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### **Eritrea: Crop Rotation, Irrigation, and Policy Reform**

Eritrean food security is a special case, in the sense of its origins. Having suffered under oppression at the hands of other countries, then being thrust onto the world stage when they gained independence, the citizens of this newly formed country have suffered more than necessary. Water and food are both scarce and expensive, leading to thousands of deaths. We all share the same genetic codes within our DNA, yet when an indigenous group of people faces hardship, those with the means to help them cultivate a bright future refuse, citing the fact that "It's not my problem." This blatant disregard for human lives only goes to show the lackadaisical approach to encouraging activism, which the more fortunate populaces of the world possess. While the current government of Eritrea, in its less than lackluster condition, has made attempts to reach out and help nearly impossible.

To grasp what a 'typical Eritrean subsistence farming family' actually is, one must first understand the world that they live in. As a result of decades of war and the effects of continual drought in the early 1980s, the country of Eritrea has been devastated. Many Eritreans left the country because the ongoing conflicts with neighboring countries, and were forced to flee to refugee camps in the neighboring countries of Sudan and Zaire (now the Democratic Republic of Congo), and all the way to Kenya. In addition, economic instability, national service, the threat of another outbreak of the border war with Ethiopia, and suspected insurgent activity along the Ethiopian and Sudanese borders mean that many Eritreans are continuing to flee their country ("BBC News - Eritrea Country Profile - Overview.").

Eritrea is located in the Horn of Africa, between Djibouti and Sudan. To the south, it is bordered by Ethiopia. The country's coastline stretches over 1,000 kilometers along the Red Sea. Asmara is the capital city. Eritrea is approximately 121,300 square kilometers in area. Eritrea is a hot, dry desert strip along the Red Sea coast. It can be divided into three main regions: the central highlands, the western lowlands and the eastern escarpment and coastal plains. The capital city of Asmara is located in the central highlands, which is a narrow strip of land running through the middle of the country about 1980 meters above sea level. The climate is cooler and wetter in the central highlands, semi-arid in the western hills and lowlands. Rainfall is heaviest during June to September, except in the coastal desert. The highlands receive the most rainfall, with an annual average of 40 to 60 centimeters; the region's fertile soil and favorable climate (averaging 18°C) make it the most populated and cultivated area in the country. Principal crops grown in Eritrea included sorghum, millet, barley, and wheat. Legumes, vegetables, fruits, sesame, and linseed are also grown.

Most Eritreans live in rural areas in an extended family of several generations that includes parents, uncles, aunts, cousins and grandparents. The average family has approximately six children. Family is very important to Eritreans, and generally, they extend this sense of welcome to strangers. Traditionally, families arrange marriages. There is a high regard for the elderly and their role is often to settle household conflicts. Women have more recently been accorded more respect following their role in the fight for liberation. Since independence, the government has pursued an active policy for women's equality and has allocated a quota of 30 per cent for women in the local and provincial assemblies; however, much of Eritrean society remains traditional and patriarchal, especially in rural areas.

Eritrea's health care system has deteriorated because of years of war and recurring droughts. Most medical facilities, including hospitals and birthing centers, are in the capital, Asmara, as well as in the other two main cities of Keren and Massawa. Hospitals are generally understaffed and underequipped. The government has launched a program to decentralize health care and health care facilities, yet the challenges of providing adequate staff and equipment continue. Private health care is available but very expensive. The practice of modern medicine is not widespread. Eritreans usually do not see a doctor until a health problem is serious. Most people respect a doctor's authority although their understanding of prevention and causes of diseases is somewhat limited. As modern health care is inadequate, many Eritreans turn to indigenous medicine, which are ideas that developed over generations within various societies before the era of modern medicine. Healers use herbs and other local ingredients to treat common illnesses. Healers do not take money for payment; instead preferring to exchange goods for their services. A lack of trust in the government has made paper money worthless in the eyes of a subsistence farmer. Most Eritreans would greatly prefer to receive food instead of money, something they rarely use.

