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Ethiopia, Factor 11: Malnutrition

Ethiopia: Using Biofortification to Save the Future

What is malnutrition? Most often, when someone mentions this issue, the first thing that comes to mind is hunger. Unfortunately, the public could not be more wrong. Malnutrition is not a question of whether one has enough to eat but rather, whether that person is receiving all the necessary nutrients required to live a healthy lifestyle. While hunger is a very prevalent problem for our growing society, approximately 1 in 3 people are undernourished in some way, around the world (Zero Hunger).

Despite the numerous efforts being made to solve this crisis worldwide, the country of Ethiopia continues to suffer.

With an increasing population of 106.6 million, Ethiopia is ranked as the twelfth-largest country in the world (Ethiopia Population), and because only 20.6 percent is urban (The World Factbook), the rural population is subjected to overpopulation. Ethiopia's federal parliamentary republic has made attempts to slow this growth and help the people, but it has not achieved much (The World Factbook). The one million square kilometer state is also landlocked, surrounded by its neighbors: Djibouti, Eritrea, Sudan, South Sudan, Somalia and Kenya (The World Factbook). While Ethiopia contains a large amount of land, a substantial amount of it proves to be non-arable, ranging from elevations of 125 meters (about 410 feet) to 4,550 meters (about 14,927 feet) due to the many mountain ranges and other physical features (The World Factbook). Not to mention the state is located above sea level and the tropical monsoon climate is extremely troublesome for agriculture as the soil may be acidic and poor in nutrients (The World Factbook).

Furthermore, only 36.6 percent of the land is agricultural and of that only 15.2 percent is arable, proving a difficult situation (The World Factbook). Smaller farmers own average farm sizes of 0.9 hectares (2.223 acres), while other larger farmers cultivate an average of 3.5 hectares (8.645 acres) (The Economic Lives ...). The principal crop in Ethiopia is coffee. However, other Ethiopian crops include many cereals and grains, oilseed, cotton, sugarcane, and vegetables including khat (Ethiopia *OEC*). In addition, following coffee as the largest export, Ethiopia exports gold, oilseeds, vegetables, flowers and multiple animal products (Ethiopia *OEC*). This leaves an abundant amount of the grains for the country's people to eat, but feeding around 106 million people is not easy.

Nonetheless, Ethiopians regularly eat, unless droughts occur. A typical Ethiopian family consists of around 4-5 people (Ethiopia Rural Socioeconomic ...). This includes either a working or non-working mother, working father and 2-3 children (Ethiopia Rural Socioeconomic ...). They live in houses made of mud or thatch walls, with very few rooms and likely, dirt floors; these houses are often painted in bright colors and decorated with nice blankets, rugs and pillows (Houses in Ethiopia). Typically, a family eats one or two meals a day (Ethiopia *Adoption Nutrition*). These meals consist of injera, which is a sour flatbread made of fermented teff, a popular cereal, along with wat, which is a stew of legumes and possibly some meats (Ethiopia *Adoption Nutrition*). Coffee is often a popular drink. Several Ethiopians are banned from pork, as this is a taboo for some religions, which has resulted in a vegetarian dietary preference (Ethiopia *Adoption Nutrition*). Ethiopian diets are quite high in fiber and provide enough calories, but they lack various other needed nutrients including calcium, iron, zinc and multiple vitamins (Ethiopia *Adoption Nutrition*).

Most families grow their own food through subsistence agriculture though spices and vegetables can be bought in markets (Rural Life in Ethiopia). Women are then responsible for cooking the food starting with pounding the grains to create flour (Rural Life in Ethiopia). Over 80 percent of Ethiopians farm; those working smaller farms earn about \$0.80 per person daily, while those working on larger farms have an income of about \$2.10 (The Economic Lives ...). Due to such low wages, younger children often tend to work by raising and selling family livestock or helping in the fields. The major barrier for earning a living and access to food is the climate as well as physical geography. When droughts occur, farming production decreases significantly and this causes several problems. However, the lack of arable land and major differences in elevation prove to be major drawbacks when the option for growing nutritional food arises.

Regarding daily life other than agriculture, women often receive an average of eight years of education while men receive around nine years (The World Factbook). However, this education is frequently cut short due to the need for children to work and bring in family money. Families also fail to receive affordable access to health care, along with clean water and sanitation (Ethiopia WHO). While they do not receive these services, they receive and utilize electricity, telephones, roads and local markets, surprisingly in rural areas (Ethiopia WHO).

Still, the issue of malnutrition cannot be ignored. The lack of certain nutrients in a daily Ethiopian diet affects critical body functions. Deficiencies in vitamin D and calcium affect the growth and strength of bones, as well as muscle contraction, blood clotting and nerve-cell communication (Ethiopia *Adoption Nutrition*). Long term deficiencies of both nutrients will impact bone development by slowing development or softening them (Ethiopia *Adoption Nutrition*). In addition, iron is essential for providing oxygen to the body, therefore a lack of this mineral has multiple repercussions (Ethiopia *Adoption Nutrition*). These include anemia, or lack of red blood cells, decreased immunity, fatigue, and poor performances in work or social interactions (Ethiopia *Adoption Nutrition*). Vitamin A and zinc also play vital roles in the body from visual function to immune function and growth and development (Ethiopia *Adoption Nutrition*). Insufficiency of these nutrients can cause blindness, delayed growth, impaired immunity, and a wide range of lesions (Ethiopia *Adoption Nutrition*). All these issues are consequences of malnutrition: a problem that has not been solved.

