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The Advantages of Biotechnology in East Africa

Approximately 14% percent of the entire world's population is undernourished. This means they do not receive enough vitamins and basic nutrition each day in order to sustain a healthy life, as defined by the United Nations. In Africa, forty percent of the people are unable to obtain enough food each day to sustain life. (IFAD) There are several reasons for this disparity. This paper will discuss several of the challenges affecting the impoverished farmers living in East Africa as well as consider several solutions to help those farmers create self-sufficient communities.

While the "Green Revolution" exponentially advanced agricultural output in America, China, Mexico, and several other modern countries, East Africa was left out. East Africa continues to suffer from extreme poverty in rural areas where people depend solely on farming to get their needs for life. Similar to India and South Asia, East Africa is one of the poorest areas of the world. However, the promise of new agricultural sciences gives hope to the poor farmers of Africa. Norman Bourlaugh, Nobel Prize laureate and prime instigator of the Green Revolution, believes that with simple introduction of what are now considered common practices in other parts of the world, East Africa can completely turn itself around agriculturally and modernize its economy.

Farmers in East Africa live very different lives than farmers in modern countries. In Ethiopia, farms headed by a male average about 6.11 persons living on about one acre while farms headed by females average about 3.9 persons living on a 0.64 hectare farm. Responsibilities belonging only to men include land preparation and seed selection, while only women clean, dry, store, and fumigate the seeds. Both genders weed the fields, harvest the crops, and tend the livestock. On sustenance farms, sorghum and maize are the primary foods. The average hectares devoted to sorghum on farms are 0.73 ha and 0.55 ha for male and female run farms, respectively. Sustenance farms are farms that are only able to produce enough food for their own needs, and on which any surplus grown is put forward for new farming equipment. There is little to no fertilizer, no irrigation, and no available storage for food. Every year, instances of drought, pestilence, severe weather, or environmental degradation will cause millions of families to go hungry. Half of the people in Eastern Africa earn an average of 65 cents per day. Children are vital to the workforce, and therefore only a lucky handful may go to school.

Large families are very hard to maintain for poor farmers in Eastern Africa. In Ethiopia, a typical farm family has about six children. Unfortunately, due to malnutrition, the child mortality rate is extremely high. In nearby Kenya, family size has dropped dramatically due to natural family planning and because parents realize they will not likely have enough food to feed children adequately. By raising smaller families, farmers can slowly try to raise themselves out of the vicious cycle of poverty inflicting much of Eastern Africa.

Africa is the most impoverished continent in the world, especially the eastern portion. 10 of the 21 countries in this area have a per capita income of less than 400$ (Rural Poverty Portal). In Kenya, the impoverished (about 31.3 million, or about half of the country's population) live densely packed in a small zone compromising 18% of the country's land that has a medium-high potential for agriculture.

The extremely poor (about 7.5 million) live spread out throughout the rest of the country, generally on arid zones in the north of the country. The main reasons for poverty in Kenya include low agricultural productivity, unemployment and slow economy, poor government, inadequate transportation, high education/health costs, and the influence of HIV/AIDS. Ethiopia has faced similar problems, more specifically drought, environmental degradation, and limited access to support services due to communication and transportation issues.

Because of the tremendous amount of issues affecting the populace of Eastern Africa, methods of increasing agricultural output are needed in order to assist them. New techniques will help farmers grow more crops and thereby live healthier lives. Innovative technologies recently available in modern countries can be delivered to poorer areas of the world, where they can be used to improve life for thousands of families suffering from malnutrition. Increasing yields will also allow for families with larger net incomes, which will let children take time off working at the farm to go to school, where they will become educated and possibly pull themselves out of the cycle of poverty.

One of the most important steps for East Africa's agriculture-based economy will be the embracing of biotechnology. Biotechnology, a proven technique to improve crop yields by crossing genes from different plant species into a single organism for increased benefits, will be discussed later in this paper. However, before the investment into biotechnology can be made, farmers in Eastern Africa need to achieve basic agricultural technology so that they can provide simple needs for themselves. Education of the farmers in Kenya, Ethiopia, and surrounding countries is probably the most important step towards the future of biotechnology. Farmers need to learn to practice agroforestry, correctly use fertilizer, produce storage, and add agricultural technology/equipment to these practices

Agroforestry has a large potential for increasing crop yields in Africa. Due to the large presence of savannahs, trees and crop lands are usually intermingled. By carefully integrating crops with trees, the crops can benefit from shade and wind resistance. Shade is important because it prevents evaporation of water from the soil, which keeps plants hydrated and stops the soil from desiccating and losing its nutrients. Since wind erosion has ruined countless arable lands throughout the world, this type of farming allows trees to act as wind breaks, preventing precious topsoil from being carried off in strong winds. A Swedish company, the Vi Agroforestry Programme in Stockholm, has devoted resources to training East African farmers around Kenya and Ethiopia in the practice of agroforestry. Today they assist over 150,000 poor farming families, which is over one million total people. They have seen benefits from increased income, including education for children, instruction for adults on proper farming technique, and more agricultural opportunities such as fertilizer and better equipment.

