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Ethiopia: Managing water and adapting farming practices to provide food security

Ethiopia is located in the Horn of Africa. The country has a high central plateau, with many mountains. Elevation is generally highest just before the descent of the Great Rift Valley, which splits the plateau diagonally. The climate is temperate on the plateau and hot in the lowlands. The weather is usually sunny and dry with short rains occurring February through April and the big rains occurring mid-June and ending in mid-September. Ethiopia's population is a mixture of highly diverse groups. There are more than seventy-seven different ethnic groups with their own distinct language. Amharic is the official language.

The Ethiopian economy is based on agriculture. The major agricultural export crop is coffee. Sugar has also become an important agricultural crop as well. Ethiopia's agriculture is plagued by periodic drought and soil degradation caused by inappropriate agricultural practices. The drought conditions are also caused by overgrazing, deforestation and underdeveloped water resources. Poor transport infrastructure, and high population densities make it difficult and expensive to get goods to market. Yet, this country depends on agriculture. Agriculture is also Ethiopia's most promising resource. The potential exist for self-sufficiency in grains and for export development in livestock, flowers, grains, oilseeds, sugar, vegetables, and fruit.

In Ethiopia, the lowlands are not optimal for water usage and agriculture, as the average annual rainfall is about 500mm, or a little under 20 inches. Water scarcity has the potential to aggravate conflict between rural and urban areas, as both seek to use water for drinking and other activities unique to each area. The higher population densities in urban areas will create a higher demand for drinking water. Usage of water also includes purposes such as fabricating, processing, washing, diluting, cooling, or transportation. It is also used for sanitation. Industries that use large amounts of water produce commodities such as food, paper, chemicals, refined petroleum, or primary metals.

Water is the origin of every form of life. Without water, how would the world survive? Water is used to grow food, and it is used to transport that food and other resources to other parts of the world. Ethiopia has some great water resources however they are not developed and used to their potential. Clean water for drinking, cooking and sanitation is a very big problem for Ethiopians.

As Ethiopia's population grows at a rapid rate (it is currently one of the fastest in the world), the available fresh water for drinking will also shrink. Because of the high population densities in areas such as Addis Ababa, the capital of Ethiopia, the demand for fresh water will be greater, but so will the health risks associated with the water.

Urban Problems "Between 1990 and 2025, the number of people living in urban areas worldwide is projected to double to more than 5 billion....Africa has the highest urban growth rate of all world regions: 5 percent per year." This trend has serious implications for the future security of developing countries such as Ethiopia. Burgeoning populations in urban centers will create problems related to food, water, disease, infrastructure, and waste. The formation of slums due to an inability of the government to keep up with rapid population growth will lead to many problems. The lack of infrastructure will make it difficult to provide basic services such as clean water to the population, and will exacerbate poverty and inequality in urban areas. Limits will be put on food and water distribution, waste management and

disease prevention will be much harder if the infrastructure is not there to cope with the high densities associated with overpopulation.

In rural Ethiopia, women and children walk up to six hours per day to collect water. Most people collect water from shallow, unprotected ponds which they share with animals. Other people collect water from shallow wells. Both of these sources are subject to contamination as rain water washes waste from surrounding areas into the source. The jugs women use to carry water back to the village can weigh up to 40 pounds. In the last 20 years, Ethiopia has experienced recurring droughts followed by food shortages and famines. During times of drought, water-related diseases are rampant. Surface water sources such as springs and ponds dry up. Remaining water sources are heavily contaminated by human and animal waste. The stagnant water serves as a breeding place for mosquitoes. In times of drought, there is often not enough water available for people to bathe regularly. As a result, community members, especially children, suffer from scabies and eye infections. During these times, in an effort to conserve water, hand-washing after defecation or before eating is rarely practiced. Diarrheal and water-related diseases are among the principle causes of death in young children.

Ethiopia is extremely vulnerable to drought and other natural disasters such as floods, heavy rains and heat waves. These extreme weather events cause loss of lives, property and disrupt livelihoods. Ethiopia's people are heavily dependent on rain-fed agriculture, which is affected by the impacts of climate change. Ethiopia is particularly vulnerable to drought which has caused loss of life and property as well as mass migration of its citizens and the citizens of surrounding countries.

Ethiopian farmers identified shortage of land as the single biggest constraint to adapting to climate change, followed closely by lack of information and credit, labor, inputs, and water, as well as poor soils. In comparison South African farmers identified lack of access to credit as the major obstacle to adapting, followed by lack of water, information, and market access, and insecure property rights. Farmers, who did adapt, irrigated more, planted different crops or crop varieties, changed planting dates, planted trees, and practiced soil conservation. Farmers were more likely to adapt if they had access to credit, agricultural extension, information on climate change, owned private property or livestock, had more farming experience or education, and were economically better off. (New Research Shows Challenges African Farmers Face in Adapting to Climate Change | International Food Policy Research Institute. Article 1 Paragraph 2 and 4.)

