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Chad, Factor 2: Water Scarcity

### **A New Farming Technique in Chad**

“That’s one small step for a man, one giant leap for mankind.” These are Neil Armstrong's words on setting foot on the moon in 1969. Prior to this, space was considered out of reach for humankind and was thought to be a fantasy. With the help of science and technology, we successfully ventured into space and further conquered the quest to land on the moon. It took many years of hard work, several innovative minds, and technological breakthroughs from launching a rocket into space to successfully landing a man on the moon. The once considered impossible became possible with small steps. Not only did going to space help our understanding about space and rocket science, it also benefitted typical human beings. The idea behind state tests and youth institutes is to create an all-inclusive environment, wherein young students and teachers can come and work together to make America and other countries address major challenges faced today. Let’s imagine the daunting task of eradicating poverty and hunger. The first steps in the right direction is bringing groups of people together to first target and solve regional food problems, followed by educating the mass to tackle poverty. If the idea to solve the regional problems works, then they can use or share that same method to solve the similar problem within the country and extend the solution to other countries. If these steps are taken up by a team of more problem solvers or organizations working at the grassroots level together with the young aspiring students, it provides an opportunity of learning to the students. They will be better prepared as citizens to understand their nation’s needs and to tackle some of the major problems that nations, states, and regions are facing today, including food insecurity. The USDA defines food insecurity as a state in which “consistent access to adequate food is limited by a lack of money and other resources at times during the year.” Good shorthand terms for food insecurity are “struggling to avoid hunger,” “hungry, or at risk of hunger,” and “hungry, or faced by the threat of hunger.” Food security has led countries to war, dictatorships, and corruption. Lack of economic development, poverty and food insecurity, has fashioned national unrest and instability leading to civil wars in the African continent in the past few years. By drawing global attention to the real challenges a nation faces when it comes to food insecurity, one can address the issue timely, before it gets out of control. Several factors can contribute to food insecurity: a consequence of a national calamity, national instability with corrupt governments, poverty, lack of proper food distributions system, severe food shortages and lack of modern agricultural technologies. The case study I have chosen as an example to address food insecurity in the country is Chad in Central Africa. Chad is one of the most corrupt and poorest countries on earth and most of its people are impoverished. The Fund for Peace considers Chad a failed state. Food insecurity in Chad is further complicated by prolonged periods of drought, severe water shortage, and reduced crop productivity. Fortunately, Chad in Central Africa is politically stable country compared to its neighbors Nigeria, Niger, and Sudan, making this country an interesting state.

Chad, one of the largest countries in Central Africa, has a land area of 1,284,000 square kilometers according to the U.S Department of State. Chad is divided into three agro-climatic zones, and the land area encompasses two main zones: the desert and the Sahel Belt. The Sahel Belt is an area wherein the arid, desert air and the humid, savannah air converge together to create an unstable atmosphere of dry and wet weather. The northern part of Chad consists of the Sahara desert and the lower part consist of a much greener area. Chad is surrounded by many countries with Libya to the north, Sudan to the east, and Central African Republic (CAR) to the south. The countries west of Chad, which are Niger, Nigeria and Cameroon, shares a lake known as Lake Chad. This lake is the main source of water for Chadians. Apart from the geographical location, the country has an unevenly distributed population. According to 2016 census, only 26% of the country’s people live in urban areas, with half of them under the age of 15. The country’s capital is virtually the only urban area in Chad and has the highest population density, apart from the Logone Occidental Region which is also densely populated. The average household in the urban