## **Widespread Lack of Strategic Farming Methods, Irrigation, and Modern Infrastructure**

### **Factors contributing to the current problem**

#### **Instability**

Eritrea's food supply is very unstable. In good years, the country produces around 60 percent of its total food needs, and in poor years, it produces no more than 25 percent. On average, once every ten years, the country is threatened with famine. Annual crop production depends on rainfall that is variable and unevenly distributed from year to year. Eritrea has not managed to raise crop production to a level that can support the entire population, and is forced to cover nearly 50 percent of its annual cereal requirements through imports-commercial and food assistance. The majority of Eritreans farmers live close to a subsistence level, even during normal agricultural season; they complement their income by working as manual laborers and selling firewood to support themselves and their families ("CIA - The World Factbook.").

#### **Cost**

Crop rotation is needed, but many families cannot afford the initial cost of crop-rotation, as it results in a lower profit margin for the first few growing seasons. The situation is moderately severe, because the fact that many farmers do not want to face a lower profit margin, or have to grow a cheaper cash crop. Many farmers grow only at a subsistence level, because of the high difficulty in attempting to turn a profit year after year, and thus do not care about crop rotation. The environment, the dirt specifically, is degrading at an alarming rate because of the consumption of nutrients which are not given the opportunity to self-replenish. The southern part of Eritrea is devoid of nutrients in the ground, making any form of farming difficult, if not impossible. Only in the northern part, where rain can restore nutrients lost in the process of growing can restore the fertility to the ground, is farming profitable ("Food Security Strategy."). While subsistence farming is the number one occupation in Eritrea, fertilizing crops is a rare occurrence, because of the high purchasing cost, and lack of places to buy it in general.

#### **Climate**

Climate change projections reported by the Eritrean government are less than optimistic; temperatures could soar by more than 4 degrees Celsius by 2050, shrinking precious sources of water such as boreholes and run-off, which is excess water from rain or other sources flowing

over the land. All of these contributing factors have pointed to droughts that are expected to become longer and more intense. Rainfall is inadequate and underground resources are declining. The World Bank listed Eritrea, which imports 40 percent of its food requirements in a good harvest year, among the countries worst affected by the crisis. The International Monetary Fund said more than eight percent of gross domestic product (GDP) was spent on food and fuel in 2008, and the price of some staple grains rose fourfold in 2008 (IRIN Africa).

### **Lack of strategic farming methods**

A majority of farmers in Eritrea only practice a subsistence level of farming, neglecting proven techniques that would bolster their crop output. This is because of both a lack of knowledge, and obtaining the supplies and manpower needed to implement them. Root rots such as phytophthora have greatly increased in soybeans because of short or no crop rotations. Insects in soybeans, almost non-existent in 1975, are now a constant threat to the Eritrean's livelihood. Crop rotation requires the grower to be able to deal with lowered crop output in the first few years, something many farmers cannot afford to do, at the risk of disease, famine, and even death from starvation.

### **Poor Policy Management**

Poor choices in policy management have hindered the pursuit of individual and economic freedom, as well as aid from the outside world. A stubborn government has refused any aid besides that which is of utmost importance in keeping its country under control. Some policies have been proven to work, while others have only hurt the economy. Potential policy changes regarding the future of water pipelines, and water supplies in general, are highly unrealistic, as the price of implementing water transportation technology is immensely expensive. Multiple policies which outline the isolationist attitude of Eritrea have caused nearly all of the strain on the country, resulting in foreign countries that are willing and able to give aid becoming weary of the hurdles to do so. This policy is not viable in a third world country, still fighting to prove it deserves the independence it so valiantly fought for

### **Labor Intensity**

The labor that is involved in farming is physically challenging. Women are often not able to perform the tasks that are necessary to run a farm. As such, they usually marry into a farm-owning family, and perform domestic chores. The trends relating to this factor are slowly improving, as more and more farmers are focusing solely on agricultural pursuits.

### **Benefits of improving the current factors**

It is impossible to control the climate, so improving the lack of rainwater falls on the implementation of improved irrigation techniques. While the climate cannot be improved, other methods, such as what methods farmers use in their day to day lives, and what crops farmers plant can be improved.

### **Strategic Farming Methods**

Crop rotations increase crop yields by improving soil conditions and reducing weed and insect populations. Rotations also help producers use conservation tillage successfully. A well planned crop-rotation system can help producers avoid many of the problems associated with conservation tillage, such as increased soil compaction, perennial weeds, plant diseases, and slow early season growth. Crops can be produced with fewer inputs when grown in rotation. Corn following soybeans, for example, can be produced with about 40 pounds per acre less nitrogen fertilizer and without a soil insecticide, which often is needed to control corn rootworm larvae in continuous

corn. Therefore, corn planted after soybeans will cost producers about \$25 per acre less than continuous corn. With the already startlingly narrow profit margins in crop production, these yield increases and reduced production costs would have a great effect on overall profit, allowing a greater sense of personal freedom, something which Eritreans value (Rankin).

