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Chad, Climate Volatility

### **Chad: Fighting Desertification with Sustainable Agriculture**

The Republic of Chad is a landlocked country in central Africa with a population of 14.9 million, according to The World Bank. By land mass, it is the fifth largest country in Africa, and it is the 22nd largest country in the world. Due to its massive population and lack of resources, hunger is a significant issue for Chad. In fact the country ranks 73rd out of 78 countries on the Global Hunger Index, meaning it has one of the highest levels of hunger in the world. Chad's main economy consists of cotton and crude oil exports. The country joined the oil market in July 2003, and produces an average of 4.1 million tonnes of oil a year according to the World Energy Council. The official languages of Chad are French and Arabic, due to history of colonization by the French. France captured the Lake Chad area in 1900 and absorbed it into French Equatorial Africa in 1909. French colonial activities degraded the soil fertility of the area due to overfarming and overgrazing. The French neglected the colony with no resources being put towards infrastructure as claimed by the U.S State Department country studies. After many years of subjugation, Chad declared its freedom from France on August 11th, 1960. Freedom was short lived for the country, due to how the first president, Francois Tombalbaye, turned Chad into an autocratic state almost immediately. This triggered a civil war between the Muslim north and the Christian south that lasted approximately 24 years. Idris Déby came to power in the 1990's, finally ending the civil war. The war affected Chad profoundly, and the economy has never really recovered.

Chad is in the center of Africa, and is bordered by: Sudan, Central African Republic, Cameroon, Nigeria, and Niger. Due to Chad's central position and relative safety, thousands of refugees from neighboring countries have entered Chad in recent years as shown by data from the UNHCR. Since the economy of Chad is so strained, these refugees rely mostly on aid from the international community. Chad is split into 3 main climatic Zones: the Sahara Desert in the north, the Sahelian belt in the center, and the Savannah in the southern part of the country. The Sahelian belt serves as a transition zone between the Sahara and Savanna. These climatic zones are caused by differences in rainfall. The Sahara receives under 50 millimeters of rain a year (2 inches), the Sahelian belt gets 300 to 600 millimeters (11 to 23 inches), and the Savannah usually gets over 900 millimeters a year (35.5 inches). Thus the country's climate ranges from tropical to desert. Unfortunately, due to deforestation and climate change, the Sahara desert has began to expand southwards, causing the more fertile soil of the Savannah to become dry and devoid of nutrients.

The Sahara Desert is growing at an alarming rate. Research done by scientists at the University of Maryland, published in the Journal of Climate, has found that the Sahara desert has expanded by 10% since 1930 and  $\frac{1}{3}$  of that expansion was proven to be directly caused by humans. This means the Sahara Desert has been expanding at a rate of 30 miles south a year. The Borgen Project claims that Chad is the most vulnerable country in the world in terms of climate change. Climate scientists predict that climate change will severely widen Atlantic Multidecadal Oscillation (AMO), this means that dry seasons will last even longer, and severe droughts will become more common. In fact, AMO has been in a negative phase since 1960, which caused a severe drought for sub-Saharan Africa in the 1980's. Droughts like this greatly affect Chad's water sources. For example, Lake Chad is extremely shallow and is prone to surface fluctuations. According to the United Nations, the overall surface area of Lake Chad has decreased by 87%. This has been disastrous for the communities on the lake and for farmers in the region. The soil in the area of the lake is losing fertility because of this, thus speeding up the rate of desertification. Meaning

that land is constantly being cleared to build new farms, and due to unsustainable agriculture practices, that soil quickly loses fertility.