Basic crop hybrid breeding is also another step needed to be taken. By crossbreeding regular corn with corn varieties resistant to drought, pests, or other problems, farmers can increase their yield without needing biotechnology. Traditional breeding works by planting one stalk of a certain variety of corn on each end, and stalks of another variety down the row, "sandwiched" by the two of the first variety. The center stalks' heads are cut, preventing them from fertilizing other plants, essentially making them female. The outer stalks remain able to pollinate, rendering them male. The male variety spreads its fertilizer to the female varieties, and a new corn plant is grown from the female variety, containing both traits from the mother and from the father. This technique can be useful for poor farmers trying to raise their total crop yield.

Fertilizer is one of the most important options a farmer can utilize. In Canada, 40% of the crop production increase can be associated with the correct use of fertilizer. Fertilizer comes in many different types. It has been used on crops since almost the beginning of agriculture itself. Long ago, manure from livestock was used on plants to increase levels of nitrogen, phosphorus, and potassium. These three minerals are essential to healthy plant growth. As time went on, chemicals filled with these three minerals were found to be even more effective on crops. Plants also require fertilizer or added nutrients at specific times throughout the growing cycle. Few farmers in poor rural areas have access to fertilizer. Even if fertilizer is available, in-depth knowledge of the soil is needed for farmers to use the correct amount of fertilizer to prevent crop damage and maximize potential.

Taken together, the use of basic agricultural techniques along with the promising future of biotechnology will greatly benefit poor farmers in Eastern Africa. It will not matter how resistant the corn is to bugs if the farmers do not know how to properly water, till, and fertilize their crops. By promoting causes which help farmers become more educated in the agricultural practice, an African "gene revolution" may soon become a reality. The "gene revolution" is a term used to speak about the increase in net crop output due to the usage of genetically modified crops. In addition, farmers cannot be expected to afford biotechnology on their current earnings. By learning the above practices, yields, and subsequently, incomes, will increase, allowing farmers greater freedom to buy transgenic crop seed.

Currently in East Africa, small subsistence farmers suffer greatly from the lack of "modern" food technologies. They lose crops each year to pests, erratic water supply, and poor soil. By using agricultural technology recently embraced by America, East Asia, Latin America, and Europe, the countries of East Africa could become food secure and develop into a truly modern country. By using biotechnology, the American Midwest has grown to be one of the most prevalent agricultural areas in the entire world. Drought resistance, pest immunity, increased yields, and more nutritious crops, have boosted the agricultural based economy of the central United States. Similarly, in China, where biotechnology was recently embraced, genetically modified crops of cotton, rice, tomatoes, corn, petunias, poplar trees, and sweet peppers have all been modified to reduce pest infestations and increase crop yields. This is especially important for China, because of its vast population and large potential for agriculture. China is far ahead of nearby countries in Asia, such as Vietnam, Cambodia, and Mongolia, because of their concentration on biotech crops. Following after their neighbor, countries like Japan and South Korea have invested large amounts of money into quickly growing biotech companies. Countries not investing into biotechnology will soon be even less food secure and have to import even more cereal foods to feed the poor. If they don't employ biotechnology, they're going to be left behind," said Dr. Cho Kyun Rha, a professor of biomaterial sciences at the Massachusetts Institute of Technology. (Greenbio)

There are about 145 million acres of biotech crops planted throughout the world. Most of which are in North and South America, where the biotech craze began. In 2007, the total number of countries using biotechnology was 23, 11 of which were industrial countries and 12 of which were developing countries. In the past 10 years, the amount of biotech crops in developing countries has gone up from 5 million bt (biotech) crops to 50 bt crops. Countries with bt crops have benefitted from increased yields, less pesticide usage, and better nutrition from food.

In India, where cotton is the crop base, bt crops have grown at an alarming rate. From 2006-2007, the number of bt crops grew 63%. Farmers realized that the superior cotton could put an end to

their poverty cycle and chose to embrace the technology. By using bt cotton, India has increased cotton yields by 50%, halved the use of pesticides, which used to be a severe problem, killing thousands of youth each year from harmful chemicals, increased farmer income by about 250$ per hectare. India's total cotton output has nearly doubled, and the country now globally exports the material, instead of importing. India's Minister of Finance said, "It is important to apply biotechnology in agriculture – what has been done with cotton must be done with food grains". Clearly, bt crops have the ability to turn a country's economy around favorably.

By investing in biotechnology, countries like Sudan, Kenya, Eritrea, and Ethiopia could dramatically change their agricultural based economies. Each year, basic crops such as maize and cassava are ruined on a large scale due to lack of water, pests, and diseases. In Kenya, a recent study by the Insect Resistant Maize for Africa group (IRMA) under the direction of the Kenya Agricultural Research Institute showed that about 40% of maize crops are lost to pests each year. Kenya's agricultural minister Chris Obure said, "Kenya has the capacity to produce sufficient food for her people, and even for export, however, new innovative methods are required to be put in place if this is to be attained". Recent infestations of stalk borers, the most prevalent destroyer of maize crops, have been known to destroy entire fields. This ruins the entire community's already bleak economic status and sends hundreds of individuals further into poverty.