area of Chad has around five people per household. This statistic may not fascinate you, but when you compare this to the average household in the U.S, which has around three people per family, the numbers are significant. Chad has over 200 ethnic and linguistic groups and they are classified according to their geographic region. The Sara live in south and represent the largest ethnic group, while Sahel, sedentary people, live with nomadic people and are the second largest ethnic group. The literacy rate in Chad is very low. Facts collected by the CIA, looking at adults who are fifteen years or older, suggests only forty percent of the population is literate. This means that only less than half of the population in Chad has the privilege to read and write. Even though the country upon independence in 1960 made education compulsory and free at the primary level, only three-quarters of children are enrolled in schools. Chad suffers from lack of adequate school funding, severe shortage of teachers, teaching materials, and facilitates. In 2009, Chad spent 2.3% of its gross national income on education. This is compared with an average spending of 3.6% by developing Sub-Saharan countries. With the low levels of education, it is tough to educate Chadians about the spread of the infectious diseases. Due to low literacy and lack of knowledge, a lot of Chadians suffer from leprosy, tuberculosis, and other serious diseases. There is help coming from hospitals as it is stated by Mapsoftheworld, "There are a number of hospitals in the country, which try hard to fight against the widespread diseases of the country." Due to the lack of good health in Chad, people live short lives. The Mapsoftheworld states another fact, "the general life expectancy of the people is 46 to 48 years." The low life expectancies are due to prevalent diseases, lack of medical infrastructure, and medication to prevent and treat diseases, which largely can be attributed to the high rates of illiteracy in the country.

Agriculture and livestock are important economic activities in Chad, which contributes significantly to the country's economy. "Two-thirds of the population lives in the rural area, with 80% of Chad's labor force is dedicated to agriculture" (U.S. Department of State). A majority of the rural populations are either herders or practice burn and slash agriculture. Even though agriculture and livestock breeding are important economic activities that employ the great majority of the population, it generates just over 10 percent of official GDP. The jobs in north and south rural Chad is described by, "In the drier regions of the north and east, dairy products and millet are the most common ingredients in dishes"(Our Africa). This information can help make a precise inference that the people of northern rural Chad live as herders because their main diet is dairy, protein, and carbohydrates. The southern part of Chad, the Sahel belt, has most of the farming since it is more humid and has more water. However, the unpredictable weather patterns, drought, and desertification in this area leaves less of an area for farming. Added to the above problems, diseases, pest, and climate changes have further affected agriculture. On the contrary, the Kanem and Bahr el Ghazal regions in western Chad are chronically food insecure, and periodically experience acute malnutrition rates. This problem alleviates the situation of severe food shortages and malnutrition in the country.

One would imagine that Chad, which is in the Sahel belt, would logically have more farming area and rich agricultural productivity. However, research have suggested that the lack of farming area, constant droughts in Chad Lake leading to desertification and the climate change in the Sahel Belt might have negatively impacted agriculture. The Sahel belt is what keeps Chad alive, but at the same time, keeps the agriculture from advancing forward. This stretch of land has many killers that cause the country of Chad to fall to its knees. This killer is explained by IFAD, an organization who helps the people of Chad still stay on their knees and not go further down, "Climatic conditions are extreme, from drought to torrential rain and flooding." To make this point clear, imagine a scenario. On a given year, the Sahel belt receives high rainfall from changing climate patterns leading to severe flooding. Majority of the crops are destroyed due to flooding and the topsoil is lost to erosion, leading to desertification. As a consequence, the country faces severe food shortage arising from reduced agricultural productivity extending to the next planting year. Given the geographical location, this cycle is likely to repeat overtime, with the exception of few good years of bumper crops. A good crop will be just enough to feed the Chadians for a few years. Farmers are constantly competing in Chad. Since there is a lack of water in Chad, many herders and farmers clash. They destroy each other's land, livestock, excreta, which results in food shortage and water management problems. The unstable weather makes many rural people of Chad live

nomadic lifestyles. The Chad Lake is in the southwestern part of Chad and extends few hundred kilometers into the country wherein most of the farms are found. These farmers depend solely on the Chad Lake for irrigation and fishing. The only problem is that there is not enough water for more farming space. The Food and Agriculture Organization supported by the United Nations state that, "The lake occupies less than 1 percent of the drainage basin and is extremely shallow, with a mean depth of 4 m" (TakePart). Even during the regular farming season, the lake is very shallow with only an average of four meters of water. With this information, take a guess on the amount of water the lake supports during a drought? Once again, FAO collected some more data and found this out, "The dry season ... variations in water levels is about 0.5 m" (TakePart). During the drought season, the water levels go lower than half a meter. It's hard to imagine how "Life in Chad" would be during drought, with extreme shortages of food and water. Not only do people starve, heading the country to economic hardship, instability and political unrest. I propose two solutions to address the major challenges faced by Chad today.

