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Restoring Soil Fertility in Kenya

Introduction to Kenya

Kenya is a lower middle-income country in East Africa. It is located on the equator, bordered by South Sudan, Uganda, Somalia, Ethiopia, and Tanzania, and is known for its beautiful and diverse climate. As of July 2017 Kenya's population was 47,615,739 ("Africa: Kenya"). The most densely populated areas of

Kenya are the capital, Nairobi, the city of Mombasa, the areas surrounding Lake Victoria, and the area near the coast of the Indian Ocean ("Africa: Kenya"). While the official languages spoken in Kenya are Swahili and English, many Kenyans speak a tribal language from one of the more than forty different ethnic groups ("Culture of Kenya").

Sometimes called the "Cradle of Mankind" ("Kenya Archaeological Sites"), Kenya was home to some of the earliest people on earth. As early as 2000 BC ethnic groups from around the world settled in Kenya ("History of Kenya from Pre-colonial Period to Today"). In 1885 East Africa was divided into several parts at the Berlin Conference and Kenya was declared a British colony ("130 years ago: carving up Africa in Berlin"). This did not sit well with native tribes. In 1942 the Kikuyu, Embu, Meru and Kamba tribes began working toward obtaining their freedom from colonial rule which led to civil war and the death of thousands of Kenyans. Finally, in 1960 they obtained their independence and Britain handed over power to the Kenyans. Kenya is now a democratic Republic, ruled by a president and by parliament ("History of Kenya from Pre-colonial Period to Today").

Kenya's climate is diverse. It ranges from the cool and wet mountainous regions near Mount Kenya and Mount Elgon, to the grasslands surrounding Nairobi, where temperatures are moderate and there is reliable rainfall, to the desert like climate of northeastern Kenya ("Climate of Kenya"). Kenya typically has wet seasons in April, May and November. The remaining months are usually pretty dry ("Climate – Kenya"). Kenya's varied climates, natural beauty, and biodiversity have attracted visitors from all over the world.

In 2008 the Kenyan government formed Kenya's Vision 2030 Development Plan designed with the hope that Kenya could emerge as a "middle-income country providing a high quality of life to all of its citizens by the year 2030" ("Vision 2030"). The 2030 Plan contains various social, economic and political goals. While the country has made progress "its key development challenges still include poverty, inequality, climate change and the vulnerability of the economy to internal and external shocks" ("The World Bank In Kenya"). If Kenya continues to address these issues it will be poised to become Africa's next success story.

Family, Food, Housing and Health

The typical Kenyan family consists of approximately four people, though extended family often lives with each other (Munene). Housing varies depending upon whether a person lives in an urban or a rural area. In rural locations, Kenyans often live in huts made from mud and saplings with thatched roofs. In urban areas, housing typically consists of apartments or houses made of cement or stone ("Kenya").

Kenyan diets often include corn, maize, potatoes and beans. In some areas, people eat rice and cassava, tomatoes, kale and cabbage. One of the most commonly eaten foods of Kenya is ugali, which is a porridge made from maize. It is eaten with meat stews and used as a "food scoop" or spoon ("Food in Kenya"). In order to eat, most Kenyans in rural areas are dependent upon growing their own food. Women are usually responsible for meal preparation and have traditionally cooked with a three stone fire.

Kenyans living in cities have access to a variety of employment opportunities. Kenyans in rural areas primarily work in agriculture; 75-80% of Kenyans work in agriculture and “most of these workers are subsistence farmers” (“Kenya”). In addition, “Many Kenyans work in what is called the “jua kali” sector, doing day labor in such fields as mechanics, small crafts, and construction. Others are employed in industry, services, and government, but the country has an extremely high unemployment rate, estimated at 50 percent” (“Kenya”). According to data from the World Bank in 2017 the GDP in Kenya per capita was \$1508 USD (“GDP Per Capita”).

Access to healthcare is a problem for many Kenyans. Despite the fact that health insurance is available, only 20% of Kenyans actually have access to it (“Improving Healthcare for Kenya’s Poor”) Additionally, there are only 0.2 physicians per 1,000 Kenyans (compared to 2.57 physicians per 1,000 US citizens), which makes finding a doctor quite challenging (“Physicians”).

