

Amaleah Mirti
Eastside High School
Gainesville, FL
Ethiopia, Factor 2

Ethiopia: Developing Water Resources to Benefit Small-Scale Farmers

At twenty-six, Lielit Akiliu is an Ethiopian mother of four children, with another child on the way. However, her current pregnancy is not Lielit's fifth pregnancy, it is her seventh. Her first child died soon after childbirth. "There were complications." Or that's what people said, since no one knew for sure, no doctor was present. Disease and death are a daily occurrence in her life; many children in the surrounding area have died of malaria, for there is no protection from the omnipresent mosquitoes. Her third child, Demeke, was only two years old when he died; he had been so small when he was born. That was the year that the rains never came, and soon her child's body became emaciated from lack of food. Lielit lives with her children, aunt, grandmother, and husband. It is a hard life; her large family lives on a farm of average size in Ethiopia, about one hectare (2.5 acres), in a cylindrical wattle and daub house with a conical roof made of thatch (Mohr). While it is a small hut for such a large family, Lielit feels at home on the beaten earth floor, and surrounded by the smell of spices and the sweat of hard work. While Lielit is cooking, gathering water and wood, and farming, her husband is plowing the fields, procuring seeds, and trying to trade to keep enough food on the table (Mohr). Usually there is only some stored teff, which she makes into injera (a spongy unleavened bread), and some potatoes or lentils, which she is able to combine with a berberey paste to make a stew called wat (Mohr). When the crops fail in the fields, and they lie dying on the parched soils, Lielit is only able to make porridge from the small amounts of grain available. Infrequently, she is able to cook some lamb or beef with the wat. Lielit's work in the field increases when there have been especially good rains and nature has been kind to their crops. Most years in the field they grow sorghum, teff, potatoes and enset. These crops make up the core of Lielit's family's diet. Each year Lielit looks around her dwelling, at the fusion of scrub trees and rocky soils that line the horizon every way that she turns. She feels the sun beat down on her weary back, and she hopes that this will be the year that her children have enough food in their bellies, the rains sate the barren soil, and the wrinkles of worry disappear from her husband's face.

Lielit is a fictional woman, however her story is that of any rural mother and wife living in Ethiopia where eighty-two percent of the people live in rural areas and the population growth rate is three percent (Ethiopia, 13 July 2012). Her story highlights the problems and challenges that families and individuals face across the impoverished country. Eighty five percent of Ethiopian's ninty-three million people are employed in agriculture, which accounts for approximately forty-one percent of the nation's Gross Domestic Product (Ethiopia, 13 July 2012). In this country whose society and economy depends on agriculture annually, each year five to fifteen million people are in need of food aid (Famine Relief). Grains are the staple food of the diet; in 2002, eighty-one percent of dietary energy was gained from cereals and starchy roots, while only six percent was derived from animal-based substances (Belew, 21). The plentiful amount of grain in the diet does satisfy an appetite, but it does not provide a well-rounded diet. Ethiopians suffer from many nutrient deficiencies due in part to the small percentage of animal protein in their diet. Yet, protein deficiencies and anemia are only part of the problem. Iodine deficiency is prevalent in mountainous regions and there is a high degree of Vitamin A deficiency, which is caused by a diet lacking in animal products, and leafy greens and fruits rich in carotenoids (Belew, 33). In addition to diseases related to lack of adequate nutrition, many water born illnesses greatly impact children's health, and malaria affects around fifteen million individuals annually (Belew, 14). Ethiopia also has one of the highest number of people living with HIV/AIDS, about 1.1 million (Rural Poverty in Ethiopia). In 2005, seventy-seven percent of the rural population had to travel at least twenty kilometers (km) to a health facility (Belew, 18). Due to a lack of both government funding and awareness in the rural

community, in 2005 only twenty percent of children younger than two years of age had been fully immunized, with twenty-four percent receiving no vaccinations at all (Belew, 14).

