water scarcity, geographic isolation, and widespread disease were the foundation for this project being launched. Ethiopia struggles with these same afflictions making UD implementation a realistic proposal for improvement in the regions overall sanitation and health. Lastly, by providing a natural catalyst to plant growth, the UD toilets will provide a stepping stone on the track to ending malnutrition within the impoverished country (Samwel).

While comparing the success in Nepal to the issues at hand in Ethiopia is vital to rally for implementation, it is also necessary to analyze the relationship between UD toilet functions and weather conditions. When looking into the environmental aspect, UD toilets have been known to yield greatest success in regions with high average temperatures, long dry and short rainy seasons, or arid climatic conditions. These conditions help to naturally preserve feces at a consistency that is necessary for successful and timely transportation and fertilization. Ethiopia produces these prime conditions, thus reducing any barriers for success that may be expected.

By simply containing the waste of the people in UD toilets, the spread of loose, contaminated water can be stopped along with the spread of diseases, both diarrheal and fly-borne. Flies and mosquitos are not attracted to the feces and urine since it is stored partially underground rather than exposed. Beyond this, food contamination is also reduced since flies will no longer be as attracted to the villages (“Global”). By storing people’s waste in the UD toilets, pollution of open water sources will be reduced, allowing Ethiopians to continue to wash their hands and bathe themselves. Small sanitary acts will help to cut the rising amount of deaths by disease in the country (Samwel).

However, with any implementation comes a variety of obstacles such as cost, transportation, access, cultural barriers, and government policies. Without fully diving into Ethiopian culture, one cannot be certain if such a process would be a realistic proposal.

To begin to bring Ethiopia back to their feet, one must target the most impoverished villages and begin the change from here. Carrying out this task means bringing UD toilets to the villages of Koraro and Foro. Both of these villages have suffered from a widespread famine and drought along with disease plaguing the overpopulated areas. Their geographical isolation has made it nearly impossible to provide for their people (“Koraro”).

Bringing change to these areas would be extremely realistic seeing as both cost and installation are fairly inexpensive and efficient. To fully build and get one toilet working takes one week from beginning to end at a cost of \$1,061.13 per toilet (including upkeep products). Estimating one toilet for every 10 people, 5,500 toilets would be needed in each village meaning a total cost of \$11,672,430. Funding for this project would be made possible by the UN seeing as they are supporters of the use and implementation of UD toilets in developing countries and are almost entirely responsible for funding in Nepal. Mission groups would also help to raise the remaining money and open donations would have to be accepted. A small group of five to seven people is the extent of the arms necessary to build the structure. With the number of groups that visit Ethiopia for service each summer, and help from the UN, both villages could have their toilets installed and ready in just under two summers (“Africa”). Like any structure, the UD toilet is built from the foundation up with a stable ground to hold the toilet above the level soil. The type of foundation depends entirely on the area of installment. If the ground is solid rock, then reconstruction of soil is not necessary. If rock is not present underneath the soil, excavation begins with a 30 cm deep and 25 cm wide round foundation. Once this trench is dug at a minimum of 1.5 meters by 1.5 meters, the hole should be entirely filled with cement. To save money, however, the trench can be filled with large stones and the remaining space filled with cement (Samwel).

Once the foundation is built, the feces chamber must be constructed of high-quality cement with a thickness around 7-10 cm in order to ensure minimal leaks and breaks. The area should then be left to dry for one to two days before furthering the construction process. Next, outside walls must be built of brick or concrete with a minimum of 60 cm but more preferably 80 cm to allow the chamber to last longer. When building the chambers, a small hole in the side, about 50 mm in diameter and 20-40 cm above the floor, must be built for the outflow of urine into a separate chamber. A chamber dividing wall must then be constructed directly in the center of the square foundation and sealed tightly. After the seal has dried chamber doors, made of either wood or metal, must be put in (“Bathrooms”).