Crop rotations are also essential to controlling many of the crop-disease problems that occur in Eritrea. Diseases such as gray leaf spot in corn, take-all in wheat, and sclerotinia in soybeans can be partially controlled with crop rotation. Where these problems occur, crop rotations must be considered carefully in the profitability analysis. For some crops, such as alfalfa, continuous cropping is almost impossible because of autotoxicity, a phenomenon that occurs when toxic compounds produced by the previous alfalfa crop inhibit new alfalfa seedling germination. One of the only other major issues that Eritreans face is a scarcity of water. Water for daily use is pumped out of wells by diesel-powered generators, but Eritrea imports all of its fuel, making diesel an expensive option. A rapid assessment of water sources by the government's Water Resource Department found that 58 percent of households in rural areas have access to safe drinking water (IRIN Africa).

Proper crop irrigation techniques are vital to the growth of crops. Countries rely only on 10 crops, out of a selection running in the thousands, accounting for nearly 80 percent of calories. Many, if not all of the main crops that are grown by Eritrean subsistence farmers require large amounts of water to grow, as well as being a large source for degraders of water, as a result of fertilizer and pollution run-off.

Farmers are seeing slow gains in their output because of a large push in the usage of crop rotation and fertilization techniques. The trends for this factor are being measured by government-sponsored surveys. Eritrea is performing these surveys without any preconceived bias, to entice potential trade partners in Africa and Europe. The measurements which have been performed are showing very slow gains in technique distribution, far too slow to cause any worthwhile changes in quality of life.

### **A recommendation on how to implement water conservation, distribution, and crop growing strategies, utilizing the appropriate roles of communities, the national government, corporations, and other organizations**

Outcomes for Eritrea are limited by its mission of total independence and self-reliance. Both the national government and organizations such as UNESCO, World Bank, and UNICEF must all take part in a revitalization project of the country's infrastructure. Rural farm and urban families must be involved in this revitalization project. Rural farmers must implement crop irrigation, and crop rotation techniques, while urban families must do their part, supporting whatever efforts are undertaken to improve their homeland.

### **Water Conservation and Distribution**

Three main drainage systems exist within Eritrea:

- The Mereb-Gash and Tekeze-Setit River systems, draining into the Nile River;
- The eastern escarpment and the Barka-Anseba River systems, draining into the Red Sea;
- The river systems of a narrow strip of land along the south-eastern border with Ethiopia, draining into the closed Danakil Basin.

Although no measurement of runoff is available, the internally produced renewable water resources are estimated to be around 2.8 cubic kilometers per year. Most of these runoff areas are located in the western area of the country. There is only one perennial river, the Setit River, which also forms the border with Ethiopia. All other rivers are seasonal and contain water only after rainfall and are dry for the rest of the year. There are no natural fresh surface water bodies in the country. Artificially dammed water bodies are seldom found in the highland parts of the country. Groundwater is available for harvest in nearly all areas of the country, but the harsh quality and the dismal quantity eliminate any hopes of relying upon them for all water needs. According to the “Eritrean Aquifer Study” conducted by Aquastat, Four hydro-geological units, based on the different geological units, recharge conditions and hydraulic characteristics, can be detailed:

- Granular aquifers, which cover large areas in the western and eastern lowlands and along river valleys and flood plains. Unconsolidated aquifers consisting of the alluvial and colluvial sediments are also found in the Asmara area, Red Sea coastal plains and at the foot of fault scraps and mountains;
- Fissured and jointed volcanic aquifers, which are found in the central highland plateau southeast of Asmara and west of Assab, the Alid hot spring and in the southern part of the country;
- Fissured and karstic aquifers of consolidated sedimentary rocks, limestone, coral reefs, evaporated deposits and the marbles of metamorphic assemblages;
- Fissured aquifers of the basement rocks of crystalline metamorphic rocks and associated intrusive rocks, which are localized along weathered and fractured zones, with limited groundwater resources,

