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Niger, Water Scarcity

Niger: Addressing Water Scarcity through Sustainable Agricultural Practices

As the global population expands, there is a greater need for developing sustainable agricultural practices. It is becoming increasingly important to focus on producing more food, conserving water, and creating efficient farm systems that can be used in many different countries and climates. Although there has been advancement of technology in so many parts of the world, not all solutions are suitable for all situations. Each set of circumstances must be examined to determine the path to resolution.

The African country of Niger currently has limited resources and capability to produce food for its people. However, through the advancement of technologies, such as drip irrigation, Niger could expand its crop yields per acre, as well as transform barren land to fertile soil, with more accessible nutrients to grow crops. With increased yields and transformation of unused land, Niger could not only produce enough food for its citizens, but also make modest contributions to global food supply.

The government of Niger is a semi-presidential republic, which means the President is the head of state and the Prime Minister is the head of government (Chepkemoi, Joyce). The current President is Mohamed Bazoum (Mohamed Bazoum Declared Niger's New President) and the Prime Minister is Ouhoumoudou Mahamadou (Hoije, Katarina). Niger is made up of 36 states. It is a small country of 1,266,700 square kilometers (489,075 square miles) (Worldometer), located in Western Africa (Laya, Diouldé). In April of 2021, Niger had a population of 24.90 million people, and a population density of 19 people per square kilometer (49 people per square mile). Comparatively, the density is 4 people per square kilometer (11 people per square mile) in Canada (Worldometer). The majority of the Nigerien population practices the Islamic faith (Niger). The median age of inhabitants is 15.2 years (Worldometer), while the average life expectancy is 62.02 years (The World Bank in Niger).

Niger's climate has been described as intensely hot and dry, with most of the country in a desert region. There are three distinct climatic regions, each impacting soil quality in different ways. The northern region is made up of the southern part of the Saharan desert. Approximately 80% of Niger is covered by the Sahara desert (Niger). Except for occasional oases, most of the soil is infertile, receiving an annual average rainfall of 25 mm (0.9 in.) from June to September. There is also a transitional zone, known as the Sahel, which is a semi-desert area between the Sahara desert and the land in the southern part of the country. This region receives an annual average precipitation of 110 mm (4.4 in.) from March to September. Soil in the Sahel is covered by a thin, salty crust, created by intense evaporation, rendering the soil mostly unproductive. The third region, in the extreme southern part of the country, by the Niger River Basin, is a tropical climate region. From March to October, this area receives an annual average rainfall of 585 mm (23 in.) (Climates-Niger). The soil in this area consists of fertile land that is cultivated.

The highest populated areas in Niger are rural settings, where approximately 83% of the population lives . The remaining 17% of the population lives in urban centers (O'Neill, Aaron). A typical family in Niger is

made up of 5-6 people (Average Household Size). Niger has the world's highest human fertility rate, of almost 7 children (average of 6.91) per woman (May, John F). Only about 50% of families in Niger have access to health care, and those who do, receive inadequate health care with a lack of resources and quality treatment (Niger: Country Profile). Access to education is lacking, as the curriculum is undefined, and more than two thirds of children are uneducated. As in so many underdeveloped countries, these numbers are higher among girls. (Children of Niger). Only 56% of the population has access to any sources of clean drinking water, most of which are unreliable, while 13% have access to basic sanitation services (Water, Sanitation, and Hygiene). About 14% have access to electricity that has frequent brownouts and blackouts (Vast Need for Energy Access - Coupled with a Vast Need for Interventions), and 5% have access to technology (Niger: Internet Users). Nigerien diets are typically based around rice, millet, maize or biebe (a type of bean). Meat, vegetables, sauces, or sometimes spices, are then added to make the meal complete. (Niger Food and Drink). Overall, more than half of Niger's population is faced with insufficient food consumption. Sadly, 49% of children under the age of 5, suffer from chronic malnutrition, while a further 14% experience acute malnutrition (Hunger Map).

Niger is commonly known as one of the poorest countries in the world. Approximately 80% of Niger's population relies on agriculture for food and income, centering on subsistence crops and underfed livestock (Integrated Production and Pest Management Programme in Africa). Even though agriculture accounts for 40% of its Gross Domestic Product (GDP), Niger's poverty rate was extremely high in 2019 at 41%, affecting more than 9.5 million people. Approximately 17.7 million hectares of land (43.719 million acres) are cultivated annually. (World bank in Niger). The average farm size is 3 hectares (7.5 acres), with more than 95% of farms being under 5 hectares (12 acres) (Niger - Climate). Niger is currently the world's leading producer of uranium. The majority of the country's produce includes peanuts, cotton, and pulses, which are used for export, as well as millet, sorghum, cassava, and sugarcane, which are mostly grown as food for the citizens of Niger (Laya, Diouldé).

Niger is challenged with growing crops in its arid areas, due to a sparse water supply, much of which is unclean (Farmers in Niger Enhance Resilience with Better Crops). This low quality water presents another challenge, in addition to the shortage of water. Niger must find ways to convert this available water resource into water suitable for agricultural practices.

