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Chad, Climate Volatility

Chad: A Nation Full of Promise, Ravaged by the Extremities of Climate

Climate change has impacted food production and security across the globe, preponderantly affecting Sub-Saharan Africa. The Republic of Chad, in particular, alongside other nations of Western Africa, is facing a widespread food and nutritional crisis of extraordinary proportions. Food security, or accessibility to sufficient and affordable food, in these countries, has drastically declined, for rates of acute food insecurity nearly quadrupled over four years from 2019 to 2022, implying hunger is the predominant issue in a sea of conflicts (Musa, 2022). 5.3 million people in Chad were estimated to be food insecure as of 2022, depicting the highest hunger rates in the world (Musa, 2022). This insecurity is incited by multiple factors including widespread droughts and inconsistent flooding, both such adversities stemming from climate change ("Chad," n.d.).

Chad has a hot, tropical climate, with average temperatures rising to 35 celsius in the summer and going down to 20 celsius in the winter ("Chad," n.d.). Because Chad receives little rainfall throughout the season, it is therefore highly susceptible to extended droughts and rapid floods ("Chad," n.d.). Subsistence farming, along with raising livestock in the form of ranching, incurs rare profits, for these primary forms of income are the main contributors to the fact that 42% of Chad's 17.778 million people live under the poverty line (Chad, 2019; Chad Population, 2019). The effect is shown in the standard architecture of the state, a circular-shaped structure made of mud brick walls that are 4 feet in height and 9 inches thick (Virtual Chad: A look, n.d.). The roof of the house is widened at the top, woven with straw in separate rings, and temporary houses are built next to agricultural lands in harvesting seasons, which are commonly constructed of straw entirely (Virtual Chad: A look, n.d.). Even so, these mud-brick houses are highly susceptible to wind and rain, let alone flooding, dampening walls, and creating large cracks, which make conditions extremely unsafe in such structures (Islam, 2009). These problems are extensively due to the lack of stable income from occupations that are not constantly impeded by the effects of increased greenhouse emissions into the atmosphere, the effects of climate change.

Moreover, the average size of a Chadian family is relatively large, with eight to nine people with six to seven children ("Children's Page, n.d.). A routine diet of this typical family consists principally of self-produced grains in the form of maize, millet, and sorghum, with minute rations of vegetables and meats ("Food in Chad, Africa," 2018). In a nation where 76.22% of the population resides in rural areas, 80% of the Chadian population relies on subsistence farming, a form of agriculture where farmers produce only enough to provide for their family (Chad - Rural Population, 2023; Children of Chad - Humanium, 2011). While the state exports cheap raw materials like petroleum and cotton as well as minimal cattle, meat, and fish, it primarily imports expensive machinery, foodstuffs, and textiles (Chad - Finance and trade, n.d.; "Chad Imports," n.d.). Since the typical Chadian household relies solely on subsistence agriculture to feed and support a family of nine people, Chad's climate volatility takes a detrimental toll on farmers, individual families and even the entire country from progressing in terms of development ("Children of Chad - Humanium", 2011; "When the desert", n.d.).

For example, on top of the difficulty of labor-intensive farming and ranching, while droughts have desertified once fertile land in some areas, floods have scoured entire regions. Constant droughts have severely impacted Chad's agricultural production, affecting nearly 2.4 million people ("Chad," n.d.). A persistent drought season has also accelerated desertification in the northern part of the country, causing agro-pastoral areas to decline and livestock grazing areas to shift further south, reducing both lands for farming and ranching ("Chad," n.d.). The stark contrast between droughts and floods in the generalized location of Chad is present due to the nation's different terrains, especially between wetlands and drylands

(Grove, 2018). While droughts affect wetlands more significantly, floods devastate dryland because the water cannot sink into the ground ("When the desert", n.d.). Floods affected 20 of Chad's 23 provinces in last year's record rainy season, displacing thousands of people in the 1.2 million affected by the floods ("When the desert", n.d.; "WFP Chad," n.d.). Flooding has destroyed greater than 465,000 hectares of agricultural land, heightening the food insecurity situation that is placed at critical levels ("Chad – Floods Affect," n.d.). The same floods affected 1,140 schools with 430,130 students, deleteriously impacting accessibility to education, which in turn, keeps the cycle of subsistence agriculture going ("WFP Chad," n.d.). Due to future generations' inaccessibility to education, they are naturally forced into subsistence agriculture, exacerbating climate change's impact to numerous generations. Apart from these various cases of climate variability, resources are depleting due to these tremendous climate changes. In 2020, 10.9% of Chad's Gross National Income, as a comparable measure, was lost due to natural resource depletion ("Adjusted savings," n.d.). For instance, water scarcity has been wreaking havoc due to climate change. Indeed, NASA predicts Lake Chad, once one of Africa's largest freshwater bodies with the ability to support 30 million people across four nations, could now disappear within 20 years at current usage rates because of climate change-induced droughts, additionally depleting the fertile land around the lake ("Chad," n.d.; "Climate change, conflict," n.d.; "News, A. B. C.," n.d.).

