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## **The Cries of the Desperate in Ethiopia**

Africa. When that three-syllable word hits our ears, what do we envision? Roaring lions, sweeping savannas, towering giraffes, trumpeting elephants? Maybe you can even feel the hot, dry desert air blowing through your hair or the burning sand underneath your feet; the drums of a tribal dance echoing in your ears. What is behind the closed doors in a quiet village? What about the people? What about the starving children? What about the mother watching the life slowly drain from her child's eyes? What about the father unable to provide for his family? We live such a sheltered life here in the United States. Not many of us know what it's like to go to bed hungry or to watch someone you love slowly disappear into nothing but flesh and bones. We do not know the meaning of the word "poverty." When we want something, we buy it, simple as that. But it's not that simple, is it? We can afford to buy these items that we so desperately need because we have jobs. We have a steady income. If we get sick, we go to the doctor, but what would happen if there were no doctors? If we are thirsty, we go to the fridge or sink and fill up a glass, but what if the water we depended on to live could kill us with one sip? Every day we wake up, make breakfast, maybe get the kids ready for school, or finish that assignment at the last minute. We then bustle out the door to go to school or work, making our contributions to society. In Ethiopia, the people wake up to see who survived the night. Here in America, we can't imagine what it would be like to live in such a nightmare, where basic survival is every day's struggle. In Ethiopia, Africa, that nightmare is reality.

Ethiopia is located in Eastern Africa, more specifically "in the Horn of Africa– the pointy peninsula-like landmass that emanates out of the eastern part of the continent" (Encyclopedia of the Nations). Ethiopia has an area of 1,127,127 total square kilometers (Encyclopedia of the Nations). Of that, water covers around 7,444 kilometers. The climate of Ethiopia and surrounding areas can be described as "tropical monsoon with wide topographic-induced variation" (World Facts). This makes it difficult to find crops that can not only withstand drought, but also floods. Half of the country's gross domestic product, GDP, depends on the success of agriculture in the region. When crops are not bountiful, people suffer and go hungry, and the surviving population plummets below the poverty line. What if we can end this never-ending cycle of death and suffering? If all of our great minds work together and we were to design plants that are both flood and drought resistant, think of all the lives we could save.

The average Ethiopian family size has been declining over the years but is still fairly large – around seven people according to the Guttmacher Institute. With not much food to go around, many Ethiopian children from stunting, "a lifelong condition that results when children miss out on critical nutrients while in the womb or during the first five years of their lives" (10 Things Everyone). The lack of necessary nutrients can be explained by the diet of Ethiopians. An average family in Ethiopia consumes one or two meals in a day with a few snacks during the day's course (SPOON Foundation). The most commonly consumed foods are plant proteins such as millet, sorghum, teff, and plantains. A lack of community markets means that the Ethiopian diet, or lack thereof, is directly proportional to the success of the annual crops.

Education in Ethiopia is quite inadequate and not available to everyone. Six years of schooling is available to both males and females (Fhi360). Some parents simply cannot afford schooling for their children, while other families keep their daughters home, while the sons get educated, to help with the domestic chores as the home is believed to be the place of women (Womankind). More female engineers, doctors, and even teachers can help the people and improve the quality of life. In fact, Ethiopia has one of the worst health care systems in the world. A website titled Women and Child Healthcare in Ethiopia states that "34 percent of women receive care from a professional during pregnancy [and only] 10 percent

of births [are] attended by skilled health personnel.” In addition, “80 percent of the health problems in the country are due to preventable communicable and nutritional diseases” (Colombia University).

The average Ethiopian rural family owns around 2.5 acres (Scientific & Academic Publishing). The staple crops of Ethiopia include the following: teff, wheat, barley, corn, sorghum, millet, plantains, pulses and coffee beans. Cattle, goats, horses and mules, camels, sheep and poultry are also raised. The farming techniques in Ethiopia are described as “basic” (Climate & Agriculture). “Despite the country’s many rivers and lakes, only around four percent of land is irrigated” and “investment in farming and the supply of better seeds and fertilizer could lead to a significant increase in crop yields” (Climate & Agriculture). Because of the increasing population, farmers are forced to use more and more set aside land and forest areas for livestock and crops to try to counteract the rising starvation and malnutrition levels. This destruction is causing a problem for a sustainable environment in the future.