It is a difficult task for Niger to provide an adequate supply of food for its citizens (Giovetti, Olivia). Niger's high population makes it more at-risk than other countries that have fewer people per acre. There are approximately1.76 cultivated acres of land per person to produce food. This is minimal when compared to a country, such as Canada, where there are approximately 4.5 acres of cultivated land per person. As of 2018, only 14% of Niger's land was arable (Niger-Arable Land). The challenge is to increase current productivity per acre, as well as to greatly increase its arable land base.

Climate change contributes additional stress to an already taxed water supply in the dry, Middle East. May to October has traditionally been the Niger rainy season, with most of the rain concentrated in July and August (Niger - Climate). In recent years, however, massive droughts, for extended periods of time, have led to massive soil erosion. This erosion has caused major drops in crop production, resulting in the loss of many farm animals, due to a lack of food and water (Building Climate Change Resilience in Niger

to Keep Hunger Away). Niger is not alone in experiencing similar changing weather patterns (Central Bureau of Statistics).

With the challenges that Niger faces, it may seem an unlikely country to experience agricultural success. However, rather than by being stifled by these hurdles, Niger has been motivated to explore new technologies. It is a nation that recognizes its need to do more with its limited resources of water and arable land. In 1961, Niger had 11.5 million arable hectares (28.4 million acres), while in 2018, it had 17.7 million arable hectares (43.7 million acres) (Arable Land (Hectares) - Niger). As of 2017, only 0.6% of its fertile soil was irrigated (Niger-Food Security Indicators).

Although Niger has positive relations with its neighboring countries, it can not depend on them for resources. Therefore, it is imperative for Niger to have the ability to produce enough food for its own people. It is currently experiencing an influx of refugees and those seeking repatriation from some of the surrounding countries, further contributing to the strain on food accessibility (Nigeria Violence Sees 23,000 Refugees Flee into Niger in the Last Month Alone). As Niger slowly begins to attempt to increase food production, being able to grow crops efficiently to support its economy is of utmost importance (Niger - Foreign Relations).

A method that is now increasingly being tested and implemented to address water scarcity challenges is drip irrigation, also known as trickle or micro-irrigation. Drip irrigation brings low-pressure water to the base of individual plants through small holes in a network of plastic tubing (Uncovering Israel). It is known to increase crop yield, quality, and consistency, while using less water per unit of land than traditional irrigation. Little to no water is lost to evaporation. The phrase, "more crop per drop," is commonly used to describe this practice (Central Bureau of Statistics). Drip irrigation was invented in Israel in 1959 by Simcha Blass and Yeshayahu Blass. In 1965, the Netafim company was founded to commercialize Blass' technology (Uncovering Israel). "Israel has gained a worldwide reputation for its ability to turn barren desert into useful and arable land." (Central Bureau of Statistics).

Drip irrigation is a viable means to address Niger's challenge of growing better yielding, healthier crops, despite the frequent droughts. It is one solution for tackling world hunger and poverty, as it requires less water than sprinkler irrigation. However, only 4% of the world's irrigated agricultural land is currently using drip irrigation technology. Although it is not yet used in many other areas of the world, Niger has the potential to boost its economy, and supply food for its people through implementing this technology (Planting A Climate-Resilient Future for Niger). The brilliance of drip irrigation is that it not only increases food quality and production, while conserving water, but also increases the number of cultivated acres in an arid climate. It can be used both indoors with greenhouses and outdoors with crops and orchards, widening its potential for use. The technology of drip irrigation is producing successful results in the quest for water sustainability. In recent years, some Nigerien farmers have been given access to solar-powered drip irrigation technology, through an initiative of the private sector.

Niger could utilize this world class technology to expand its arable land. In this way, its unused land masses have the potential to not only produce food efficiently, but also to produce more food for its citizens. The Israeli-based group leading in drip irrigation technology, Netafim, has partnered with the International Finance Corporation (IFC), and the Climate Investment Funds (CIF), to create the Niger

Irrigation Program (NIP). Through this initiative, drip irrigation technology has been introduced to small and medium scale farmers through a three year plan. Participating farmers, most of whom were women, reported early savings of 30-55% of their water usage. (Palmer, Caitriona).

Recent developments in drip irrigation include the use of sensors throughout fields, to customize the amount of water needed for specific areas of land. In this way, different parts of the same field receive varying amounts of water. Land is not uniform; therefore, watering using traditional methods, such as sprinkler irrigation, overwaters parts of fields, while underwatering other parts. Technology maps fields and applies the correct amount of water to each section of land, as needed. This practice results in using substantially less water and less energy than former methods. The sensors work in tandem with a mobile app. Producers are able to monitor and operate drip irrigation through their smartphones (Uncovering Israel). The challenge is increasing technological accessibility to allow this method to be used to its full capabilities.