During the imperial period, from 1941-1974. The development of the agricultural sector was retarded by a number of factors, including tenancy and land reform problems, the government's neglect of the agricultural sector (agriculture received less than 2 percent of budget allocations even though the vast majority of the population depended on agriculture), low productivity, and lack of technological development. Moreover, the emperor's inability to implement meaningful land reform perpetuated a system in which aristocrats and the church owned most of the farmland and in which most farmers were tenants who had to provide as much as 50% of their crops as rent.

To make matters worse, during the 1972-74 drought and famine the imperial government refused to assist rural Ethiopians and tried to cover up the crisis by refusing international aid. As a result, up to 200,000 Ethiopians perished. Although the issue of land reform was not addressed until the Ethiopian Revolution in 1974, the government had tried to introduce programs to improve the condition of farmers. In 1971 the Ministry of Agriculture introduced the Minimum Package Program (MPP) to bring about economic and social changes. The MPP included credit for the purchase of items such as fertilizers, improved seeds, and pesticides; innovative extension services; the establishment of cooperatives; and the provision of infrastructure, mainly water supply and all-weather roads. Imperial government policy permitting investors to import fertilizers, pesticides, tractors and combines, and (until 1973) fuel free of import duties encouraged the rapid expansion of large-scale commercial farming.

Inaccessibility, water shortages, and infestations of disease-causing insects, mainly mosquitoes, prevented the use of large parcels of potentially productive land. In Ethiopia's lowlands, for example, the presence of malaria kept farmers from settling in many areas.

There are two predominant soil types in the highlands. The first, found in areas with relatively good drainage, consists of red-to-reddish-brown loam that holds moisture and is well endowed with needed minerals, with the exception of phosphorus. The second type consists of brownish-to-gray and black soils with a high clay content. These soils are found in both the northern and the southern highlands in areas with poor drainage. They are sticky when wet, hard when dry, and difficult to work. But with proper drainage and conditioning, these soils have excellent agricultural potential. The plains and low foothills west of the highlands have sandy and gray-to-black clay soils. Where the topography permits, they are suitable for farming.

Soil erosion has been one of the country's major problems. Over the centuries, deforestation, overgrazing, and practices such as cultivation of slopes not suited to agriculture have eroded the soil. In addition, the rugged topography of the highlands, the brief but extremely heavy rainfalls that characterize many areas, and centuries-old farming practices that do not include conservation measures have accelerated soil erosion in much of Ethiopia's highland areas. In the dry lowlands, persistent winds also contribute to cause soil erosion.

During the imperial era, the government failed to implement widespread conservation measures, largely because the country's complex land tenure system stymied attempts to halt soil erosion and improve the land. After 1975 the revolutionary government used peasant associations to accelerate conservation work throughout rural areas. The 1977 famine also provided an impetus to promote conservation. The government mobilized farmers and organized "food for work" projects to build terraces and plant trees. During 1983-84 the Ministry of Agriculture used "food for work" projects to raise 65 million tree seedlings, plant 18,000 hectares of land, and terrace 9,500 hectares of land. Peasant associations used 361 nurseries to plant 11,000 hectares of land in community forest. Between 1976 and 1985, the government constructed 600,000 kilometers of agricultural embankments on cultivated land and 470,000 kilometers of hillside terraces, and it closed 80,000 hectares of steep slopes for regeneration. However, the removal of arable land for conservation projects has threatened the welfare of increasing numbers of rural poor. For this reason, some environmental experts maintain that large-scale conservation work in Ethiopia has been ineffective. ("Agriculture in Ethiopia." *Wikipedia* Article: L and use. Paragraph: 6.)

Ethiopia has small farm sizes as does most other countries in Africa. Africa has approximately 33 million small farms, representing 80 percent of all farms in the region. Data for Africa Farms are particularly scarce. Data on small farms are available for less than half of all African countries. Existing data suggests that small farms are most prolific in Ethiopia, which means that small farms are producing the majority of agricultural output for the country. Small dairy farmers in Ethiopia contribute 97 percent of total national milk production and three quarters of commercial milk production. Ninety percent of all agricultural production in Africa is derived from small farms.