Improving agricultural productivity takes a lot of financial support whether it is a first world country or a third world country making an agricultural change. Ethiopia does not have the sufficient funds to upkeep a research project, partly due to its corrupted government. Even though Ethiopia is ranked as one of the five fastest growing economies in the world, it still remains extremely poor (Wondifraw). This corruption is hurting the people and their families and needs to be stopped (McKenna). This change can come about simply by people working for the better good and not just to fill their own pockets. Peaceful protests can also help since this country is so used to violence and war. A soft voice, rather than a shout, will be heard by more people. With so much of the population’s monthly income remaining below the poverty line and people struggling to survive, there needs to be a change in both the people, and the government, so the hungry can be fed. The Agricultural Sector in Ethiopia is responsible for around eighty percent of the employment (About Ethiopia). If a rural family’s only source of income is the produce from its field, it is difficult for that family to be financially independent when the crops do not survive the harsh conditions. As discussed earlier, a typical Ethiopian family’s diet consists primarily of plant vegetation. What is grown in their fields or gardens is their source of food since there is not any extra money to spend at the food market. An increased income can give the people a larger variety of food and in turn, provide better nutrition.

Because most of Ethiopia’s GDP depends on agriculture, creating a stable crop income will help increase the GDP per capita and the amount of available food. Most of the crops grown now in Ethiopia aren’t drought or flood resistant. Having a wet and dry season with fluctuating temperature ranges means that there is a high need for plants to be able to withstand these climate changes (World Travel Guide). The lack of resistance to these seasons means both money and food sources are lost by the hectares. If we were to just eat from our farms or gardens, think about what we would consume and all the minerals and vitamins we’d be lacking if we didn’t have access to the grocery store. In Ethiopia, their diets are high in fiber, low in dairy products, and low in fat, which is causing nutrient deficiencies. The following minerals and vitamins have been discovered to be lacking in a typical Ethiopian diet: iodine, iron, vitamin A, vitamin D, and zinc (SPOON Foundation). Access to a food market can help provide the lacking minerals and vitamins, but food from an outside source can’t be afforded by all. There is little evidence of plant research being conducted in Ethiopia. The agricultural farming techniques being practiced now are hurting the environment and are only worsening the issue. Over-farming and deforestation are both dire obstacles prohibiting Ethiopia from having a flourishing agricultural sector and are making it even more difficult to feed the growing Ethiopian population (Chase).

Women, rural poor, and developing countries are all particularly disadvantaged when it comes to ensuring food security. The lack of gender equality prohibits most Ethiopian girls from going to school and possibly becoming a scientist, engineer or teacher that could help her country feed its hungry. Even a woman being allowed to work in the fields can provide another set of working hands and another brain to problem solve and increase productivity in the fields. Poor rural families in Ethiopia depend on their farm as their only income and food source. Brave women who are not afraid of being shunned for stepping outside of a woman’s place can help ensure food security by simply communicating with the other wives

and sharing the education and new farming practices her family has learned and can begin to change the mindset this culture has about women and what they are capable of.

Currently, in 2015, the trends for plant science in Ethiopia are at a standstill. According to the Consultative Group for International Agricultural Research, or CGIAR, “progress [for international plant breeding programs] has been slow, and much remains to be done.” The amount of crops harvested for human consumption and for market sale would need to be recorded, as well as the number of malnourished people in the country to see the trend of plant science. Since starvation and malnutrition are still an issue in Ethiopia, the country’s need for outside help has not changed and will only increase over time. As the population increases in Ethiopia and the environment worsens every growing season, the situation for rural families that depend on their farms for money and food isn’t improving. The organizations that provide food now are helping to delay the inevitable, but for the country to make progress as a whole, the people of Ethiopia need to look for long term solutions that are complemented by the short term solutions, in order to become self-sufficient.

The Millennium Development Goals set forth in 2000 have reached their 15 year expiration date and have not had the effect as was expected. The reason for this failure is because the goals “were considered targets for poor countries to achieve, with finance from wealthy states” (Sustainable Development Goals). The United Nations has set forth new and improved goals called the Sustainable Development Goals that focus more on food security and ending poverty worldwide. These new goals are based more on how a third world country can improve in both a social and physical aspect. They state that a country will be food secure, have education available to everyone, have zero traces of gender inequality, conserve the environment, etc. (Sustainable Development Goals). Increased focus on the makeup of Ethiopian staple and cash crops, along with the invention of more resistant seeds can help make these new goals be successful in the next 15 years. Educating ordinary citizens about these new goals set for their own country can help the people be more accepting of new practices and give them a different perspective on their own farming practices and ways to improve on such.