Ethiopia, a country in the Horn of East Africa, is known for its unique history, with human habitation more ancient than almost any other place on Earth. Lucy, the oldest hominid ever found, was discovered in Ethiopia, and many crops cultivated have originated and been domesticated there, like coffee, castor beans, and sorghum (Country Profile: Ethiopia). Ethiopia also houses an old sect of Christianity, known as the Ethiopian Orthodox Church, which is one of the original branches of Christianity. The monarchs that ruled the country for hundreds of years are supposedly descended from King Solomon and the Queen of Sheba (Mohr). Ethiopia was one of the only African countries to remain free of colonial domination, having been able to repel successfully the Italians in the late nineteenth century (Ethiopia, 13 July 2012). Being so rich, diverse, and unique in its history, one would think that Ethiopia would be a beacon of innovation and advanced development to the rest of the continent. Unfortunately this is not the case, and the problems of disease, drought, inequality, refugees and underdevelopment faced by Ethiopians are the same as, if not worse than, the rest of the continent. This paradox is perplexing, if this area of the world was an Eden at the beginning of humankind, why isn't it now?

After the overthrow of the monarchical dynasty in 1974 that had ruled Ethiopia for hundreds of years, there was a scramble for power. Eventually a socialist regime was established called the Derg, which remained in power until 1991 (Country Profile: Ethiopia). At the beginning of their rule they made all land in Ethiopia publicly owned. Although the new and present government established a free market economy, it did not eliminate the old land policy set up by the Derg, which resembled a feudal system. The original purpose of the Derg land policy was to stop the exploitation of the rural population by the wealthy landowners (Gebreselassie). The system put in place was intended to be like the one set up in the early Soviet Union. However, instead of large collective farms, in Ethiopia there were-- and still remain--very small farms. This land tenure system presents obstacles to agricultural reform and food security because many Ethiopian farmers feel that without ownership of the land they should not risk monetary or labor investment in new techniques, since the land is not 'theirs' (Gebreselassie). For Ethiopia to emerge fully into the twenty-first century as a food-secure country, they must deal with this issue within the context of the country's prominent challenge of the development of their water resources.

Ethiopia has an extremely varied landscape, with changes in altitude all over the country. Some areas of the highlands receive as much as 2,000mm of rain, while the lowlands only receive 250mm annually (Annual Rainfall in Ethiopia). Due to higher rainfall, the population is concentrated in the highland plateaus where it was estimated that eighty percent of the population lived on approximately thirty-seven percent of the total available land (Belew, 9). The concentration of people living and farming in the highland region is a primary cause of environmental degradation and soil erosion, which is further exacerbated by the cyclic droughts.

Ethiopia can be divided into three main regions, each characterized by different weather patterns. In the western region there are two seasons, a wet season from June to September, and a dry season from November to February (Annual Rainfall in Ethiopia). The central and northeastern sections of the country have two rainy seasons, June to September and February to May, and known respectively as Kiremt and Belg, with the latter having less precipitation (Ethiopia 2008). The dry season, known as Bega, lasts from October to January (Annual Rainfall in Ethiopia). The South of Ethiopia is predominantly lowlands, with agriculture in the area being chiefly pastorally based (Annual Rainfall in Ethiopia). This area also receives the lowest amounts of rainfall, since the climate is generally warmer than the highlands. The area has four seasons, two dry periods, December-February and July-August, and two rain seasons March-June and September-November (Annual Rainfall in Ethiopia).

Ethiopia chronically has been subject to cyclic droughts that continue to cripple the country and most of its population, leaving an estimated forty-five percent of the population being food insecure (Belew, 18). In the summer of 2011, the Horn of Africa experienced its worst drought in sixty years affecting 11.5 million people in the region (Famine Relief). Ethiopia has experienced droughts several times in recent decades, one of the worst in 1984 when 7.8 million people were affected in Ethiopia alone (Return of Drought). Climate change appears to be affecting the arrival and magnitude of the rainy and dry seasons. When the rains become unpredictable, crops are at greater risk of failure, and a family is left to survive without the harvest that they need. Of all arable land being farmed in Ethiopia (ten million hectares) only about 290,000 hectares is irrigated, or roughly three percent of arable land (Ethiopia 2005). This leaves a majority of farmers dependent on rainfall and especially vulnerable to fluctuations in the weather. As a result, rural farmers struggle with food security in times when the weather becomes less predictable.