Typical boreholes depths range from 20 to 70 meters. Deep aquifers, which can be tapped for long term usage when faced with a severe drought, are not known to exist anywhere within the country. Problems of groundwater depletion have been reported in various parts of the country. There are very few natural springs, but an official inventory has not been made available. Currently there are around 187 dams with a water capacity of over 50,000 cubic meters each. About 42 percent are for municipal use and irrigation, 40 percent for municipalities only, 13 percent for irrigation, and 5 percent are not used. The total capacity reaches over 94 million cubic meters of water ("Eritrean Aqua Stats"). Through proper irrigation techniques, such as leveling of fields, surge flooding, and capture and reuse of runoff, droughts have less of an effect than previously seen. Another method, where water is gently sprayed from a hanging pipe uses water more efficiently. This method increases irrigation efficiency from about 60 percent (traditional spray irrigation) to over 90 percent. Plus, less electricity is needed. The combination of crop rotation, and proper irrigation and water resource management techniques can lead to higher gains in crop output, as both are proven methods of first-world farmers, around the globe. The fact that the Eritrean government has failed to utilize 5 percent of its water supply from dams is telling of the utter lack of proper policy management (“Irrigation techniques”).

Because of the potential changes in the future, which are outlined in the Government of the State of Eritrea Food Security Strategy, thousands of cubic meters of water will be saved through the watercourse improvement programs by minimizing water losses in the watercourses and applying more evenly through land leveling and improved water application techniques at the farm level. One policy which has seen extensive championing for implementation is the National Government’s Food Security Strategy. This policy, as previously mentioned, is designed to save thousands of cubic meters of water through the watercourse improvement programs, by minimizing water losses in the watercourses, and applying more evenly through land leveling and

improved water application techniques at the farm level ("Food Security Strategy."). The situation that many rural farm families face is slowly improving, but is not guaranteed to follow this pattern unless the Government enacts all of these planned changes, instead of keeping them in a state of limbo, unsure whether they will be implemented or not.

### **Crop Growing Strategies**

According to Kjell Hødnebo in his book *From Cattle to Corn: Economic Trends in Northeast Africa*, corn has emerged from a crop only grown in North and South America, to one of the most important crops on earth. The question still remains as to why Eritrea has not taken, with all the benefits associated with corn, a reason to adopt it. One such benefit of a corn-soybean rotation is it helps control diseases and pests that bother each crop, a major problem Eritreans face. According to Palle Pedersen, Iowa State University soybean extension agronomist, "Producers are really taking a chance if they don't rotate, diseases and pathogens build up in the soil and rotation helps manage them." This chance which so many Eritreans choose to take has led to an extremely alarming degradation of natural nutrients, causing Eritrea to face an insecure future. ("Corn-Soybean Rotation Still Makes Sense."). In the Sub-Saharan region, which includes Eritrea, animal husbandry becomes less of a nomadic practice, causing many herders to begin integrating crop production into their practice. This is known as mixed farming, or the practice of crop cultivation with the incorporation of raising cattle, sheep, and goats by the same economic entity, is increasingly common. This interaction between the animal, the land and the crops are being done on a small scale all across this region. The residues of previous crops provide animal feed, while the animals provide manure for replenishing crop nutrients and draft power. Both processes are extremely important in this region of the world as it is expensive and logistically unfeasible to transport in synthetic fertilizers and large-scale machinery. As an additional benefit, the cattle, sheep, and goat provide milk and can act as a cash crop in the times of economic hardship, which Eritrea has been facing for the majority of the last two decades (Powell).

### **Utilization of Higher Powers in Regards to Policy Change**

The WRD/UNICEF report of 2003 "Eritrea - Planning, management & advocacy tool for rural water resources development" mentions a goal of safe water sources coverage of 60 percent of the rural population by 2015. Irrigation-related objectives on the 2010 horizon are to add 49,400 acres of land by the construction of small dams and wells, development of joint irrigation-hydropower schemes, and a survey of the water resources. The WRD also has plans and strategies to introduce cost-effective and environmentally friendly water technologies and sustainable water supply management systems. Water resource availability does not seem to be the immediate constraint. The current problem involves both the absence of a water policy, and effective institutional capacity to manage the water. Another constraint faced by Eritrea is the lack of legislation to regulate water control in respect of both supply and demand. Presently, much of the scarce water is being wasted because of lack of management. One of the challenges of the new and redeveloped management will be to cope with the high variability regarding the availability of resources.

