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Ethiopia, Factor 5: Climate Volatility

### **Ethiopia: Drought-resistant Hybrid Crops to Minimize Vulnerability to Climate Volatility**

Ethiopia is covered with rich, arable soil filled with nutrients from volcanic material. The hopeful potential present in this land stands in stark contrast to the reality of the severe, widespread destitution that affects many. Though foreign emergency food aid has worked as a temporary solution, it remains an unsustainable stopgap. As is common in many underdeveloped countries, a serious lack of infrastructure accompanies the food insecurity. Although Ethiopia has seen development in education, health, and food security in recent years, climate volatility prevents serious progress towards Ethiopia's becoming a sustainable country with a reliable food supply. Droughts, in particular, have caused crop yields to drop dramatically. Plagued repeatedly by these devastating droughts, Ethiopia has struggled to develop the infrastructure needed to withstand these environmental shocks. Each severe drought leaves millions who need food aid in its wake (Tutton). There is a clear and pressing need to address the threat that drought poses to Ethiopia's food security. One promising possibility is expanding initiatives to bring drought-resistant hybrid crops to Ethiopia. By decreasing Ethiopia's susceptibility to shocks from drought, these hybrid crops could lead to greater food security and ultimately, greater economic and social stability in Ethiopia.

With 82% of the population residing in rural areas, Ethiopia has a populace that consists mainly of smallholder farmers. A staggering 39% of that population lives below the national poverty line, meaning that a significant number of Ethiopian families are struggling to find enough food ("Ethiopia Statistics"). Compounding this struggle is the fact that many of these families are very large, with multiple generations often living together (Bluffstone). Families are generally composed of six or more people, as Ethiopia has one of the highest fertility rates in the world, with 5.23 children born to each woman as of 2014 ("Ethiopia (1)"). Unplanned pregnancies are common, making up about 41% of Ethiopian pregnancies. They often contribute to a higher rate of food insecurity, as resources cannot handle the unexpected, increased burden (Ball).

Furthermore, many of these farm-based families do not receive an adequate education; at 39%, compared to a global average of 84%, Ethiopia's literacy rate is one of the lowest in the world ("Adult and Youth", "Ethiopia (1)"). Alarmingly, rural access to basic healthcare is also substandard. Most of the population remains unvaccinated, and most illnesses go untreated. Problems concerning vaccine rationing and a lack of physical access to resources worsen the situation (Bluffstone).

Access to arable land is also a growing concern. More than 85% of farming households operate on fewer than two hectares of land, while more than 40% farm 0.5 hectares or less ("Ethiopia (2)"). Crop yields are extremely limited by these small plots of land, leaving many rural families at the mercy of unpredictable and unreliable harvests. Additionally, although most farmers raise livestock, the consumption of animal products in rural areas is exceptionally small. As a result, farmers rely on grain-based crops to make up the majority of their diet ("Federal Democratic Republic").

With these factors impeding agricultural productivity, the main barrier to earning a living wage for rural Ethiopians is low crop yields. It is crucial to farmers' livelihoods that they are able to produce enough crops to support themselves, a goal that feels less achievable after each drought and subsequent famine. Because 85% of people work in agriculture, compared to 5% in industrial work, the persistently low crop yields pose a problem for the majority of the population ("Ethiopia (1)"). Worse still, physical access to food markets is limited by the lack and uneven distribution of roads. Food markets are often volatile, with

wide price spreads, meaning that there is a large disparity between what vendors sell their goods for and what consumers are willing to pay for those products (Olofinbiyi). Low crop yields, a lack of access, and unstable markets prevent people from truly receiving enough food, which results in higher rates of malnutrition (“Federal Democratic Republic”).

The major crops grown in Ethiopia include corn, teff, and sorghum (“Major Staple Crops”). In particular, corn “continues to be a significant contributor to the economic and social development of Ethiopia” and “plays a central role in Ethiopia’s food security”, according to the International Food Policy Research Institute. Corn, with the greatest production by more than a million tons, is the clear staple crop of Ethiopia. With a larger reach than other crops, it is critical for any successful plan concerning Ethiopian food security (Getnet).

However, corn and many of the other crops commonly grown in Ethiopia, necessitate water-intensive agricultural practices. The two main crop seasons are Belg and Meher, from February to June and June to October, respectively. Cereals, mainly corn, are grown during these seasons and when rains failed during the Belg season in 2008, farmers reported a severe reduction in crop harvests. These agricultural seasons are no longer reliable indicators of precipitation, as in recent years rainfall has become increasingly irregular (“Ethiopia 2008 Crop”). High amounts of rainfall are needed for several of Ethiopia’s staple crops, and the natural water supply is by no means certain (“Major Staple Crops”). As Ethiopia’s water shortages worsen, the crop yield will only decrease. Frequent droughts are the main barrier to improving Ethiopia’s agricultural productivity (“Rural Poverty in Ethiopia”).