After progress has been made with new crop research programs and success has been noted, food availability in Ethiopia will increase. The technology of genetic modification is an appropriate solution for food security because we know exactly what type of crops we need and what needs to be done to get said crops, so as to increase the immunity to high temperatures and excessive rainfall. With the technology available to us, we know exactly what genotypes to look for in a seedling’s genetic makeup to make sure that adult plant can survive the harsh conditions. This can make for a stable high crop yield that is permanent. With a surplus of food, comes money. Families who survive day to day can finally have the relief of knowing they are financially independent and stable. With the constant pressure of having enough food to eat gone and the farmland used to its full potential, over-farming and deforestation would cease to exist and the environment could recover and be preserved in its natural state.

Farmers would especially be benefited from plant research because it is their fields and hard-work that can create this change to help get the country back on its feet. Smallholder farmers also will be the first to benefit from the improved crops with a boosted income and plentiful food. Providing the women with the education needed to become the leader of a research team or a medical unit, can show the people that women are equals and are capable of just as much as men are. Seeing women coexist with men as equal counterparts and working towards a common goal can help eradicate the gender prejudice that comes from the culture of the people and prove that women are not a lesser class to be ignored.

According to the Natural Resources Defense Council, or NRDC, “climate change is the single biggest environmental and humanitarian crisis of our time.” It also states that the overabundance of carbon dioxide in the atmosphere is responsible for this fluctuation in temperate and weather patterns. Farmers in Africa have been reported as saying that “they have seen ‘big changes’ in the continent’s weather patterns” and that rainfall occurs even less than it did before, but when it does finally rain, it does so in large amounts and the land begins to flood (Climate & Agriculture). This has had devastating

consequences in the past and farmers have lost all of their crops. Creating flood and drought resistant crops can provide a safety net for the country's economy and not allow the weather to determine the life expectancy of a poor farmer and his family. Water scarcity also can affect crop production in the future since all plants need water to flourish; however, water scarcity is a part of African culture and the people have adapted. Success in creating a drought resistant seed will reduce the amount of water the field needs. Population growth is another trend to consider. The pressure of needing to meet crop and money demand will only increase with the population and farmers will feel the need to use more and more farmland to provide for society. Using Ethiopia's farmland to its full potential will stop all unsustainable measures taken for maximum crop production to occur.

Creating flood and drought resistant cereal breed seeds has been done before in developing countries. Scientists in Nepal, from the International Rice Research Institute, or IRRI, created a flood and drought resistant rice seed that can withstand up to one and a half months of drought and two weeks of flood at any given time (Prasad). The method used is called Marker Assisted Selection, or MAS, using a quantitative targeting locus, or QTL. Using QTL mapping prior to MAS allows for more reliable markers, that mark the desirable traits, reduces the number of breeding lines needed, and allows for selection during the earlier generations, meaning the plants that do not have the desirable flood and drought resistant traits can be discarded sooner (IRRI). QTL finds the quantitative traits in a plant given a specific locus, or circular targeting area. This method is desirable for genetic modification because it "permits a more effective breeding design" by being "simpler compared to phenotypic screening, [allowing] selection [to be] carried out at seedling stage [and allowing] single plants [to be] selected with high reliability" (IRRI). This process can speed up phenotypic screening, which is selective breeding done on a visual level rather than a molecular level, and allows plants with the desirable flood and drought resistant traits to be bred faster. If we used this method to create flood and drought resistant cool weather cereal, teff, and warm weather cereal, sorghum, there would always be a stable crop yield, no matter the season in Ethiopia (Major Cash Crops). The infrastructure needed for this solution is rather advanced, as good specimens of DNA need to be used in order to see the traits that will be mapped (Collard). However, since this exact method has already been used and has been proven successful, this solution may very well be the answer for food security in Ethiopia. Using MAS to design these new teff and sorghum plants means that by 2030, the expiration date of the new Sustainable Development Goals, the new seeds will be produced and in the experimental stages. Programs on how to begin integrating them into the agricultural sector of Ethiopia and the goals set for each community to reach will also be under way.