Poverty and small farms are prevalent in Ethiopia despite the importance and volume of production that smallholders generate, they are gripped in poverty. In addition, small farmers are among the most disadvantaged and vulnerable groups in the developing world. Half of all undernourished people in the world, three-quarters of Africa's malnourished children, and the majority of people living in absolute poverty can be found on small farms. (Small farms: current status and key trends. Article: Poverty and Small Farms Page 10)

A typical subsistence farm family in Ethiopia has about 5.5 children in the family. Their lifestyle is different than the lifestyle we are used to here in the United States. In Ethiopia, the home of a farm family is usually a one to two room hut. There is no indoor plumbing and they have to go to the restroom outside. There is also no running water so if they want water, they have to walk to a nearby well or river which can be up to seven miles one way.

Due to the dry conditions the main diet is sorghum. Sorghum is a grain that grows similar to corn however needs less water. They also grow wheat and teff. They grind these grains into flour using two flat rocks, grinding the grain by hand between the rocks to create flour. From that flour, they make injera. Injera is sour dough bread that is cooked on a large griddle (about 18 inches in diameter). This becomes their staple food. They put a stew on the injera, they stew vegetables or stew meat, and add strong pepper spices.

The education system in Ethiopia is very slim compared to education here in the United States. I went to an Ethiopian school when traveling through Ethiopia a few years ago, I can tell you first hand that their schools are very different than our schools here. Their education is very sporadic and usually only goes to the age of 15. School supplies are very rare and they have to share a desk with sometimes two other kids. All education costs money and even then it is not available to every child.

The access to health care is very rare and almost nonexistent for most of the rural poor. Most children get their shots at the school they attend, if they attend school at all. Others who don't attend school and live on farms, usually do not get shots or health care if needed because it could either be too far away to reach, to far or hard to contact, or too expensive to pay for the care needed.

In 2002, the number of farms in Ethiopia with less than 2 hectares was 9,374,455 farms. A hectare is equal to 2.5 acres. The average farm size in Africa is 1.6 hectare, In Africa, for instance, the average size of landholdings shrank from 1.6 hectares in 1970, to 0.5 hectares in 1990. 62 percent of all farm households operated land holdings of less than 0.5 hectares. As population grows the land holdings of the farmers is shrinking. (Small Farms. Table 2: continued.)

If reservoirs and simple irrigation systems could be built, it could allow a greater variety in nutritional foods. It would also even out the availability of foods from the time of rain through the time of drought. Those who pick the sorghum, coffee or any product being sold and exported out of Ethiopia, earn a little money but not enough to live off of each year. In urban environments people could grow fresh food on small plots of land in a much more intense manner with irrigation. Ethiopia's climate allows for year round production of fruits and vegetables. People who are malnourished, cannot work as hard, therefore, the crops aren't as good as they can and should be.

One of my ideas for small scale irrigation development in Ethiopia is to have the farmers in a water drainage area form a cooperative. The cooperative would provide irrigation assistance in three different ways. The first way, would be for the farmer or group of farmers to submit an idea and a basic plan for irrigation development along a small stream or river. The cooperative would then work with a NGO to review the plan and provide technical assistance. The next role the cooperative would play would be to provide micro financing for the construction of the irrigation project. The third role the cooperative would play would be to act as a wholesale purchaser of construction supplies at a reduced price that could then be sold to the farmer members of the cooperative.

Diet diversification through small scale irrigation would be a great benefit for many rural poor. My father has told me stories of farmers who lack proper nutrition and a diversified diet in the dry season. He was able to travel to rural western Ethiopia and meet with farmers who encountered just such a problem. My dad and I discussed the situation these farmers (in Dembi Dolo) faced. The farmers (14 families in

all) had the use of a fairly large land base but all of their agricultural crops were rain dependent. During the rainy season, they could grow a wide diversity of crops. But the only crops they could store for sale and personal consumption were ones that could be dried and stored (corn, sorghum and peppers). This limited their diet for most of the year to corn, sorghum, and hot peppers. This group of farmers was able to develop a small spring at the base of their land in a valley. The spring had a catchment basin and a faucet to allow the families to fill water jugs and carry them back up the hill to their homes. But there was no method for them to irrigate even a small garden during the dry season. If a simple pumping device could be installed, they could lift the water several hundred feet up the hill and grow a wide diversity of fruits and vegetables for their families during the dry season. Potential solutions might include, a solar power pump, wind powered pump, and a human power pump. The initial purchase and design of the system would have to be donated through a NGO. In this particular situation a petro power pump would not be a viable solution because the nearest fuel is in the village thirteen miles away. Likewise, a larger scale irrigation project would not be that beneficial to these farmers because they would have no way to transport the extra produce that irrigation system provided. However, their lives and the health of their children could be greatly improved through a small irrigation system.