Drip irrigation can be used on all types of crops, including orchards, such as fruit trees. Tiny sensors are embedded in the trunks of trees to determine the amount of water required. This technology has the potential to be used successfully to grow native African trees, including desert date, black plum, and tamarind, which are commonly found in Niger (Cemansky, Rachel). Sprinkler irrigation systems are 50-70% efficient, whereas drip irrigation exceeds 90% efficiency (Uncovering Israel). Although very little work with drip irrigation and solar drip irrigation has been done, in the areas that have begun using this technology, production increases of 83% are being seen (Niger: Fertile Ground for Resilience). At the same time, the amount of water used can be reduced by 50-70%, and the use of fertilizer by 70% (Creating a Sustainable Future Through Education).

Farmers in Niger require the financial support of their government to help implement drip irrigation systems. Increased income from the export of peanuts, cotton, and pulses, could be generated by focusing on the use of drip irrigation in those crop production areas. Other funding could come from the profits of mining uranium in Niger. It is important for the government to see the balance between the investment in drip irrigation education, its infrastructure, and the return of viable food production. A system of training producers to mentor other producers in a particular area could create a foundation for successful drip irrigation in Niger. Local cohorts could learn from and support one another, with access to a supervisor with expertise. With the majority of farmers being women with a large number of children, the workload could be shared in day-to-day farming operations. When family members become more involved, they would not only begin to take ownership of their food production, but also acquire the knowledge of best agricultural practices to pass on to future generations.

Governments around the world need to create a plan to fund further development to ensure the protection of global water resources. One way to do this would be to monitor producers for every gallon of water used in irrigation, and work with them individually to improve their efficiency in water usage. Developed agricultural countries need to come up with a plan to fund and research global water sustainability. In developed countries, it may work to charge more money per gallon of water for those who use inefficient irrigation systems, while charging less money per gallon to those using sustainable irrigation methods. Rebates could be offered as incentives as well. In this way, governments could generate revenue to develop programs to ensure that the worldwide water supply is protected and sustainable. Developing

countries, however, could benefit from discounted seed or fertilizer prices, if producers demonstrate that they have not been overwatering crops. Charging a fee for water usage may initially be resisted by large, agricultural producers in countries like Canada, who are currently accustomed to having access to an unlimited, free water supply. Change will not come about in wealthy countries until unsustainable practices become cost prohibitive.

The revenue raised could be used to offer grants to agricultural producers, in countries such as Niger, to improve upon sustainable practices. Producers might be better able to improve their practices and use new technology with the support from grants, subsidies, and other incentives. These finances could also be used for research and development in several different areas. For example, there needs to be more research to adapt the technology of drip irrigation for large areas, including corporate farms. If drip irrigation could be implemented at a subterranean level on a large scale, it would allow producers to continue with traditional farm operations. Additionally, more research is required to explore waste water management in urban centres in other countries. Perhaps there are ways to more efficiently recycle waste water in less dense populations.

In order for Niger to meet the challenge of growing crops, it is imperative to find farmers who are interested in such a project. Four aspects must be taken into consideration in making drip irrigation an affordable and easier-to-implement solution. First, a reliable source of water would need to be secured. Secondly, it is important to know what type of equipment and technology is required for the number of farm acres. The farmer must then determine needed funding and seek sources for financial support. Finally, it is essential that proper education is given to the farmer on how to set up, use, and maintain this technological equipment.

A proposal to set up drip irrigation should include a number of details relating to the four aspects previously outlined. Determining the source of water will depend on the location of the farm. Farms located near the Niger River can access available water more readily, while others may have to access internal drainage ponds or temporary rivers. They may benefit from the support of government agencies including the Niger Irrigation Project, or Niger State Rural Water Supply & Sanitation Agency, to help determine their options. The type of equipment and technology needed would be dependent on the location and accessibility to the water source. A firm such as Netafim could aid farmers in deciding the most appropriate equipment required. Once these needs are identified, a budget would be set, and seeking a source of financial backing would then follow, whether it be from the government, a private firm, or a combination of the two. Perhaps global organizations, including UNICEF, might be called upon to provide support in this area, as well. It is important to have on-the-ground support to guide and educate farmers throughout the process.

If this four step plan could be run by the government in partnership with a firm like Netafim, the impact would be significant. This would result in farmers who have sustainable operations that would be able to provide food for not only their families, but also for the region as production increases. The farmers who were taught these sustainable agricultural practices could then become mentors for other farmers who could then also benefit from this cutting edge technology.

In conclusion, as the global population expands, there is greater need for developing sustainable agricultural practices. Water is an invaluable resource that needs to be protected. Governments can play an important role in maintaining change. There are many benefits to implementing sustainable water practices, such as drip irrigation, as well as the education and funding of those in the agriculture sector. Niger is in the early stages of using solar-powered drip irrigation and has already seen improvements in water efficiency. Elements of this technology can be used by any country, regardless of climate or region. With continued development in agri-technology, Niger could not only produce more food for its citizens, but also produce food more efficiently. In short, water scarcity can be effectively addressed through sustainable agricultural practices. Niger has taken a significant first step by introducing drip irrigation technology.

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