Action Against Hunger, or ACF International, is "committed to ending world hunger... [and saving] the lives of malnourished children while providing communities with access to safe water and sustainable solutions to hunger" (Action Against Hunger). This global humanitarian organization has programs in 40 developing countries, including Ethiopia, and is focused on long-term food security issues as well as short-term solutions. The mixture of providing hunger relief now and ensuring that a community can provide for itself in the future is the answer to food security and what makes this organization and others already doing work in Ethiopia, such as The Hunger Project, a necessity to the survival of the people (The Hunger Project). Getting more people specifically involved with these organizations can broaden the range of developing countries helped. Another local project in Ethiopia is the United Nations Development Programme, or the UNDP. This project focuses primarily on helping countries meet the Millennium Development Goals. Battling against gender racism and the lack of primary education availability can help a country become more stable and more susceptible to accepting foreign aid and becoming more financially independent.

IRRI, as they have the experience, equipment, and scientists to use MAS, can play the leading role in developing the improved teff and sorghum seeds, by expanding their research to other cereal breeds. CGIAR, a global partnership that concentrates on research involving increased productivity in poor countries, can also assist in the research or implementation of the new seeds. The World Bank combined with the non-profit organizations doing work in Ethiopia, such as Angelfire or United Nations Children Fund, or UNICEF, can provide the money for this research program and proper distribution of the seeds

to Ethiopia, along with the education needed to equip farmers with the knowledge of sustainable farming. Private companies can help by assisting with the funds or equipment and space needed for a large scale solution to occur. The Red Cross Association can provide the doctors and resources needed to assist the number of malnourished children in Ethiopia and provide the proteins and nutrients to help the malnourishment issue. Kids Against Hunger, or Meals from the Heartland, can provide nutritious meals that the Ethiopian people can consume for the needed amount of calories and nutrition. Any humanitarian organization with a respected reputation can help the social aspect of accepting foreign aid and can connect with the people of Ethiopia. Our national government can reach out to the Ethiopian government and provide our assistance in helping the poor by funding more mission trips to Ethiopia.

Rural farms in Ethiopia will be the main driving force in this food security solution. It is their farms and their crops that provide the money for the agricultural sector of Ethiopia. How well the crops do during the growing season determines just how many people will get to eat and how many will starve. Improving the actual seeds used and ensuring crop production during floods and droughts is the answer to food security in Ethiopia. Farmers will have to be open to changing the way they have farmed for generations. Being educated about sustainable farming practices and the advantages of flood and drought resistant plants will also help Ethiopian farmers ensure food security in their home country.

We can no longer ignore the cries of the starving or the look of anguish in a farmer's eyes as yet another crop perishes due to the cruel weather. How can we stand by while innocent children are dying from malnutrition in developing countries and even in our own country? With the technology we have today, we can save lives. Instead of worrying about what the latest fashion trends are or who the best players to have on a Fantasy Football team are, ordinary American citizens can donate their time and hard work by getting involved with packaging food, making diapers, tying blankets for children, etc., without spending a single penny. As a first world country, we are blinded by our own ambitions, our own apathy, and even our own ignorance. By helping those in need, we can begin to be a less selfish people.

Malnutrition and starvation are the two biggest issues facing Ethiopia today. These both can be traced back to the crops grown in Ethiopia, both staple and cash crops, not being able to withstand the harsh drought weather or the heavy floods. Through the research I conducted, it was evident to me that creating drought and flood resistant seeds can not only help the people, but also stabilize Ethiopia's economy as it is heavily based on the agricultural sector. Providing a poor Ethiopian farmer with seed that could save his starving family is the answer to food security in Ethiopia.

The only way to meet the Sustainable Development Goals by 2030 and to ensure food security by 2050 is if future and past generations work together. New farming techniques combined with flood and drought resistant crops can help Ethiopia and surrounding countries that face the same issues. With the help of IRRI's facilities and scientists along with the research teams and expertise of CGIAR, better variations of the teff and sorghum plants through MAS breeding techniques can be made. These plants then can be distributed throughout Ethiopia to struggling farms and begin to flourish and produce even more than they did before. The agricultural sector of Ethiopia can begin to rebuild itself and the economy can become more stable, thus increasing each family's income. With malnutrition ebbing back into non-existence, Ethiopia's time of being a poor, developing country can finally be over and the people can utter a sigh of relief. Africa. That three syllable word can be the sound of victory. A victory we accomplished together.

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