These various problems necessitate a three-pronged compound solution, consisting of one permanent and two temporary solutions in the permanent creation of stormwater drainage systems and short-term actions of constructing highly adaptive floating agriculture systems and the continuous rehabilitation of soil-clastening crops.

The proposed stormwater management and support system, tailored for Chad, is an amplified attempted replication of Cameroon's effective strategies in flood impact mitigation and agricultural water enhancement, designed to counteract upon the dual challenges of flooding and drought by integrating flood control mechanisms with agricultural productivity enhancement through need-based water management (Bank, 2019). The core of the project is built upon the development of a sophisticated infrastructure network that consists of a 3.5-kilometer central drainage canal alongside additional secondary canals spanning 6 kilometers each and a series of stormwater reservoirs (Bank, 2019). These elements perform multiple roles to not only protect residential and agricultural areas from flooding but also store substantial rainwater quantities that can later be harnessed for agricultural use during drought seasons, which provides a dual-edged water supply for irrigation (Bank, 2019). However, both the catalyst and driving force of maintenance lie in its community involvement with the goal of fostering local ownership and sustainability of the stormwater management system in partitioning the structure itself and the responsibility of care (Scholte, Kirda, Adam, & Kadiri, 2000). This comprehensive sustainment plan involves the creation of community-based management committees on top of the training programs that will be developed in partnership with local Chadian organizations such as Association pour le Développement Durable et la Protection de l'Environnement au Tchad (ADDPET) and Réseau de Protection de l'Environnement au Tchad (REPET) both of which organizations have vast experience in instruction on sustainable agricultural practices, water system management, equipment optimization, and emergency response, partnering for the sole purpose of equipping community members with the necessary skills for effective system management, including technical training on infrastructure maintenance, water quality monitoring, and emergency response protocols (Global Environment Facility, n.d.; United Nations Development, 2023; Scholte, Kirda, Adam, & Kadiri, 2000). Additionally, these workshops will focus on sustainable farming practices that will then instruct on the maximization of the use of collected rainwater, explaining the most efficient agricultural practices such as crop rotation, soil conservation techniques, and the use of drought-resistant crop varieties in the face of resource limitations (Zieba, Yengoh, & Tom, 2017). These programs are designed to empower communities themselves, ensuring they possess the knowledge and skills to manage their water resources and agricultural practices, dramatically increasing the impact of the infrastructure (Zieba, Yengoh, & Tom, 2017). The project will use the accumulated stormwater to significantly bolster existing irrigation systems in adding another

source of restockment, directly translating to a stable and enhanced water supply that directs agricultural resilience and productivity (Bank, 2019). Financing this system according to the constraints in Chad, with its expansive geographical landscape and the dual goal of flood prevention and irrigation, would be projected to require a budget ranging from $50 to $70 million over five years, scaled according to the precedent established by the completed project in Cameroon (Bank, 2019). This investment would then cover the costs associated with constructing the detailed canal and reservoir network and implementing community engagement and training initiatives through specialized local organizations like Fondation Tchadienne pour la Protection de l'Environnement (FTPE), an NGO that focuses on natural resource management and community education in high-impact areas, especially Lake Chad (United Nations Convention, n.d.; Zieba, Yengoh, & Tom, 2017). This funding would consist of fiscal withdrawals and investments from numerous organizations including the World Bank, the African Development Bank, the Green Climate Fund, and the Chadian government, drawing parallel confidence from the successful external funding of the Yaoundé Sanitation Project in Cameroon, indeed funded by the World Bank, setting an unequivocal precedent (Bank, 2019). The key trial implementation sites would be Lake Chad Basin and the Logone River floodplain, considering their large-scale agricultural potential and vulnerability to climate extremes (Wanie & Ndi, 2018). The Lake Chad Basin, despite experiencing significant water level fluctuations, becomes the perfect lens to observe the project's impact on water security and promote cross-border climate adaptation efforts (Wanie & Ndi, 2018). The Logone River floodplain, on the other hand, known for its fertile lands prone to flooding, demonstrates the project's ability to transform environmental challenges into agricultural development opportunities (Wanie & Ndi, 2018). In fact, the Lake Chad Basin has the potential to support millions, given its once vast extent supporting over 30 million people across four countries, with significant portions of its populace engaged in farming, fishing, and pastoralism (Wanie & Ndi, 2018). Similarly, the Logone River floodplain, with its annual inundations, enriches the soil, creating fertile grounds for crop cultivation that, if properly managed, can substantially increase agricultural yields (Wanie & Ndi, 2018).