From an engineering standpoint, one of the ways to solve this problem is to develop a network of advanced drip irrigation system. A typical sprinkler system consists of three main parts: a tank or well, sprinklers and a network of pipes. The conventional sprinkler irrigation systems, even though are effective, are not efficient in water usage. I propose designing an advanced drip irrigation system using a system of sensors that can measure the relative humidity to provide desired amounts of water for irrigation. Another control in the system is use of sensors to calculate the real moisture content in the soil. This added feature would provide crops and orchards measured volume of water, leading to minimal water usage to retain appropriate soil moisture, reducing over usage of water for irrigation. The advanced drip irrigation system saves more water than occasional sprinkler would do. To be more precise, Irrigation Tutorials give statistics, "Drip irrigation is the most efficient method of irrigating. While sprinkler systems are around 75-85% efficient, drip systems typically are 90% or higher." This means that using a drip irrigation system is the smartest way to save water. The system that will be used in Chad will be more efficient than the ones used in typical farms. Firstly, during torrential rains and flooding, there will be U-shaped canals to collect the water which would be coated with metal or clay over it, preventing the water from seeping through crevices. A network of canals will also develop, leading to Lake Chad as well. This will include several hundred canals, which are a foot deep and eight to ten inches wide. The canals will flow into large tanks instead of wells to decrease loss of water from evaporation. Next there will be sensors to measure the humidity outside and the amount of water needed in the soil. The data from the sensors will be fed to a computer to figure out the precise amount of water that is needed for irrigation. According to the University of Florida, the cost of a drip-irrigation system range is between 500-1000 per acre. The estimated cost of this system is about 1 million dollars using 1280 acres of land. However, this can be made even cheaper if the labor and material to build the system comes from Chad and not the U.S. We would hope to get funding from UNESCO for education of the farmers of the new technique and World Food Prize Organization for building the drip irrigation system. Fundraisers would also help get enough support, volunteers and donations for this project. Before the drip irrigation is put into place, a sample would be needed to be taken. A ten-acre plot of farming area would be using the system to record the effectiveness of the drip irrigation for two years. If it is found effective, then the whole plan would be implemented to a larger scale of 1280 acres of land.

The second solution I propose for improving agriculture productivity is through expanding planting of diverse crops. These crops, apart from the stable crops, will include edible xerophytes and vegetables adapted to grow in low water conditions. Xerophytes are plants that rely on very little water. These plants usually have spikes like cacti so less water is released during respiration. There are also other plants that do not require too much water. Oregon State University did an experiment to figure out what types of plants require less amount of water than an average plant would require. Their study results concluded that "Some vegetables, such as beans, are adapted to drought conditions at a very basic, cellular level." These vegetables include beans, black-eyed peas, cowpea, okra and many other unique plants. Snap beans and pole beans have the same cellular makeup and also have short growing seasons. Not only did OSU researchers learn that there are crops that require less water, but also that some edible crops "establish deep root systems quickly and can draw moisture from the deeper soil long after the surface has become

dry.” These plants include tomatoes, squash, melons and a couple others. These two steps can help make Chad a greener place and improve its agricultural productivity. This will require investments, which can be attracted through World Development Banks and other agencies. In return, there will be prosperity of surpluses in economy and agriculture in Chad.

Educating the farmers would be very essential. It wouldn't be proper to hand farmers a course guide and make them go through it. One on one education would have to be implemented. Once the drip irrigation is put into place we would educate farmers who would want to use the drip irrigation system. Volunteers of engineers and scientist would teach these farmers, face to face, on how to use this system. Once the farmers learn about using the drip-irrigation system, they would be monitored for 2 years to see how they are doing. After two years of monitoring, the volunteers would leave the responsibility all on them. For the planting the variety of seeds, volunteers would teach the “trend setting” farmers on how to preserve and plant the seeds. These farmers would set the trend, what seeds to use and how to keep them, to the other farmers.