In the East African drought of 1984-85, one million Ethiopians died from hunger due to the catastrophic effects of not having enough water to raise sufficient crop supplies (Ross). In 2008, two successive seasons without sufficient rainfall left Ethiopia with 3.4 million people who needed food aid (Riebeek). The last major drought in Ethiopia happened in 2011, and the United Nations called it its worst drought in sixty years. The extent of the damage was so great that approximately 3.2 million people were affected (“Horn of Africa”). It is clear that Ethiopia’s rain-dependent agriculture is simply too vulnerable to the drastic volatility seen in patterns of rainfall. The nation barely recovers from one drought before another hits, and the consistent droughts make the negative effects seem perpetual. One Western diplomat stated that ““This year’s problem is very serious because last year’s was serious””, highlighting the cyclical vulnerability (Addis).

The underlying problem of climate volatility has only worsened. Drought has become more frequent and extreme throughout Ethiopia over the past decade, and the trend is worsening. As global temperatures continue to rise, rainfall has continued to decrease in eastern Africa, specifically due to the warming of the Indian Ocean (Funk). Predictions generally show that the average precipitation totals in Ethiopia will continue decreasing or will remain below the typical average. This will be a pronounced change from the substantial rainfall that normally occurs during the rainy seasons to the benefit of many of the crops grown. Now, the persistent lack of rainfall is considered a “major factor” in rural poverty in Ethiopia (“Rural Poverty in Ethiopia”).

Maintaining crop yields, despite a volatile climate, would greatly benefit Ethiopia in terms of sustainability. Breakthroughs in hybrid crops have allowed for plants to increase their yield even when factors like disease and extreme climate are involved. By introducing drought-resistant hybrid crops into Ethiopia, the risk for reduced crop yields could be significantly lowered. Already existing programs centered around strengthening Ethiopian food security could be expanded to include distributing hybrid seeds and information about them. Replacing Ethiopia’s current stock seed with Optimum AquaMAX Hybrids, a form of drought-resistant hybrid corn, could help Ethiopia, especially because corn is its staple crop.

Tested in 42,084 farms, Optimum AQUAmax has shown promising results. Advanced stomata control allows for more efficient use of water, while deeper kernels maintain their yield under late season stress, thereby broadening the window of opportunity for growth. An efficient root system captures moisture from deeper soil, maximizing any nearby water resources. With nearly a 7% increase in yield during drought conditions, Optimum AquaMAX corn could increase crop yields significantly, even with concerns over volatile weather. This 8.5 bushel/acre yield advantage during drought could constitute a large increase in crop yields. Moreover, during times when droughts do not occur, this hybrid still has an advantage of 1.7% over typical corn crops, making it a versatile, beneficial choice. In these favorable conditions, Optimum AquaMAX corn has a 4.2 bushel/acre yield advantage ("Optimum® AQUAmax® Hybrids"). Because a hectare is about 2.5 acres, there would then be an increase of 21.25 bushels per hectare. This translates to an increase of half a ton of corn harvested, given that the commercial bushel size for corn is approximately fifty pounds (Murphy). With drought as its main problem and corn as its major crop, Ethiopia stands to gain tremendously from a hybrid, drought-resistant version of its staple crop.

Although this hybrid corn would become a huge staple in the Ethiopian diet, it would not necessarily lead to a sole dependence on it. Some other native Ethiopian crops such as sorghum and millet, although not nearly as pervasive in Ethiopia as corn, require less water ("Major Staple Crops"). Those slightly more drought tolerant crops could be encouraged to grow in higher numbers to increase resistance to climate volatility, in addition to adding variety to the Ethiopian diet. Furthermore, other drought-resistant hybrids of native Ethiopian crops like wheat could be implemented in a similar manner to the suggested hybrid corn. A combination of drought tolerant native and hybrid crops could lead to decreased vulnerability to environmental shock and a corn-centric but still diverse Ethiopian diet.

In fact, pilot testing in African countries has demonstrated that drought-resistant hybrids can be a major force in maintaining agricultural productivity under limited water conditions. The Water Efficient Maize for Africa (WEMA) program is dedicated to using breeding and biotechnology to produce drought-resistant corn. The results have been more than encouraging. Tested first by scientists and then by a growing number of farmers, hybrid corn seeds have shown impressive resistance to droughts. Water efficient hybrid corn is projected to improve yield by significant amounts, a hypothesis supported by tests done in African countries. Just recently, in January of this year, farmers in Western Kenya harvested 4.5 tons per hectare of a hybrid corn named DroughtTEGO ("WEMA Celebrates Successes"). To provide a frame of reference, the national average for a maize harvest is 1.8 tons per hectare (Nyoro).