While trends of this crisis have slightly reduced in past years, it is continually proving to be very severe. Approximately 50.5 percent of all children from ages 6-59 months suffer from stunting in rural areas (Ethiopia Rural Socioeconomic ...). Stunting is a condition in which one is too short for their age and is a clear sign of malnourishment. This is a result of children being deprived of critical nutrients while either in the womb or during the first five years of their life. In contrast, only 31 percent of children are stunted in urban areas (Ethiopia Rural Socioeconomic ...). This produces an average of every 2 in 5 children being stunted throughout the entire country of Ethiopia (Ethiopia Rural Socioeconomic ...). Because malnutrition is a lifelong condition, it affects Ethiopia's quality of productivity and education. Stunting is the cause of "approximately 16 percent of grade school repetitions" (10 Things ...). In addition, due to the high child mortality rates, Ethiopia's workforce has decreased by about 8 percent (10 Things ...). Stunting, however, does not just affect the younger generations. Roughly 67 percent of Ethiopian adults also suffered from this condition when they were young, proving that the problem of undernourishment has been ongoing (10 Things ...).

Additionally, 81 percent of all undernourishment cases among children go untreated, which leads to the fact that 28 percent of Ethiopian child mortality is associated with malnutrition (10 Things ...). Malnutrition is a higher concern among children who are under five years old because if they are malnourished in the early stages of their life, this could affect their entire life span. Missing out on nutrients during this stage of life will create a weak immune system, making the child easily vulnerable to outside diseases. Along with that, early malnourishment prevents growth and development, which is why

children will become stunted. While this topic mainly corresponds to the children of Ethiopia, it especially affects Ethiopian women as well. Ethiopian women who are pregnant may not be able to provide themselves or their children with enough nutrients causing multiple health problems. However, the cost for adequate health care is not cheap and has added to the country's financial issues. Ethiopia is one of the poorest countries in the world, and its government spends around 5.5 billion dollars on child malnutrition annually, which amounts to 16.5 percent of the country's GDP (10 Things ...).

Ethiopia has attempted at multiple efforts to reduce malnutrition, however none of these attempts have been sufficient enough to resolve these issues. In 2008, Ethiopia's government began Community Based Nutrition, CBN, as a component of the National Nutrition Program. It was backed by the World Bank for 5 years, or until 2013, and managed to reach over a million children in Ethiopia as well as make significant progress. The five-year program itself allowed families and children to receive medical care and taught mothers how to make meals that are more nutritious for their young ones. This was only the first phase and a second phase was set into place from 2013 to 2018. Another program, which lasted four years and ended in 2015, was supported by both the European Union and UNICEF. It was a national nutrition security program known as Government's Health Extension Program. The program deployed 36,000 health extension workers who then set up health posts in most rural areas which provided nutrition counseling and growth-monitoring sessions each month (Nesbitt). Due to these actions half the children that had first started the program in 2011 no longer needed care because they had been declared nourished (Nesbitt). Additionally, stunting rates were decreased from 57 percent in 2000 to 44 percent in 2010 (Ethiopia Community-Based ...) and the amount of undernourished children declined from 58 percent in 2000 to 38 percent in 2016 (Ethiopia Preparing ...).

While these programs may have ended for any number of reasons, it is assumed that this resulted from insufficient funding or government interests. All in all, the programs made great strides. However, despite past achievements and the impact that these programs have had, it seems that Ethiopia and other countries are overlooking a quite simple solution that has proven to be very sustainable. According to the World Health Organization, biofortification is "the process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding, or modern biotechnology." Though most people may think of genetically modified organisms or GMOs when they hear biotechnology, biofortification is not genetic engineering. Biofortified crops are for the sole purpose of providing more nutrients than a normal crop contains, whereas GMOs are typically used for mass production and include pesticides or genetic engineering designed to resist certain situations.

Dr. Howarth Bouis was an economist who started his research to understand whether calories were the reason behind poor nutrition. He concluded that calories did not have as much an effect on malnutrition as deficiencies in minerals and vitamins did. Now that he knew this, Bouis began to question whether he could produce a different variety of a seed that would be higher in certain nutrients. This would mean smaller farmers would be consuming their own, more nutritious staple food, and therefore, would intake more nutrients without even noticing. In addition, "research had shown that wheat seeds with higher zinc content were more vigorous and viable. Seedlings got a better start and yields were higher" (Harvest Plus). Thus, this proves that not only would adding nutrients to the staple crops benefit the people, it would produce higher yields and benefit the crops. Bouis created a feasible solution to malnutrition known as biofortification.

But why choose biofortification, as opposed to other possible solutions? The Harvest Plus organization goes into detail regarding the benefits of biofortification, as well as mentioning the other countries that have been supported by Harvest Plus and have begun using this solution in their countries.

