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Ethiopia, Factor 1

Ethiopia: Increasing crop yields and improving disease and drought resistance in Ethiopia through research and breeding of improved plant varieties

Ethiopia, located in Eastern Africa just west of Somalia, is a landlocked country. The country is relatively mountainous, with the highest mountain being the Ras Dejen, in the Amhara Region at 4,620 meters. Ethiopia is twice the size of Texas at 435,186 square miles. The country's many climates can be a large factor in the crop yields. In addition, the country used to be about 30% forest but after deforestation for fuel, and clearing land for agricultural use, the county is now about 4% forests.

Ethiopia is a federal republic that comprises nine ethnically based states and two self-governing administrations. It is the oldest independent country in Africa and one of the oldest in the world.

The average Ethiopian family consists of a father, mother, children, and extended family members. The mother will typically stay at home and take care of the children, while the father will work in the fields. The traditional rural home will be made from wattle, a structure made from sticks and woven lattice, and daub, a mixture of mud, clay, sand, or animal dung. The roof will often be made from leaves and branches and will be supported by sticks. Most families follow the teachings of the Ethiopian Orthodox Church. The staple of all meals is called injera, a spongy type of bread made from teff grain. The injera is typically dipped in a stew made from vegetables such as cabbage, spinach, potatoes, carrots, or lentils.

The economy is based mainly on agriculture, and 85% of the people living in Ethiopia are subsistence farmers. More than 50% of the farmers cultivate less than 1 hectare, (abbreviated: ha.1 ha=10,000 m^2) for their own consumption. The average family's income depends on many factors such as, deforestation, soil degradation, and food demands; but "an estimated 8 million of Ethiopia's 60 million people are at immediate risk due to drought[2]," which becomes the most important circumstance affecting their lives. One drought in Ethiopia caused a huge famine that lasted from 1983-1985 and killed approximately 1 million people. These deaths were caused because of the extreme heat and lack of water which destroyed the crops and lead to entire families dying because their small farm could not produce enough to feed the family. Food was often airdropped in by other countries, but it was still not enough to save these people[3].

Ethiopia is subject to drought because of irregular patterns in weather and lack of storage for the water that does fall. The rain is sporadic and is unpredictable, making it unreliable for the local people. The other reason for drought is that the water is often not stored and conserved properly to last through the dry times. Ethiopia should consider taking a two-pronged approach to reduce the impact of drought on crop yields. Two areas of study to be investigated should be water management and the introduction of genetically modified (GM) crops.

Water management is considered an essential solution to fight the impact of drought. Because of the irregular rainfall, water needs to be saved when it can. New techniques to save water are being taught across Ethiopia. This training entails showing the people how to build dams, basins, trenches, gullies, and terraces to conserve as much water as possible. Today about 80% of the Tigray region is covered by these conservation areas, which is making dry areas capable of supporting crops. Water conservation is playing a big role in protection of crops from drought.

Along with water conservation, GM crops should be introduced that fight disease, insects and drought.

In Ethiopia, nearly all of the cultivable lands are worked by subsistence farmers. The subsistence farmers have small plots of land (most less than 1 ha) that are close to each other. This gives plant diseases, such as Rust, the capability to spread easily. The farmers are too poor to purchase pesticides. The introduction of GM crops would allow the farmers to improve crop yield by supplying them with an effective way to combat both disease and drought.

With a combination of droughts, plant diseases, and other factors, it can be very difficult for crops to survive in the harsh droughts and environment of Ethiopia. Millions of lives could be saved if crops were engineered to survive the harsh droughts that threaten Ethiopian crops and lives. Recently, a drought resistant gene has successfully been spliced into rice by scientists in Asia and India. The gene allowed the plant to produce a sugar that would protect the plant during dehydration periods. This gene, or genes similar to it, could be put into common crops all across Ethiopia such as, millet, maize, sorghum, wheat, barley, and tef. The plants' nutrition is not affected, and the plants' DNA stays almost exactly the same.

The Ethiopian Agricultural Research System dates back to 1953. With funding from the United Nations and the Food and Agricultural Organization, a long-term commitment was made to the study of crops in Ethiopia; plant-breeding research was a major component of their studies. Thousands of experiments have been conducted towards disease resistance and commercial development. The Ethiopian agricultural research organization, which is responsible for the national agricultural policy, has neglected to prioritize these studies in the field of drought resistance.

The first genetically modified crop approved for marketing occurred in 1996. GM crops have been in use since then and have been a safe and successful way to produce higher yields.
Both Monsanto and DuPont have developed drought resistant strains of maize using two techniques. Both traditional selective breeding and modern genetics analysis have been used to improve crop yield in various drought scenarios. Ideally, both methods should be tested in a variety of microclimates within Ethiopia, but these tests have only been performed in America so far. While important progress has been made in developing drought tolerant maize through conventional plant breeding, the likely effect of climate change predicts drastic declines in yield, requiring major adjustments in maize-based systems.[4] One solution to this situation would entail a modern genetics approach for crop engineering. Genetic analysis would allow rapid modification of genes to make drought tolerant crops.