Despite Kenya’s Many challenges, Kenya has made great strides in improving education in recent decades. 78% of the population is literate (“Africa: Kenya”). Children receive a free education through age 14, although many Kenyans are wary of putting their children in public schools, feeling that a public education is inferior to a private education (Clark). Many put their children in private schools, but it comes at a heavy price: “on average having one child in one low-cost private schools cost 12% of the income of the household’s main earner” (“Why poor parents in Nairobi choose private over free primary schools”).

Challenges Facing Kenyans

Poverty is a major challenge for Kenyans. While the country has made some advances in development, there is a discrepancy between the standard of living in various counties within Kenya. For instance, in richer counties such as Kajiado “only 12 in every 100 people are classified as poor” (Omari) but in “the poorest county, Turkana... 94 people in every 100 residents are considered poor” (Omari). While poverty has vastly decreased in some counties, it remains a significant problem in many rural counties which are more dependent upon agriculture.

Almost three quarters of Kenyans work in agriculture for their primary source of income. Unfortunately, the amount of arable land in Kenya is severely limited. Around 50% of Kenya’s land is cultivated (“Agricultural Land”), but only 10% of Kenya’s land is considered arable, or good for farming (“Arable Land”), which significantly decreases yields for Kenyan farmers. This is further illustrated by the fact that most African countries produce about 1 ton of maize per acre in comparison to the United States’ 12 tons of maize per acre (Gilbert). Low crop yields, often times caused by shortages of arable land in Kenya, is one of the reasons why nearly 26% of Kenyan children under five suffer from chronic malnutrition (“Kenya: Nutrition Profile”)

Because many Kenyans are hungry and impoverished, they often use more land for crops in an attempt to obtain higher yields (Gettleman). The overuse of land in Kenya has led to many problems such as deforestation, soil degradation, and water scarcity. “many African families can’t afford to let land sit fallow and replenish.... This steadily lowers the levels of organic matter in the soil, making it difficult to grow crops.” (Gettleman) Many Kenyans try to better their lives by farming on more land, but sadly, instead of reaping the benefits of a substantial harvest, they face the consequences of depleted soils, decreased water supply, and deforestation (Mwangi).

Many Kenyan farmers have also tried to raise crop yields by utilizing synthetic fertilizers, but the high cost of obtaining these fertilizers has severely limited their use (Duflo et. al.). Kenya does not produce much of its own fertilizer, and therefore rural farmers who need it most are forced to pay high prices for

imported fertilizers. (“The World’s Most Expensive Fertilizer Market: Sub-Saharan Africa.”). Considering what a hefty investment it is for farmers to purchase fertilizer, it is surprising how little many farmers know about what types of fertilizers are best suited for their soil and the crops that they are growing (“AgroCares Nutrient Scanner.”). “For many farmers all over the world, soil is a puzzling black box; to which they apply fertilizers without knowledge of what the soil actually needs” (“AgroCares Nutrient Scanner.”). Not knowing what nutrients the soil needs has led to rather inefficient use of fertilizer in Kenya, further contributing to low crop yields in the country. (Bindraban et. al.).

Suggested Solutions and Conclusion

Since almost three-quarters of the Kenyan population make their living from agriculture (“Kenya”), improved farming methods could substantially reduce food insecurity. Increasing crop yields could lift millions out of poverty, significantly decrease malnutrition, and slow deforestation. However, the problem of low crop yields is a complex one, and there is no single simple solution.