Another key issue in the desertification process is deforestation. In French colonial times, every tree on a farmer's land belonged to the government. If it was discovered that any tree was cut down without authorization, the farmer would be threatened with life in prison. The law was supposed to help preserve trees, but it became a sign of protest to cut down the trees on the farmland. Due to this law, and agricultural expansion, Chad has lost much of its forest. Data from the U.N. Food and Agriculture Organization shows that the country lost a total of 79,000 hectares of forest (about 195,000 acres) between the years 1990 and 2000. Today, only 9.2% of Chad has forest, and 9% of that forest is protected by conservation. This agricultural expansion has been driven by accelerated population growth, and thus greatly increased food demand. The United States Geological Service states that the average annual rate of agricultural expansion is 5% in Chad, which is one of the highest rates in Central Africa. With nothing being done to improve soil fertility, the need for new agricultural land has been on the rise, and this has led to agricultural expansion in the Sahel. The sparse vegetation cover that acted as a barrier against the desert was cleared or grazed, making the soil looser and more mobile. Sandy areas have increased in the Sahel due to this, speeding up the rate of desertification.

Desertification and the loss of soil fertility has been disastrous for farmers in Chad. 40% of Chad's land is currently cultivated, according to the United Nations. Farms are mostly family based, and the majority of the families in rural areas do not have the resources to improve soil fertility. The average farm size in Chad is 1-2 hectares, which is roughly the size of a professional sports field. The main crops produced are grains, such as corn and millet; and cotton. The production of cotton depletes the soil of essential nutrients such as nitrogen, and it takes an enormous amount of water to grow. Twenty thousand liters of water are required to grow one kilogram of cotton, according to the World Wildlife Fund. Additionally, the depletion of soil fertility means that synthetic fertilizer use is increasing, which can be harmful for the environment. Cotton is one of Chad's main exports, along with gum arabic and livestock.

United Nations data shows that a typical family in Chad will have 5-6 people in a household.. Homes are not very large, so living conditions may be quite cramped. Most of the houses in rural areas are made out of dried clay bricks, and are circular in shape. The walls are usually around 4 feet high and have a width of 9 inches; the roof is made out of woven grass, and arranged in a cone shape. A farm is usually attached to the house, and families will usually produce all of their own food, due to the fact that local markets are hard to access. The crops that get produced vary--Chad has 140 different ethnic groups-- but they all share a few common staples. Grains such as millet and maize make up a large portion of the diet, and these grains are used to make a thick porridge called boule. Boule is typically shaped into balls and served with dried fruits, vegetables, and meat. The main meal is eaten in the middle of the day, and is served in a big bowl in the center of the house on woven mats on the floor. The women are expected to cook the meals, clean the house, and take care of the children. Most of the men are expected to work on the farm. Only 35% of school aged children will attend school, according to the United Nations Development Program, and many parents want their children to be at home assisting them, and many families can not afford school fees. In addition, boys are more likely to receive an education than girls. Unfortunately, this means that only 22.3% of adults in Chad are literate, according to UNESCO.

An average family in Chad will make only \$740 a year, and expenses such as education and health care are not affordable to most. Even if they could afford health care, 65% of doctors are located in the capital, N'Djamena, which the World Health Organization says works out to an average of 3.7 licensed healthcare

professionals per 100,000 people. Health insurance is only used by 2% of the population, indicating that health care is not widely available or affordable. Diseases such as cholera are very common, due to lack of access to clean drinking water. This led to 17,000 cases of cholera in 2011 alone, according to UNICEF. Improved access to sanitation and the building of latrines has led to a significant decline in the amount of fecal matter in the water supply, and thus a decline in diseases such as cholera. World Bank figures reveal that only 8.8% of the population of Chad has electricity, only 35% of the population has access to cell phones, and landlines are practically non-existent. All this means that a typical family in rural Chad may not be able to receive medical attention, even if it is a life threatening emergency. Most families in Chad are already at a disadvantage due to chronic malnutrition.