There are two crop seasons in Ethiopia, the meher and belg; the meher is the main production period, which accounts for ninety to ninety-five percent of the nation's total cereal output (Ethiopia 2008). The belg season is longer, usually with less rain, and both short and long cycle crops are planted during the Belg rains, which allow for a short cycle harvest of plants like teff in July, and long cycle harvest of crops like sorghum and corn during the meher season (Ethiopia 2008). If rains are late by even one month, it can lead to no harvest, in turn, without a harvest there is no food to show for a year's worth of planning, planting, and work. While most families do not suffer from chronic food insecurity, a nationwide crisis, like drought, can lead to larger amounts of people unable to feed their families (Rural Poverty in Ethiopia). Rural Ethiopian families become increasingly at risk for food insecurity during the months of July, August and September, since during this time most of the seeds have been sowed, and are growing; but the harvest has not yet begun and previous years' stores are depleted (Belew).

Developing countries may feel the stress of a changing climate more acutely, since they employ less advanced agricultural and conservation practices and are predominantly dependent on subsistence agriculture. Drought in Ethiopia affects the nation's food security in a myriad of ways. In some southern areas of Ethiopia spring and summer rains have decreased by fifteen to twenty percent since the 1970's, and this trend is projected to persist into the future (Funk). Coupled with a gradual warming of the climate, this will lead to drier soils, less productivity and a decline of arable land in Ethiopia. When there is not enough rain the soil becomes dry, and the crops that have just been planted will die or be less productive. A lack of productive soil is especially problematic in Ethiopia where the small farm plots are used heavily each year, exacerbating a family's food insecurity. Due to the size of the farms and environmental factors it becomes necessary to plant on every available space to maximize output. However this can lead to adverse effects; the soil may become depleted of nutrients, and long-term leads to gradual desertification of once profitable farmland. Too much rain after an extremely dry period can result in disastrous floods, particularly in the highlands where loose topsoil can shift and bury crops. Water has a dual nature, it is a sustainer, and also a destroyer, but life is impossible without it.

Drought also impacts women and girls because of the gender-based division of labor prevalent in Ethiopia. It is the job of women and adolescent girls to travel for hours on foot to access a potable water source and return with a container that may hold up to eleven liters of water (Alemu 5). More often than not, the source of water that many families depend on for their cooking and drinking is the same water that animals are drinking, and it is unfiltered and untreated. In 2002, only 11 percent of rural families had access to an improved water source (Belew, 15). The amount of time that it takes women to find water could be spent doing other household activities, if there were sources of water closer to villages. Problems caused by drought are more serious for women because they have less mobility and they have a harder time getting aid and credit (Makombe). Males also have a higher literacy rate, about half of men over fifteen can read and write, while only thirty-five percent of women can (Ethiopia, 13 July 2012). All levels of society are affected by the lack of access to water resources.

Increasing access to water through the development of more irrigated land is one solution to the challenges of cyclic drought and climate change. There are four different irrigation systems in place in Ethiopia. The most prominent is the traditional system that is composed of earthen diversion weirs that are easily washed away each year (Makombe, 36). There are also modern communal and modern private systems. While similar in structure, they are differentiated by ownership status: the former is funded by Non-Governmental Organizations (NGOs) with the support of local farmers while the latter is financed by wealthy individuals (Makombe, 37). The last type is the public irrigation systems that are run by the government, and represent roughly the same amount of arable land as the traditional systems (Makombe, 36).

Many irrigation projects are already underway in Ethiopia, financed by the Bill and Melinda Gates Foundation, along with Oxfam, and the United Nations among many other (NGOs) (Oxfam-America Inc.). While the situation has vastly improved in the last twenty years, a majority of Ethiopians still do not have access to irrigated farmland. Developing more irrigation programs and adopting farming practices to conserve and use water effectively and efficiently is one large step that Ethiopia must take to rise from the poverty that tethers it to the ground. Water is relatively abundant in the country, but most rural families lack the technology and infrastructure to harness the water around them. Groundwater is present in most regions but has not been highly developed in Ethiopia for irrigation purposes due to high cost associated with drilling and pumping (Ethiopia 2005). Ethiopia does have one type of water in particular abundance: surface water. In 1999 the government of Ethiopia stated that the country had a surface runoff of about 122 billion cubic meters of water, lending it the name 'the water tower of East Africa' (Makombe, 36). Ethiopia also has nine major river basins that could potentially irrigate about 3.6 million hectares of land (Ethiopia 2005).