First, biofortification uses staple foods, which is the majority of what poor households and people grow

and eat. As said before, Ethiopia's major crops include cereals and grains as well as vegetables. Through biofortification, Ethiopia's crops along with crops such as maize, cassava, wheat, legumes and sweet potatoes would be mineral and vitamin induced. These products are grown through subsistence agriculture among the rural population. Therefore, biofortified crops reach the rural community quite easily and would reach more than 80 percent of Ethiopia's population. Second, this solution is sustainable. After the seeds have been fortified once, farmers continually grow and eat biofortified crops, though they are still thought of as crops. Therefore, biofortification would sustain generations to come for years, possibly eradicating the problem of malnutrition completely. Third, it reaches all people in a country, even those who are living in remote areas and may not have money to buy foods that are commercially marketed. Fourth, biofortification is environment-friendly and produces higher yields. Therefore, it will produce more food and more food will increase sales, profits and incomes. Finally, biofortification is highly cost-effective as a one-time investment keeps recurrent costs low, making it available to many countries.

Harvest Plus specifically targets three of the nutrients which Ethiopians are lacking: iron, zinc and vitamin A. The organization then breeds these minerals or vitamin with staple food crops that are key in certain countries. After screening a multitude of different types of crop seeds which are stored in seed banks that contain naturally higher amounts of vitamin A, iron and zinc, their nutritional genomicists, much like geneticists, use certain processes to help speed up the breeding selection. They then use the more nutritious seeds to "breed new crop varieties with higher micronutrient content that are also high yielding and have other traits farmers want" (Harvest Plus). Afterwards, the organization works together with farmers to test their new varieties in target regions; they partner with farmers to ensure that the farmers will want to buy the crops and like the product. Ethiopia would focus on crops such as iron-biofortified legumes and cassava, zinc-biofortified maize and provitamin A-biofortified maize and cassava. In addition, Harvest Plus conducts studies to guarantee that the crop contains enough nutrition to make improvements. Therefore, Ethiopia's farmers and community members would have to work with the Harvest Plus organization to learn about the biofortified crops which they will be working with. Later, Ethiopia's national government would have to officially release the best-performing varieties of the nutritious crops for the communities of farmers to grow, eat, and sell their products in local markets. The government would eventually have to work with Harvest Plus to implement policies and establish support for long-term sustainability of the biofortification process. This conjoined work would benefit the government in multiple ways including: ensuring more profitable business as well as markets, essentially raising the country's GDP, and establishing support mechanisms to help both the government and the people.

Harvest Plus is currently working with many other countries including India, Nigeria, Pakistan, Bangladesh, the Democratic Republic of the Congo, Zambia, Uganda and Rwanda, along with countries in the Pacific and Caribbean. According to a 2015 annual report, through Harvest Plus's work in India, the organization was able to reduce the likelihood of iron deficiency by 65 percent in children after just 6 months. (Reaching Millions ...) In addition, the organization has worked with Uganda by investing in vitamin A sweet potatoes, which have provided up to 100% of the citizens' daily needs as opposed to a once severe deficiency. Harvest Plus and their people are clearly efficient and able to provide the citizens of any country viable solutions for the problem of malnutrition. They ensure that farmers can consume and farm their biofortified crops. They also make sure to educate citizens about the benefits of the nutritious crops and engage with certain systems to verify that crops are promoted and available to farmers throughout the country. Their progress has been significant. In the Democratic Republic of the Congo alone, more than 670,000 households are growing biofortified crops. This number is very closely matched in each of the other countries as well.

Harvest Plus spent a total of approximately \$5.3 million for the delivery process of vitamin A maize in

Zambia, along with \$2.9 million for the delivery of zinc wheat in Pakistan (Biofortification Progress Brief). Though these countries are not quite as similar in their economic development compared to Ethiopia, the total cost of biofortification and delivering these crops in Ethiopia may be significantly close to the previous costs mentioned. All in all, according to Harvest Plus' Biofortification Progress Brief, "For all crop-country combinations, biofortification can be rated as very cost-effective, as costs are significantly below per capita income, which ranges from US\$365 in the Democratic Republic of Congo (DRC) to US\$3,843 in India." Clearly, the cost of biofortified crops is not too overbearing if it is below the per capita income. In addition, the DRC and Ethiopia are very similar in relation to their population sizes and poverty levels; therefore, if the DRC is capable of paying for biofortified crops, Ethiopia should be as well.

While Ethiopia is a very poor country, this solution is still in reach. In working together with Harvest Plus, who has supported over 10 other countries, along with receiving funding from UNICEF, the EU and other organizations or past programs, Ethiopia would be able to receive the biofortification process and provide the necessary nutrition to millions of their citizens. A payment plan could then be set in motion and with the inclusion of government agencies or NGOs, Ethiopia could be a food secure country in just a few years to come. The funding needed for this would come from these humanitarian organizations to provide the one-time seeds and education for the citizens of Ethiopia, and from there, the program would sustain itself so long as the seed and farming knowledge is passed on from generation to generation.

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