In Chad, food security is a dire situation. The World Bank states that 87% of the population lives beneath the poverty line, and nutritious food is hard to come by. The lack of nutrition leads to 40% of children under 5 being stunted, and in many cases to chronic malnutrition, according to the World Food Programme. Chad has a very high maternal mortality rate that can be attributed to lack of access to health services, and lack of adequate nutrition. Despite the high mortality rate, Chad has an annual population growth rate of 2.5% as shown by data from the World Bank. Part of this population growth is from refugees coming into Chad, as they flee violence in the Central African Republic, Nigeria, and Sudan. Chad had a total number of 663,064 people of concern at the end of 2018, according to the UNHCR, an 8% increase over the previous year. Out of those people of concern, 454,700 were refugees and asylum seekers. Almost all of these refugees are supported by non-governmental organizations, such as UNHCR and FAO in the Lake Chad region. The rapidly increasing population means that Chad needs solutions that will feed people and bring money into the economy. To do this, desertification must be slowed down and soil fertility needs to improve.

The first step in the battle against desertification is the planting of trees. Trees are essential for reducing erosion, increasing soil fertility, controlling the temperature of air and soil, stabilizing soil, and increasing the soil's ability to store water, according to FAO. All of these benefits would help contribute to Chad's food security greatly. Fortunately, the planting of trees has already begun in the Sahel, in a project called the Great Green Wall. The Great Green Wall effort is led by eleven different countries in the Sahel and Saharan Africa. The goal is to create an 8,000 km mile wall of trees that stretches all the way across Sahelian Africa. It is hoped that the Great Green Wall will bring jobs, food security, and stability, and slow down desertification, in goals mentioned by the United Nations Convention to Combat Desertification. The project has been going on since 2007, and is about 15% complete. The Great Green Wall has been very successful in Ethiopia, Senegal, Nigeria, Sudan, and Burkina Faso. Chad is part of the initiative, but has not been able to contribute as much, due to economic instability.

Here are some ideas as to how Chad can be more of a part of the Great Green Wall effort:

The first solution is to create reasonable tree protection laws, in order to conserve the remaining forest. Foraging for firewood and pruning could still continue, but the remaining trees must be allowed to grow and recover. This would be a temporary measure until the project was underway. After those regulations have been put in place, suitable species of trees that are native to Chad or the greater Central African region must be identified. This is so invasive species do not make their way into Chad that could potentially adversely affect the remaining forest. On the front lines in the Sahel would be *Acacia senegal*, the tree that produces sap (gum arabic) that is used as a thickening agent in many foods, makeup, watercolor paint, and medicine. *Acacia senegal* is very drought tolerant, and can be mature within five years according to the World Agroforestry Organization. It is also a good tree for controlling erosion and would be an excellent source of firewood for the people of Chad, as long as it is collected sustainably. This and many other species of *Acacia* yield high quality firewood, and are also excellent forage plants

for livestock. Other tree species with economic products that can be grown in dry conditions include cashews, african sumac, african jujube, shea tree, tamarind, and dry zone mahogany. Once these trees have been planted, the leaves and any byproducts of crops can be composted.

To improve the soil fertility of Chad, nutrients need to find their way into the soil. The simplest way to do this is through composting. Although composting is much harder in a dry climate, experimentation with different composting techniques would be extremely helpful for farmers in Chad. Animal manures would greatly enrich the soil quality, and collecting this would be highly beneficial for the compost. Community composting centers could be established, where farmers could bring in compostable materials and have their name put down on a list. When there is compost available they could return and collect compost for free that they could then use on their farms. Another way of improving soil fertility is the biochar method. Biochar is made in pits that are called kilns, and it is a way of burning plant material or manure that produces charcoal that can be used as a soil supplement. It is much faster than compost, and is very nutrient-rich.

Using compost, a mixture of soil and manure, or biochar is much less toxic than synthetic fertilizers, and can be used in a method of agriculture that originated in the Sahel. The zai system of agriculture is a labor intensive method that is quite simple in design. It has been used extensively in Mali, and has increased food security as shown by researchers at Bayero University in Nigeria. Zai pits are evenly spaced apart and are 15-30 cm wide and 15-30 cm deep. A small amount of organic matter is placed at the bottom of the pit and a seedling is planted in the pit with a enough topsoil to ground it. When watered, or when the rainy season comes, the pit will collect rainwater and concentrate the organic matter without drowning the plant. This allows the organic matter to mix with the water and permeate the soil, improving soil fertility. It also prevents flooding in fields, because it holds and drains water so well. Methods such as zai are the key to promoting sustainable agriculture in Chad. It is true that zai takes time and dedication, but the results are worth the effort. One of the crops that the zai method is completely ideal for is cotton.