To change the present state of the irrigation practices in Ethiopia, and subsequently agricultural practices, would necessitate changing a part of the culture. Therefore, a grassroots approach must be taken by which the local population is able to decide and work for themselves to achieve a betterment of their community, with the help of the government. A model of shared governance between small farmers and government can be seen in New Mexico, where the native population was introduced to the acequia governance system by the Spanish colonial government in the late 1600's (Francis). The Spanish gleaned this practice from the Moors, who had in turn learned it from areas in the Middle East (Sandoval). The purpose of the system was for a community to be able to share its water resources civilly in time of drought. Each irrigator, or farmer, had one vote to elect a mayordomo, who had the authority to settle water disputes and enforce water management rules set forth by the community (Francis). At certain times during the year, the mayordomo required every able-bodied male to help clean and maintain primary canals (Sandoval). From the primary canals, secondary canals led to individual fields. Participating farmers had assigned days in which they could irrigate their crops from the canals. A similar model could be used in Ethiopia. The slope of the land, especially in the highlands would ensure that the water would flow through the primary canal, and then pass across all of the branching secondary canals. Many aspects of Ethiopian society are focused on extended family, and a communally based life. Therefore, the acequia system would seem less foreign, and could appeal to even more traditional farmers. There already exists such a community welfare system in Ethiopia, known as '*debo*', where a farmer needing help harvesting his field receives it from members of the community (Mohr). The farmer must provide nourishment to those community members while they work for the day and the farmer also must provide labor to those people who helped him when they need it. Therefore, it is a symbiotic relationship where labor is given within a community with no real money exchanged. The basic structure of the *debo* resembles the core principle of the acequia system, in which a community of people share labor. Both the *debo* and the acequia involve labor that is undertaken for the mutual benefit of the community (Ethiopia: The Path to Self-Resiliency 23). In the *debo* it is the reciprocation of farm labor, and in the acequia system it is the shared and improved water systems. The *debo* system is a traditional community based institution, and while the acequia system would be foreign, the cruxes of both systems are the same.

In time, farmers should recognize that participation in the acequia system has eliminated some risk factors associated with rain dependent farming. The materials and supervision of the building of a canal network could be done by a joint group of the government and NGOs. The acequia canal structure is very basic, much like the traditional irrigation system in Ethiopia; however, the acequia system is constructed better, and systematically maintained because of the support of the community and organizations with the capital to build with resilient materials. With more money, concrete, or even better quality stone could be used. Lining of the bottom of the canals would also be essential, to prevent the loss of water into the ground below the canal. Since all members of the community would be involved the canal system, it is less likely to fall into disrepair, because then no one would be able to use it. The canal would collect water, and also store it, enabling farmers to protect their crops even in the midst of a drought. There would have to be trained individuals who taught the community how the system was operated, and would be able to supervise the first few years that the system was in place to insure that it was running smoothly. Therefore the members of the community could then easily adopt the system and utilize it in the future.

For the acequia governance system to be possible in Ethiopia, a level of awareness within the rural population must be attained so they understand the benefit of new techniques that need to be introduced. Virtually no rural families are able to finance any sort of innovation without the support of the national and regional governments, as well as international organizations. Since all land is publically owned, the government has a position of responsibility, and must be aware of changes to the land. While the Ethiopian government wants to see its country succeed, a developing country oftentimes lacks the needed capital to finance such endeavors. That is often the role of international organizations, non-governmental and otherwise--to provide seed funds and logistical support needed to carry out the operations to their fullest extent. A sense of cooperation must be present from all members; the government must make it easier for rural farmers to access education and insurance among other things. For any part of the process to be successful, the rural population must be willing to accept new ideas and work to implement them. However, no aspect of the process should introduce new systems or materials that the rural population will never use because they lack the knowledge, or that a farmer is unwilling to use since they feel the traditional methods are better. Another large part of trying new things is the risk associated with delving into an area that one has not experienced yet. Traditional farmers typically are unwilling to risk their crops, land and livelihood on a speculative program. Potential benefits must be identified that clearly outweigh the disadvantages of a new practice.

Ethiopia is a country with significant potential for greatness. The country is endowed with sufficient natural resources to succeed in propelling itself into a better future. Slowly, Ethiopia has progressed over time; it has an economy that is gaining stride each year. Yet many factors inhibit its ability to feed its population, the greatest of these is water. Water is a key part of the process that brings food to the mouths of the Ethiopian population. But water, specifically the development of water resources, is not the answer to the Ethiopian paradox. There is no one answer to the question. Yet one can hope that by solving one crucial piece of the puzzle that the answer will be one step closer.

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