How will we get financial support for irrigation projects in Ethiopia? One way is to give personal experiences and relate the personal stories of rural farmers and their families. In other words, put a face on the irrigation project that you would like to get support for. To improve the diets of rural families through very small irrigation projects would not take large amounts of money. Funding campaigns for small groups of Ethiopian farmers could be taken up by a wide variety of charitable organizations here in the United States. For example, a small solar system pump and some pipe may cost several thousand dollars. This amount of money could be raised by many different groups such as scouts, 4-H clubs, FFA chapters, and church groups. The donors would have a feeling of personal investment in the lives of people they had touched. This approach would require an umbrella organization and perhaps volunteer workers to put the projects together and to put a face on the need of rural families of Ethiopia. Raising the money for these types of irrigation projects is amazing and greatly needed.

In the book *Enough* by Roger Thurow and Scott Kilman, it was described that the Rufenacht brothers from Archbold, Ohio helped raise money by raising calves on donated bales of hay, and then selling them to help raise the money to build dams on the Ikiwe River in Machakos, Kenya this project helped to save more than 5,000 families from drought and hunger. By the end of 2008, the project had raised \$130,000, which had helped the farmers of Machakos Kenya construct about 5 hundred small-scale dams and water-retention ponds.

However, some research has shown that instead of building new irrigation systems, why not fix the ones that they have built and become accustomed to. This way, they will still know how to use them properly and it will not be foreign to them. In places that new ones are needed or places where there are none at all, of course it would only be reasonable to install brand new irrigation systems.

An interesting study that I researched was done in Northern Ethiopia in 2011 to assess the likelihood that a household would live in poverty based upon whether they could irrigate crops or not. The study found that the access to irrigation increases the opportunity for crop intensity and diversification, which increase cropping income. This should be no surprise to any agriculture student however the study found that accesses to small-scale irrigation increases mean household income significantly (about ETB 3,353 per year which is a 17:1 ratio in US dollars, or a 27 % increase over non-irrigating households). The study also showed pictures and data of different irrigation types. The conclusion was that irrigation lessens the likelihood that farmers will live in poverty if they can irrigate. The study also shows that concrete river diversions and canals were the most successful method for water delivery to farmer's fields, and that the pumping system used to irrigate fields should be based on the individual land owner's preference and availability of repair parts.

The World Bank or other similar institutions should set up a division within their business structure that would specialize in microfinance loans (perhaps \$1,000 US dollars or less) this would give rural agriculturists and or cooperatives a means to finance small irrigation projects. Current agricultural land use policies in Ethiopia encourage very large scale foreign investment. There is a very real concern that this will create a class system by which poor rural farmers may become even more disadvantaged. Likewise most World Bank irrigation projects tend to be very large scale and may have the same results as Ethiopian land use policies.

Small scale irrigation is ideally suited to adapt the technologies of micro-drip irrigation systems. Dr. Daniel Hillel (2012 World Food Prize Laureate) has shown this through his research. His ideas would be well suited to improve the lives of small scale farmers and their families. These farming practices could be used when very small amounts of water are available.

Although varying from region to region, the role of livestock in the Ethiopian economy is very important. Almost the entire rural population is involved in some way with animal husbandry in Ethiopia. The role of livestock includes draft power, food, cash, transportation, fuel, and, especially in pastoral areas, social prestige. In the highlands, oxen provided draft power in crop production. In pastoral areas, livestock is the basis of the economy. Per capita meat consumption is high by developing countries' standards, an estimated thirteen kilograms annually. Ethiopia's estimated livestock population is often said to be the largest in Africa, which has led to over grazing.

Ethiopia has great potential for increased livestock production, both for local use and for export. However, it will have to rely on the use of grown and harvested crops as the available grazing lands are already over used. Livestock expansion is constrained by inadequate nutrition, disease and a lack of support services such as extension education and veterinary services, insufficient data with which to plan improved services. Inadequate information is available on how to improve animal breeding, marketing, and processing. The high concentration of animals in the highlands, together with the fact that cattle are often kept for status, reduces the economic potential of Ethiopian livestock.

In summary I believe that in order insure that farmers have successful crops irrigation is needed. People in the United States could also help fundraising to help pay for the construction of irrigation projects that the locals in Ethiopia can't afford. In an overwhelmingly agricultural country such as Ethiopia, agricultural growth is an essential ingredient for growth and for alleviating poverty. Agricultural growth will depend on the country's ability to promote growth through one or more of the factors that decisively influence productivity such as water management. Other changes that need to take place include research, extension, rural infrastructure, education, market liberalization, availability of rural finance. The Ethiopian government could help with improving land property rights or land distribution. The first burst of growth has to be broad based and affect a large number of the rural population. It also has to lead to an increase in the consumption of the now larger volume of agricultural commodities and the increase in income has to be spent in rural areas so it can generate non-farm employment. This will generate increases in income as well as increase the assets that rural people have. This is essentially the only way one can sustainably reduce poverty in rural Ethiopia.

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