The toilet room must be assembled next with a wooden frame constructed above the chamber walls using 4 cm wooden slants, and made of a material that can be cleaned without mold or erosion. Wood is not an option unless it is later covered with tile or linoleum (Samwel). Two holes must then be sawed into the floor and centered above the dividing wall. Following that, a 50 mm hole for urinal piping and a 110 mm hole for the ventilation pipe must be made in the chamber. Four walls must be built about 2.2 meters high with four reinforcing bars between each of the walls. These bars should be placed at a 45 degree angle to ensure a sturdy perimeter. Finishing touches include a wooden door with small holes for light, a roof constructed of waterproof material and extending 15 cm beyond the wall on all sides, and stairs, which can be made of brick, concrete, or wood (“Bathrooms”).

After the structure is complete, a UD-Seat or UD-Squatting Slab must be placed over the holes based on the preference of the users. With Ethiopian culture being used to latrines, the squatting slab would be more likely be requested by the citizens (“Koraro”). Flexible urine pipes must be installed and should have a slope downward to avoid a negative gradient. The last step is the urine collection chamber. A larger container is recommended in Ethiopia so the chamber will not have to be emptied as often, therefore causing less of a hassle for the users. Ventilation pipes can be connected to a spout; however, this is not a necessary addition. The function of the ventilation pipe is solely to redirect odors out of the enclosed space into the air where it can be diluted. As mentioned earlier, the full construction takes a week at its longest duration (“Bathrooms”).

With installation hardly being an obstacle due to its efficiency and ease, the focus must move to the government presently in power in Ethiopia. For years Ethiopians have lived with a civil war in the heart of the country, causing widespread famine, corruption, and death. Though the true battle ended around 1991, peace hardly followed. A new constitution was established in 1994, creating a bicameral legislature and a judicial system; however, conflict flared again in 1999, causing thousands of lives to be taken before a peace deal was brokered in June of 2000. Economic progress followed instilling a new sense of hope with the Ethiopian people. Sadly, this hope was short-lived as three years of drought left food resources incredibly scarce. Malnutrition went rampant and was only relieved through international aid (“Ethiopia”).

Seeing as the government is still not in a state where such a process could be realistically mandated, the installation and transportation would have to be mostly mission work and help from foreign organizations if the hope is to get progress started immediately. While such a task may seem daunting, multiple mission groups such as African Inland, Aid for Africa, African Centre of Meteorological Applications for Development, and Projects Abroad possess the skills and access to materials necessary in order to build the UD toilets within the areas where they are most essential. Another alternative would be to use the United Nations as a resource. Seeing as they partnered up with The Department of Water Supply and Sewerage to implement a similar project in Nepal, their services would be of great help in Ethiopia as well. Their fully educated and experienced board would join the mission groups to set up the system within villages (“Africa”). Beyond this, another outlet lies in making slight additions to Ethiopia’s government. Seeing as Ethiopia is a Democratic Republic with State Councils, it would be most appropriate to establish a Board of Sanitation Services

within the State Councils seeing as they most directly collaborate with the needs of the people. While the control of this board may have to be in foreign hands to begin the process, as education is gained amongst citizens, more control can be given to this government board who could then lay out a plan for implementation as they see fit. While this board would most likely be unable to fund the necessary equipment for transportation and initial installment, they would take responsibility in establishing and maintaining contacts with companies that donated and aided the project in Nepal. By creating this board a necessary link to investors would be established. Again, funding is a real barrier in the process of implementing the UD toilets to Ethiopian villages. However, when looking at resources used throughout the project in Nepal both the UN and Ecosave are sources of financial support. Ecosave's Building Monitoring Division specializes in utility cost reduction through bill management and finds outlets to make such projects feasible within developing areas of our world. Both of these outlets create a reliable source for funding and transportation. Furthermore, this board would need to be present in each village to oversee UD functions and educate men, women, and children. This board would need to be instructed by the mission groups or members of the UN in order to ensure that they possess the necessary skills to maintain the UD toilets. Present on the board would need to be both men and women. Both genders are necessary due to the custom that women are in charge of aspects of sanitation in African countries while living in a male dominated society meaning men must have the leadership and authority. It is vital to take note of these cultural areas in order to ensure a smooth implementation ("Ethiopia").