The Government of Ethiopia, from whom Eritrea gained their independence, has a program that encourages unemployed rural people and smallholder farmers to work on soil and water conservation projects by paying them for their labor with food vouchers. The benefits from this program have been mixed, as early food security strategies were flawed, and simply did not work. Policy options for social assistance programs that increase food security include targeted or general cash, in-kind, or voucher transfers; cash or in-kind conditional transfers (school feeding, employment guarantee scheme, food for training); price subsidies; and programs for the vulnerable. Social insurance options include cash or in-kind reserves, rural credit and

microfinance, insurance schemes, livelihood diversification, and public works for the construction of infrastructure programs. The government also has the option to pursue agricultural policies that will minimize exposure to shocks, such as providing input subsidies for exportable commodities or moving away from export-led development and toward food self-sufficiency. Different social protection measures have varying levels of domestic and international support and are effective for targeting different groups of vulnerable people in Ethiopia. In response to the 2002 drought, the Government of Ethiopia revised its Food Security Strategy (FSS) and implemented a Productive Safety Net Program (PSNP) in 2004 that includes cash transfers and a food-for-work (FFW) public works program (“Annick Hiensch”).

As the neighbor of Ethiopia, Eritrea is in a prime position to implement strategies not entirely their own. But as the civil war to gain independence raged on, the ability for Eritrea to implement practices common-place in Ethiopia was lost, as the fear of being labeled as a nation dependent on their former rulers was so great, that Eritrea distanced themselves under a cloak of self-isolationism. Eritrea must drop this overwhelming sense of nationalism, and embrace changes that rational government leaders have attempted to enact in the past.

### **Foreign Intervention**

At the risk of souring the already strained relationship between the United States and Eritrea, one option is to send a provincial reconstruction team to parts of Eritrea where the help is needed the most. The lowlands have faced the most significant issues in entire country. Water scarcity and poor soil management have been problematic for years. A provincial reconstruction team is a part of the US Army’s Civil Service branch, whose goal as military units operating in an undesirable environment is to use quickly built village improvement projects to demonstrate goodwill and encourage favorable reactions from the local civilians. The only recent use of PRF teams is in Afghanistan. Usage of these PRF teams in Eritrea could result in a political nightmare for US politicians if not handled correctly, further complicating the healing process that Eritrea so desperately needs.

### **Conclusion**

In order for Eritrea to be seen as an example of a meteoric rise to relativity, the false hope that isolationism will guide them to the center stage of the world must be dropped. Failing policies, such as those involving the barring of foreign diplomats entering or exiting the country must also be discontinued. More successful policies, such as the National Food Security Strategy, must be expanded upon, accepting and adapting to criticism, both from within their government, and from nations and organizations willing to supply aid, like the UN (“Food Security Strategy.”). Strategic crop rotation techniques, such as the rotation of corn and soybean to restore and replenish nutrients in the soil must be used in conjunction with newer irrigation techniques, like leveling of fields, surge flooding, and capture and reuse of runoff. As the main principal crops currently grown in Eritrea are cereals and grains, increasing the amount of farms planting corn and soybeans is necessary to economic and social development (Hødnebø). With the introduction of those two crops, a crop rotation system makes sense. With that said, Eritrea still faces a bleak future, as there is no foreseeable end in sight to outdated and harmful isolationist policies. The Eritrean government continues to restrict the travel of all foreign nationals. These restrictions require all visitors and residents, including U.S. diplomats, to apply in advance for permission to travel outside the Asmara city limits. Recently, the Eritrean government has started to refuse all new diplomatic travel permit requests; this situation may continue indefinitely. Helping a country which refuses any and all travel to foreign relief workers and nationals is not possible at this time. Deteriorating conditions have led to a frightening increase in crime. One of the few, if not the only solutions available is to educate the farmers located within Eritrea by using native Eritreans

who have left the country. As Eritrea is fiercely self-reliant, native sons and daughters of Eritrea would easily be able to return to the country on education and revitalization missions. If the UN is not willing to do this, then private funding, and lobbying on the part of the UN are the only reasonable options left to assist Eritrea.



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