The first step to implement my proposal is to talk with the Patriotic Salvation Movement, political party currently in power in Chad. The same party supported The Agriculture Production Support Project, which has been a great success story. Therefore, if this idea is well drafted and explained, it will be easy to sell the idea to the government to get their approval and support. The next step, will be to find a community of fairly stable farmers and find model farmers who could implement the drip irrigation system and diverse cropping model. Once the proposed drip irrigation system and the suggested cropping model is demonstrated to be profitable, I strongly believe this model can be replicated and extended to. Before getting the farmers involved, it is utmost important to demonstrate a prototype of the system. There are likely to be challenges, with return of investment taking few years to recover. However, the short term loses will arguably be addressed by long term profitability of crops, improved farming economy and enhanced soil fertility.

There are many several programs, international organizations and local committees that are trying to help the people of Chad to address food insecurity and water scarcity. The World Food Programme provides cash to enable vulnerable people to buy food from local markets, and nutritional supplements to babies aged six months to two years, helping to prevent malnutrition. In addition, World Food Program provides life-saving support to those affected by conflict in Chad's neighboring countries, distributes food vouchers to refugees and returnees in Chad and Central African Republic. Political instability presents a serious challenge to this effort.

On the other hand, Action Against Hunger supports Chad through food security and livelihoods programs designed to strengthen local economies. They assist in nutrition treatment program to address severe malnutrition, and have placed emphasis on providing farmers with tools and education for growing healthy crops, vaccinate livestock, and train budding female entrepreneurs in small business management. They aim to prevent future nutrition crises in Chad and Central Africa. A very similar program is run by the Agriculture Production Support Project. Their emphasis is, “to support communities and producer organizations in increasing (i) the production of selected crops and livestock species in selected areas of the recipient's territory; and (ii) the use of sustainable land and water management practices in climate vulnerable ecosystems (World Food Bank).” The organization was able to train approximately 9818 farmers to use modern farming techniques and water management. Also, the organization has distributed 220 metric tons of sorghum and berebere seeds. Thus, more land is under cultivation, soil fertility has improved and the farm sector is a bit more stable in Chad. This project is a great success. Not only were they able to meet the project goals, in fact they have strengthened Chad's resilience to food insecurity and prevent future nutrition crises. Furthermore, by incorporating the proposed drip-irrigation system to their model of sustainable land and water management along with planting a variety of crops, will further strengthen the agricultural economy and improve food security in Chad.

As Neil Armstrong once said, “That’s one small step for a man, one giant leap for mankind.” The steps that Americans did to beat the Soviets are the same steps that humankind and nations can take to fight hunger and malnutrition in underprivileged countries. As mentioned earlier, Chad is considered a failed state. Chad needs a more stable and reliable government who are concerned about their people rather than their vested interests. Improving the living standards and the average life expectancy of Chadian is very critical for the success of the country. The country needs to lay emphasis on improving its literacy program and unequivocally address the socioeconomic problems. With about half of the country’s population averaging 15 years or younger, improved literacy and training on new skill sets will pave the path for economic development, while creating the workforce needed to support the new jobs that come along with economic development. Kofi Annan, the seventh Secretary-General of UN, quoted “Literacy is a bridge from misery to hope.” Agriculture is the mainstay of the country’s economy, apart from its huge dependence on oil production. As proposed in this paper, there are steps which when taken earnestly, can fix some of the inherent problems to improve agricultural productivity. Having an improved irrigation system, supported by a network of canals, improves water usage efficiency and soil health. Israel is using a drip-irrigation system and is working very well for them. Chad and Israel have very similar climate. This means that if Israel can be successful with a drip-irrigation system, then Chad would too. Alternately, by expanding the number of crops planted not only reduces the country’s dependence on stable crops, but provides an alternate cropping system for self-sustenance when hit by natural calamity like severe drought or faced with climate change. It is sure if the steps mentioned in this paper are taken, Chad will attain self-reliance in agriculture and put them in the list of countries considered as the food baskets of the world. If successful, the steps proposed here could be extended to other countries in Africa, the Middle East, and many developing countries throughout the world to improve food security.

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