As mentioned previously, cotton is a crop that does very well in Chad, but it is not grown in a sustainable way. The zai method could potentially address those issues and overall make cotton a less destructive crop. This method would lead to the decreased use of synthetic fertilizers, which would improve the health of the soil and local water sources. The Zai system has been demonstrated to increase water retention in soils which would lead to less water being needed. Making the switch to organic cotton could potentially have long term gains for Chad, but there may be some difficulties in the transition. Growth in the organic cotton industry has increased dramatically since 2001, with a reported annual growth rate averaging 70% a year, according to the International Trade Center. This means that there is opportunity in converting to organic cotton for Chad. In addition, corporations that market organic cotton may improve their public relations image. Among the negative aspects of organic cotton marketing, rather surprisingly, is the fact that the reliable supply of organic cotton is lower than commercial demand, leaving manufacturers with potential scarcity. Cotton farmers in Chad could form trade agreements with large textile companies to ensure a secure market. Another concern is that the conversion to organic farming takes lots of time and knowledge to be successful. There would be some risk involved with the switch, but the long term effects would help improve the environment and the economy of Chad. Once the cotton crop is finished, the waste plant material would be excellent for making biochar, thus making the whole system that much more sustainable.

There will be an unavoidable period of time, when there is a shift from conventional to organic cotton production, where farm income will decrease. This is the ideal time for the restoration of degraded land to occur. Farmers in Chad affected by this shift will be given priority in employment working on the Great

Green Wall tree planting project. If additional labor is required, other citizens of Chad would have the opportunity to participate, and if possible the refugee population in the country. The people working would be paid minimum wage, which in Chad is 59,995 CFA francs (\$102 US) a month. After an initial intensive first five years of planting, the project will be scaled back. This should be enough time to make the switch to organic cotton farming and sustainable agriculture methods. The influx of money to farming families will help to compensate for loss of cotton revenue, and enable farmers to purchase higher quality equipment in order to provide food for more people. Funding for this project will need to come from the international community. Parts of the project will need considerable amounts of funding in the areas of payment for labor and maintenance during the establishment of the plants. This project should be overseen by two core groups: The United Nations and the Permanent Interstate Committee for Drought Control in the Sahel (CILSS). The CILSS is an organization dedicated to finding ways to establish food security in the Sahel. The CILSS is based in the Sahelian region and has been quite active in Chad. With the United Nations and the CILSS working together, a balance can be struck, where both the Sahel and the world can be involved in the restoration of Chad.

An important aspect of implementation would be to identify people within communities in Chad who demonstrate strong interest in innovative farming techniques. It is likely that people would be more accepting of new practices if it comes from within their community. Volunteers from the United Nations and the CILSS could work with these people to establish composting/biochar centers and act as intermediaries between the overseeing organizations and the farmers. This would allow the people of Chad to observe first hand how these methods could benefit their daily lives. Ideally these techniques would become widely adopted and be accepted as routine farming practices.

In summary, climate change is expected to affect the entire world profoundly, and Chad is already considered by many experts to be the most vulnerable country in the world. The planting of trees, and converting to sustainable agriculture is extremely important in the revival of degraded soil. Now more than ever the world needs solutions to feed the ever-growing population. Chad is a microcosm of what much of the world may be facing in 2050: drought, hunger, non-potable water, and extreme poverty. In the case of Chad, lack of planning and the misuse of land led to the loss of soil fertility and thus desertification. In conclusion, the methods needed to halt and reverse desertification and prevent mass famine will be essential in the survival of humanity.

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