Before relying fully on mission work, it is necessary to look at the relationship between the United States and Ethiopian government. Because Ethiopia is a sensitive government centered on control, any work that threatens the government's hold on the country would be seen as unfavorable and therefore would be prohibited. However, because the United States is one of the largest foreign aid donors to the Ethiopian government and military, US visitors are, more often than not, welcome in the area. Due to this convenience, mission work could complete the necessary number of toilets Ethiopia needs to make strides in the current water and sanitation issue ("Ethiopia"). While it seems logical that the government would accept outside assistance to address a pervasive problem, it is not unreasonable to expect that the opposite could occur due to cultural, ethnic, political, or other reasons.

Beyond government, culture is a delicate piece of Ethiopian society and must be carefully examined before assuming that UD toilets would not harm a belief or cultural norm. Ethiopia is a diverse country with over 80 languages spoken, 80 individual cultures, and 80 separate religions. However, commonalities can be found between these vast numbers allowing a generalization to three major religious practices. Today these three recognized practices are Coptic Monophysite Christianity, Islam, and Indigenous or commonly referred to as the pagan religion (Fall).

Coptic Monophysite Christianity is most commonly compared to the way of life Jesus' disciples would have lived 2000 years ago in Galilee. Those who have observed this way of life feel a deep connection to Old Testament times and practices. With little change for over two millenniums, many Hebraic and pagan elements can still be found amongst the practices of these peoples. Nonetheless, the materials and the idea of UD toilets should not be seen as a threat. While many of their customs are old fashioned, they have grown as a modern people socially, reserving their faith to the previously instilled customs (Fall).

Islam, which is practiced by the majority of the population, varies slightly throughout the country. While the majority of practices are the same, interpretations of the Koran are slightly different from one group to the next. The Islamic population participates in many unique rituals that most visibly separate them from the other two religions in the area (Fall). Though the faith is unique and diverse, the UD toilet violates none of the cultural barriers. In the Islamic faith, medical examinations and appointments are where most of the taboos in the culture arise. Because UD toilets do not deal with

any of these sensitive areas, it would not interfere with the people (“Ethiopia Facts”). While the idea may be new and undoubtedly intimidating, with proper education and delicate introductions the new idea and process would be accepted and implemented without hassle.

Lastly, there is the Indigenous religion. If any religion presents an honest obstacle to the implementation it is this practice. The indigenous religion has bred a people who thrive on vitality and spirit to this day. Through centuries of hardships these people have persevered and remained on faith alone in many cases. Because of this strong devotion to 10,000-year-old traditions, a new custom could be seen as a threat to the ever-durable faith life these Ethiopians have thrived upon. While some modern practices have been seasoned into the faith through Protestant ties, the UD toilet may seem an unnecessary luxury to the people (Fall). However, as the faith continues to modernize through the education of the people, and as the desperation of this country increases, a potential for change is likely to present itself. In the case that education is unsuccessful, seeing as 9 out of 10 people are *not* Indigenous, conflict would be easily avoidable (“Indigenous”). If and when such an instance arises, the use of the UD toilets should cause minimal interferences to the Ethiopian way of life.

When looking at the larger picture, such an implementation seems to fit into the Ethiopian lifestyle. Currently Ethiopia is a country of desperate people. Thousands lack a clean water source, millions die of disease each year, and countless others are in search of a plentiful harvest after famine has been all they have known. Ethiopia is crying for a change. With the simple implementation of the U.D. toilet, lives *can* be transformed. Through the hands of generous men and women like each one of us, a country drowning in poverty and despair could see again the hope of a better tomorrow.

What all of us in the developed world take for granted, something as simple as going to the bathroom, is a disease-ridden undertaking in the developing world. While the solution sounds simple, many obstacles lie between the problem and meaningful change. Going forward, the challenge now becomes how one implements this solution, one that not only reduces disease, but also aids in the production of food through harvesting nutrient rich by-products from the human body, to such a devastating problem. While the materials may be accessible and the price affordable, though the times allow such a change and the people are willing to accept it, what remains is whether we, as a people, possess the passion it takes to make a change and work for the betterment of others. In the end, all the ideas human knowledge can create will be meaningless unless humanity has the drive to take action and make a change.

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