Because Kenya has a similar climate to Ethiopia and has also long been affected by droughts, the two countries are comparable, and the study done earlier this year in Kenya could be indicative of how a similar project in Ethiopia would work. The benefit of having a program like WEMA in addition to working with Dupont's Optimum AquaMAX hybrid corn is in the variety. In addition to the large benefits from Optimum AquaMAX and the even larger benefits from DroughtTEGO, WEMA provides information about and access to the latest and most beneficial hybrid maize seeds. In 2013, WEMA released 16 hybrids, with a plan to release 25 more in phase two of their program, to take place during 2013-2017. Trials in Kenya, Uganda, Tanzania, Mozambique, and South Africa, the five countries in which WEMA is concentrated, have already begun. Several of these countries have similar climates to Ethiopia, which faces a similar drought situation. Therefore, the heartening results seen in these tests are likely to have a similarly positive effect in Ethiopia. All of WEMA's hybrid varieties are thoroughly tested before being released. Thus, the already released hybrids are both beneficial and safe, while WEMA continues to research to achieve better, more efficient varieties ("WEMA Celebrates Successes"). WEMA has also partnered itself with Monsanto, one of the leading agricultural biotechnology brands. The benefits of a partnership like this are huge for countries like Ethiopia. Since 2008, Monsanto has developed and donated drought-resistant hybrids of corn. Through WEMA, the company has also provided royalty-free donations of the same drought-resistant hybrid corn that is commercially sold on

today's market. Considering hybrid seeds come with the drawback of higher prices and the need to rebuy them every year, programs like WEMA provide economic security and allow native farmers to benefit without much risk. Donations of this kind mean that less foreign aid would have to be channeled towards supplying these seeds, making the switch to drought-resistant corn less of an economic uncertainty. Studies already support the significant advantages of these hybrids, so if these seeds become available inexpensively, there would be very few obstacles to implementing this plan and reaping the benefits.

Monsanto and WEMA chose to focus on drought-resistant crops, because extreme weather is bound to appear more often as global warming continues and climate change becomes more erratic. Increased population growth will further aggravate the problem, driving the consumption of energy higher and continuing the global shift to more extreme temperatures. Drought-resistant corn therefore remains an ideal choice for Ethiopia, because whether the problem is bad water management or climate change, the benefits of this hybrid crop will still apply ("WEMA").

In order for the implementation of a large-scale plan such as one in which many stock seeds would be replaced by the aforementioned hybrid ones, it is imperative that local programs become involved in the process. Project Ethiopia is a program focused on nineteen villages in Ethiopia. It cites sustainable farming as one of its main goals. The program is relatively small scale right now; it could be expanded to include more geographic area, something Project Ethiopia is already doing. As it expands, this organization would have more access to more parts of Ethiopia, allowing them to distribute the hybrid drought-resistant seeds to large numbers of farmers. It could also gain access to programs like WEMA and possibly coordinate with such organizations ("Our Mission").

Project Ethiopia also seeks to improve other key infrastructure elements, like sanitation, irrigation, education, and housing. Once the foundation for sustainable farming is laid with the hybrid seeds, Project Ethiopia would then be an excellent program to begin to strengthen each community's infrastructure. With an increased crop yield, these villages will be in a good place to begin a positive feedback loop that begins with crop surplus. The money that comes from increased yields could be directed towards better living conditions. Better infrastructure, with which important components like sanitation and decent housing often come, would then decrease the chances of poverty, creating a positive cycle.

A revolution in the type of seeds sown by farmers would also require support on a greater scale. Larger communities and higher governmental powers can get involved by helping with the distribution of the hybrid corn seeds. Although this distribution may initially be handled by foreign powers, as Ethiopia becomes more stable, the government would become more independent and capable. The government also could help to upscale programs like Project Ethiopia to allow for national change that happens locally. Additionally, in order to gain the necessary quantities of seeds, the government is well positioned to negotiate with foreign powers. Finally, the Ethiopian government could potentially collaborate with WEMA to benefit from the royalty-free hybrid seeds Monsanto distributes. Ethiopia is in the same region as the other five countries WEMA has already taken on. The government could negotiate with WEMA to have Ethiopia join the program, as the nation could benefit greatly from the hybrid corn seeds the project provides.

A significant concern is posed, however, when considering the Ethiopian government's attitude. Humanitarian organizations face a problem because Ethiopia's government, which wants to avoid negative attention, has pushed international aid to the side. Unfortunately, the situation is serious and the effects of drought on the nation are consistently severe. Laws in Ethiopia that are meant to focus foreign, non-governmental aid on development seem as though they will only discourage aid efforts. In order to help the population as much as possible, it could very well be necessary for the Ethiopian government to embrace foreign aid during these harsh times of drought (Addis). Actual policy change that encourages

aid from non-governmental organizations (NGOs) could be beneficial, and the people of Ethiopia themselves could help promote these tangible policy changes.