Visions of a food secure Africa are not far off. Due to effort from companies like Monsanto, biotechnology is advancing the lives of millions throughout the world. Monsanto, a company based in St. Louis, Missouri, has been a primary instigator for bt crops, and, through research, has invented several different varieties of corn, cotton, and soybeans. In the case of Kenya, and much of western Africa, these varieties could be especially useful. Monsanto currently has two main strains of corn that are resistant to insects. They are the YieldGard: Corn Borer and the YieldGard: Rootworm. Both insects have been detrimental to agriculture in Kenya. YieldGard: Corn Borer has been tested to show a 7.4 bushel/acre increase in yield over traditional corn varieties. This variety targets traits known to make the stalk of the maize plant stronger. By increasing the stalk's strength, the corn becomes more resistant to the stalk borers and fewer plants are destroyed, resulting in an increase in yield. The Rootworm variety targets traits known to enhance the roots of the maize plant. With a larger root system, the plant becomes resistant to rootworm attacks and also intakes more nutrients, making a healthier plant. Another, very important, benefit from both types is the reduction of pesticide use. By growing corn already resistant to pests, farmers do not need to purchase and use pesticide. This has two central advantages. First, the money saved from not purchasing pesticides can be used for fertilizer or for enhancing their farm. Second, it decreases the world's total usage of pesticides and has an overall positive effect on the environment. (Monsanto)

Excessive pesticide use in the past has known to cause large ecological problems. DDT, a chemical used during the middle of the 20th century on many farms in the United States, came with many unforeseen problems. The chemical was found to cause cancer, and it also ruined ecosystems by infecting rivers, fish, birds, and mammals, each in turn. In the Rachel Carson's 1962 book, *Silent Spring*, the evils of DDT were realized and broadcast to the world (Wikipedia). A large campaign followed, avoiding a near ecological catastrophe. By reducing overall amounts of pesticide usage, Monsanto and other biotech companies hope to create a cleaner, healthier environment for humans and animals.

Another large problem facing East Africa is water supply. Currently, about 70% of the world's fresh water supply goes towards agriculture. If that amount of water could be reduced, fresh water could be provided to those in most need of it, mainly in Southern Asia and East Africa, where the Earth's poorest individuals reside. By using drought resistant crops that grow "rain or shine", farmers in Africa could receive consistently high yielding crops, even during dry years. Earlier this year, the African Agricultural Technology Foundation (AATF) announced that they were forming a partnership called Water Efficient Maize for Africa (WEMA) in order to research and develop drought-resistant strains of maize for farming in Africa. With warnings of climate change on the horizon, the resistance of crops to drought is even more important. Monsanto, with the help of the Bill & Melinda Gates Foundation plans to provide necessary research tools, germplasm, and the expertise needed to take on such a large task. WEMA estimates that research of drought-resistant crops within the next 10 years could increase yields by 20-35% and create about two million additional tons of food during dry years. They also estimate that the first few conventional varieties should only take 5-6 years, while a transgenic drought-resistant maize variety hybrid would be available in 10 years.

The Bill and Melinda Gates foundation, founded by Microsoft guru Bill Gates and his wife, strives to achieve equality in life between all humans. They work with a foundation they started, called the Alliance for a Green Revolution in Africa (AGRA) to promote scientific development in poor areas of Africa. These developments include fertilizer, equipment, and biotechnology. They also help provide better quality seeds, irrigation systems, soil containment strategies, crop management, and they even help poor farmers make better choices to better their lives. They work towards bringing biotechnology to poor farms, helping increase the nutritional value and yield totals of their crops. In the near future, the Gates are planning towards a 164.5 million dollar project to increase productivity through appropriate fertilizer use and soil management procedures.

Modernization of agricultural practices has helped farming giants such as India, China, and America. Through the work of companies like Monsanto, new sciences will soon be available to farmers everywhere. New crops with new benefits will soon become widespread. The world simply cannot feed its people without improving yields on the farms of poor areas such as Africa. Organizations like Vi Africa strive each day to improve the lives of poor landowners. By teaching valuable skills such as agroforestry, the group helps farmers live better, provide education for their children, and have enough food to eat throughout the year. Philanthropic groups like the Bill and Melinda Gates Foundation donate billions of dollars each year to projects around the globe. By providing money for research, the Foundation directly contributes to the lives of millions.

A combination of modern techniques and innovative technologies has the ability to save the lives of thousands of impoverished farmers in Eastern Africa. With the help of philanthropic organizations and research foundations, these new methods and tools will soon be available to farmers. Through these efforts, the world can be a better place and the sanctity of human life can be preserved.

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