One of the biggest barriers to increased crop yields in Kenya is its depleted soil. How can crops grow properly without being in a quality soil? In order for Kenyan farmers to determine what they need to do to improve their soil’s health they need to know what the composition of their soil is. Testing nutrients in soil can be a challenge in rural areas where there are no formal laboratories to perform the tests. The lack of infrastructure for performing these tests has proven to be a significant barrier. “Worldwide, only about 5% of the farmers have access to reliable soil testing Information.” (Van Beek et. al.) In Kenya “Soil tests are considered expensive because soil laboratory services are concentrated around Nairobi” (“qtd. in Bindraban et. al”) Rural Kenyan farmers would be better able to acquire information about their soils if they used near infrared technology. This technology is portable, quick and inexpensive (“Implementing New Technology”). This portable soil testing device is able to analyze soil samples for nitrogen, phosphorous, potassium, cation exchange capability, clay, and organic matter, and can send back the results to a smartphone in less than 10 minutes (Van Beek, et. al.). The scanner also gives feedback as to what type of fertilizers would be best for each field based on which types of crops the farmers hope to grow (“AgroCares Nutrient Scanner.”) With this technology Kenyans could learn exactly what their fields need to provide the best growing environment for their crops. They would no longer have to guess what type of fertilizers to apply and in what amounts. “With these Scanners most farmers reported yield boosts of up to 300%” (“Dutch smart technologies boost the yield of Kenyan farmers”) This technology is somewhat expensive at 3,000 euros per scanner (AgroCares Scanner Device), but the cost could easily be recuperated within a year if the farmer could sell the soil tests for 5 to 8 euros per report (Van Beek, et. al.). This is a sizeable amount of money for impoverished Kenyan households, but it would cost them less than a bag of fertilizer (Ndanyi, Mathews). Many Kenyans are unaware of the benefits of soil testing, (Bindraban et. al) but this could be mitigated by distributing the soil testing services through organizations that farmers have already built trust with such as local agro-dealers, farming co-operatives, agriculture extension officers, and NGOs. Because farmers are already familiar with these organizations, they might be more willing to use these services. Farmers might be further tempted to use soil testing services if the price were reduced for their first soil sample.

With results from soil testing, farmers would be able to determine what type of fertilizers and enrichments would be best for their fields. The test results could include a variety of recommendations such as adding fertilizers, organic matter or other soil amendments (“Integrated Soil Fertility Management”). Access, affordability, and education about some of the proposed methods might prove to be challenges to instituting the recommendations of the soil test results.

One of the biggest challenges to using more fertilizer on farms in Kenya is the cost. As mentioned earlier, fertilizer is quite expensive in Kenya. Many Kenyan farmers don’t have enough money to pay for the high upfront cost of purchasing fertilizers (Hong, David, and Stephanie Hanson). In order to make fertilizers

accessible and affordable for Kenyan farmers, microfinance could be part the solution. Microfinance is the lending of a small amount of money to individuals who would not typically be able to take out a normal loan (Kagan). Microloans are relatively accessible, especially with the plethora of mobile banking providers. Mobile banking is a good option for many farmers considering that 60% of Kenyans are reported to have cell phones (“Over 60pc of Kenyans have smartphones, shows study.”) Microloans are frequently paid back, and several microfinance institutions have repayment rates of over 98%. (Moreno) For the sake of accountability, banking institutions might find it less risky to provide loans for farmers who are willing to take out loans together with other farmers. This would provide social accountability for the farmer and mitigate risks for bankers as not all “their eggs would be in one basket.”

One of the barriers to the recommendation of adding organic matter to Kenyan soils, could be in the area of educating Kenyan farmers. Though organic matter (such as crop residue and compost) is relatively easy to find and to add to soils, many Kenyans are not aware of the benefits of additional organic matter in soils. Others lack knowledge on how to gain access to and implement them (Pius). Organic matter plays a crucial role in a soil ecosystem: improving soil structure, buffering Ph, and providing food for microbes in the soil (Vaughnan). Agriculture training programs taught by a combination of NGOs (such as the One Acre Fund, or the Food and Agriculture Organization of the United Nations), might be one way to help educate farmers. Another source of education could be utilizing agriculture extension officers who are familiar with and have built trust with Kenyan farmers. These programs could include training on topics such as the importance of ensuring that there is organic matter in the soil, and how to make compost. The One Acre Fund has had great success with its compost training programs. (“Climate and Soils”)

Kenyan farms suffer from low crop yields and declining soil fertility. Boosting agricultural yields, would help lift millions of Kenyans out of poverty, provide food security for the entirety of Kenya, restore soil health, slow deforestation, and put Kenya well on its way to reaching the goals established in it’s Vision 2030 Development Plan of becoming a “middle-income country providing a high quality of life to all of its citizens” (“Vision 2030”).

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