As the government opens Ethiopia to outside help, it could also work to channel the money from that foreign aid into the hybrid corn plan. When drought swept through Ethiopia in 2008, there was a global outpouring of generosity. The United States gave Ethiopia over \$800 million, more than half of which went directly to food. By comparison, only \$7 million was given for agricultural development. And yet, despite hundreds of millions of dollars in aid, Ethiopia is still starving (Perry).

Emergency food aid is not a panacea, and treating it as such results in serious consequences. A negative dependency, in which the people of an area alter their way of life to accommodate the outside assistance, often arises, creating disincentives to work in order to create the sustainability needed. Moreover, this dependence can create a false sense of insurance, to the point that people expect assistance in response to environmental shocks. Economic impacts can also be seen in the markets. Bringing in foreign food aid often drives down prices as food supply increases more quickly than demand. This puts pressure on farmers, who are then forced to liquidate assets to meet their immediate consumption needs. Foreign food also starts to displace domestic commodities, creating markets that are even more inaccessible to Ethiopian farmers. With so many economic and psychological problems attached to foreign food aid, it is clear that novel approaches are needed to truly aid Ethiopians in the long run (Barrett).

Instead, investment is the wisest way to supply aid. In addition to supplying the necessary emergency food, aid could also be directed towards increasing sustainable development, especially by introducing newer, more efficient crop forms, as mentioned earlier. The government could help implement this plan, as it has the ability to influence the distribution of aid on a national level. Such an investment would pay off in the next few years as Ethiopia becomes less vulnerable to environmental shocks and more stable than ever. That kind of payoff is exactly what the countries helping Ethiopia are looking for. With economies across the world becoming unstable, the drive to donate to others diminishes. Foreign aid becomes a bigger issue. Directing any current aid flow, whether from the government or from NGOs, towards sustainable agricultural development could prevent the problem from recurring (Perry).

Most important is the participation of the people this plan will affect most. The rural farmers will be involved as they learn about hybrid crops and are exposed to these new technologies. Then, they will receive the seeds from local organizations and sow them. Fortunately, the introduction of hybrid seeds requires little extra work. Farmers who have used the hybrid crops previously mentioned, Optimum AquaMax Corn, said that no extra tools were needed and that the crops required “no babysitting” (“Optimum® AQUAmax® Hybrids”). By participating actively, they reap the benefits in the form of higher crop yields and less vulnerability to environmental shocks. The lack of food is an issue that generally precedes most other problems, however, with increased crop yields from drought-resistant hybrid corn, attention can be turned to other matters. Surplus money from higher crop yields can be channeled towards building schools. Even small amounts of money can make a large difference, as in Ethiopian schools, \$1,000 covers the annual salary of a teacher. Costs are smaller than they are in western countries, so the potential for education when food is less of a problem is immense (“EREP Schools”).

Even so, education is only one part of infrastructure. As one of the least developed healthcare systems in Sub-Saharan Africa, Ethiopia’s health system remains woefully inadequate (“The Health System”). Lack of physical access to even basic facilities presents the cause of the problem. Much like the situation with education, Ethiopia’s healthcare problem has a much greater potential to be solved when the rural population is not continuously in a food security crisis. Increased access to modern products like contraception and vaccines can help solve significant problems in Ethiopia, such as unplanned pregnancies or common diseases.

The root of Ethiopia's problems is its continual poverty that comes with its recurrent droughts. With drought-resistant crops allowing yields to remain high even while the climate becomes more volatile, that continual poverty should finally come to a stop. Thus, those funds can be turned to schools, better roads for easier transportation, access to basic health care facilities.

In creating his hierarchy of needs, Abraham Maslow, a psychologist, made food the key element that all people must obtain before they can even begin to think about fulfilling other goals. Only once Ethiopia's food situation becomes less severe will progress towards sustainable development be possible. The use of drought-resistant hybrid corn is a modern, versatile solution that presents benefits tailored to apply to many situations. A blend of science and agriculture, hybrid crops are fast becoming one of the main ways to meet the growing demands for food. This is recognized by many, hence the presence of programs like WEMA. In order to break the cycle of regression that occurs as each drought presents itself, resistance to climate volatility is necessary so that Ethiopia can focus on improving other areas like education and health care instead of being forced to continually return to the food issue. The more the hybrid seeds are implemented, the more benefits will result. Higher crop yields will lead to lower food prices, which will create more accessible markets and widespread food security. Funding can be redirected towards other projects and Ethiopia's infrastructure can finally be strengthened as the basic tenet of food falls solidly into place.

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