Other plants that have been engineered to be drought resistant have also been invented. Heat, drought, and disease resistant beans have been invented[5]. Recently, a drought resistant soybean has been invented as well[5]. Some non-GM plants have also been invented that can resist drought such as a new type of rice. Pearl millet, sorghum, chickpea, pigeon pea and groundnut plants have also been made to be more drought and disease resistant[5]. Most of these plants would grow well in Ethiopia. These plants are starting to become more and more widely used across Africa, and they have already been in wide use in Zimbabwe, Malawi, Ghana, Uganda, and Kenya. These crops have also used extensively in other parts of the world and are commonly used in drought and plant disease prone areas.

With the use of GM crops, yields can be higher and agriculture in Ethiopia can be more sustainable. Unfortunately, GM crop usage in Ethiopia is restricted by three major factors. One factor is the lack of government financial incentives. The government mostly subsidizes

large, state controlled farms. The subsistence farmers have to use their own money to buy GM seeds. There are also patent issues. Farmers will need to buy new seeds for every growing season. This can be done by the large wealthy farmers but will present a prohibitive burden for the poor, subsistence farmer. A policy should be implemented to not only subsidize the large, state owned farms, but more importantly, the small, subsistence farmers as well.

Another factor restricting the use of GM seeds is a fear of using the crops produced by these seeds. On May 24, 2000, Ethiopia signed the Cartagena protocol on Biosafety. The Protocol reflects a fundamental concept known as the Precautionary Approach which means that a government may decide not to permit a particular GM crop to be imported across its borders. This is the case even if there is insufficient scientific evidence about the GM crop's potential adverse effects. Concerns could include the risk that imports of genetically engineered crops may replace traditional crops, undermine local cultures and traditions or reduce the value of biodiversity to indigenous communities[8].

Ethiopia also banned the import of GM food, saying GM plants would halt the usage of local techniques to stop crop disease. GM crops have already been introduced into many countries such as the United States, South Africa, and India. In the US, 47.6 million ha with GM crops (soybean, maize, cotton, and canola) have been cultivated. Similarly, South Africa has cultivated 0.5 million ha with GM crops (maize, soybean, and cotton). In India, 0.5 million ha of GM cotton have been cultivated. GM has been successfully used throughout these countries and many more. The usage of GM crops has increased food production and subsequently lowered consumer costs. There are legitimate concerns about the impact of GM crops on biodiversity, though. This will require study as GM seeds are incorporated into the environment.

On July 6, 2004, a seminar was held on reducing hunger at the UN Conference Centre in the Ethiopian capital, Addis Ababa. The Ethiopian Prime Minister Meles Zenawi said that Africa should not reject genetically modified crops as a means of tackling its massive hunger. Prime Minister Zenawi said that traditional and biotechnology methods can be used in tandem[7]. Kofi Annan (Secretary General of the UN) echoed these sentiments. Both had spoken out at the summit, which aimed to establish sound policies towards halving the chronic hunger facing 200 million Africans each year by the target date of 2015. The use of GM seeds may be controversial, but it should not be eliminated as a potential benefit to increase food security.

The third factor affecting the usage of GM crops is unfamiliarity with the benefits and the techniques used in the cultivation of GM seeds. There are several organizations that can help educate subsistence farmers to the benefits of using GM seeds.

Farm Africa is an organization based in Ethiopia that helps support small farmers to get out of poverty through agriculture. They provide expertise to enable smallholders in eastern Africa to increase their harvests, whether they farm crops, livestock, fish or the forest.
This helps make their products into something that can yield a better profit. Farm Africa has many programs throughout Africa and could assist by having classes to educate farmers about the benefits of GM crops and help distribute the seeds into the hands of the people.

These GM plants could be the solution to the drought and disease problems that are happening all over Ethiopia. These problems are starting to become more and more common because of climate change and the unpredictability of the weather. There should be a program that can get these plants into places like Ethiopia.

The best way to increase crop productivity in Ethiopia would be to involve any group, whether governmental or not, to help the cause. The most effective means of aid would most likely be by a government agency, partnering with universities and private institutions. The traditions of the people of Ethiopia, their diets and customs needed to be taken into account for a successful introduction of GM seeds

If these GM plants were to grow in Ethiopia and other countries in need, droughts would not be as big a problem because the plants would not die, and potentially millions of lives could be saved. If GM drought resistant plants had been brought to Ethiopia for the 1983-1985 droughts and famine, 1 million people could have been saved[1]. If a drought like that ever happens again, Ethiopia will be prepared and there will be many more survivors of the next drought and famine.

Developing a system to provide food and water security throughout Ethiopia is a solution to the problems that come with drought. Water Management techniques, education, usage of GM crops, and subsidizing small farmers could be solutions to mitigate the devastating effects of drought in Ethiopia. Water Management techniques could be used to save water for when it is desperately needed during dry periods. Education can stop the fear of using GM seeds and help farmers understand the benefits of using GM crops. GM crops can be a solution to the death of many plants during drought periods. Subsidizing small farmers as well as state-owned larger farms can help the local people afford GM seeds. With these techniques in place, Ethiopia and its people can be better prepared for drought conditions, and many lives can be saved.

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