Floating agricultural systems in Chad provide a bright example of how to adapt to increasingly severe flooding—an acutely direct outcome of climate change disturbing traditional cultivation techniques. The systems use buoyant platforms locally and ecologically made with available materials, including bamboo, wood, and recycled plastics, supporting substrate soils for growing mainly leafy greens, herbs, and small root vegetable crops (Atta, Ly, Salack, & George, 2015). These crops are selected due to their suitability for growth under hydroponic-like conditions; they will not be deep-soil seekers and will have to get adapted to drastic changes in water levels for their continued productivity in periods of massive flooding (Atta, Ly, Salack, & George, 2015). This aspect is evident among other things through strategic planning that includes deployment of these systems from pilot projects in the distinct regions of Bahr el Gazel and Ouaddaï, each chosen with unique environmental localities and community adaptability to innovative agricultural techniques (Bantin, Jun, & Si, 2017). The floating systems in such a harsh environment as Bahr el Gazel are thus extremely risky systems because of its harsh and arid climate, with unpredictable high flooding in its seasons (Bantin, Jun, & Si, 2017). The current pilot project focuses on platforms designed for durability and the ability to adapt fast to sudden floods, enabling farmers to practice agriculture in the midst of environmental extremes (Chowdhury & Moore, 2017). In such a semi-arid Ouaddaï, with seasonal flooding, stabilizing agricultural production all through the rainy season is key to proper management of the associated floodwater (Bantin, Jun, & Si, 2017). The platforms in Ouaddaï are designed to maximize water-use efficiency by hosting mechanisms for holding water and giving out moisture during short dry spells experienced post-flooding (Bantin, Jun, & Si, 2017). The pilot projects will therefore involve the design and construction of resilient platforms engineered with cost-effective and environmentally sustainable materials, which are customized to a given crop type and regional condition (Atta, Ly, Salack, & George, 2015). The second reason is an intensive program of community involvement and training, specific to the involvement of local farmers in the implementation, maintenance, and operation of the platforms through situation-specific Chadian organizations in the guise of ADDPET (previously mentioned) and FTPE (previously mentioned) with each charitable institution

focused on water-level management and natural resource utilization respectively (Global Environment Facility, n.d.; United Nations Convention, n.d.; Chowdhury & Moore, 2017). These shall cover training in specialized agricultural techniques fit for floating systems, including improved water management, development of better crop rotation practices, and organic methods to control the pests (Chowdhury & Moore, 2017). Finally, there is a strong monitoring and evaluation framework to track crop yield, efficiency of water usage, durability of the platform, and ecological impact among different sets of metrics (Chowdhury & Moore, 2017). The information acquired would be very useful in the assessment of the viability to scale up the initiative and provide a base for empirical evidence towards the refinement of systems in broader application. Projects like these require, therefore, funding from international climate adaptation funds, government grants, and private sector partnerships that support innovation in the field of climate resilience (Osabohien, Adeleye, & De Alwis, 2020). Three major funding operational strategies have been established to ensure sustainability in these projects. Features range from cooperative models where resources and benefits from floating farms are shared among farmers to micro-financing schemes whereby they support the building of small scale floating farms and local agribusiness processing and marketing produce from floating farms (Osabohien, Adeleye, & De Alwis, 2020). This financial approach ensures initial and ongoing support for the projects, making them viable and sustainable (Osabohien, Adeleye, & De Alwis, 2020). Collaborative efforts are crucial to the success of floating agriculture in Chad. It also collaborates with local governments in ensuring that these projects align with local regional development plans (Osabohien, Adeleye, & De Alwis, 2020). International NGOs with expansive experience in the field of sustainable agriculture in African countries such as World Agroforestry (ICRAF) and International Fund for Agricultural Development (IFAD) provide technical expertise and other resources (CGIAR, n.d.; International Fund for Agricultural, n.d.; Osabohien, Adeleye, & De Alwis, 2020). Under funding, leading Chadian academic institutions in agronomy like the University of N'Djamena participate in the support for research and development of innovative solutions and the continuous improvement of the floating farm systems (University of N'Djamena, n.d.; Atta, Ly, Salack, & George, 2015). Secondly, local communities are an integral part of the proposed solution to make sure it is culturally apt and managed locally (Chowdhury & Moore, 2017). This, in a way, brings in a sense of belonging and commitment toward the success of floating agriculture projects (Chowdhury & Moore, 2017). If initiatives like a floating agriculture system with such elaboration and location precision are also considered, Chad would embrace agriculture in flood-prone areas as an opportunity that would make great strides for food security, economic stability, and resilience building from climate variability (Atta, Ly, Salack, & George, 2015). Such comprehensive efforts would be aimed to solve not only the immediate problems but also the setting up of a sustainable agriculture model able to face the coming uncertain changes in climate (Atta, Ly, Salack, & George, 2015). The initiative, therefore, would build a strong agricultural infrastructure through careful planning, local community partnership, and international collaboration that could help in overcoming the menacing climate challenges that are prone to evolve, thus ensuring a secured resilient and prosperous agricultural future for Chad as a whole.

Lastly, a method currently being implemented by nonprofit organizations in Chad is the rehabilitation of degraded land by planting trees. Eroding fields and stream banks are stabilized through the planting of trees (“Degraded Land Restoration,” n.d.). Furthermore, this can create drought-resistant soil, promote biodiversity, restore grasslands, and of course increase nutrition (“Regeneration International,” 2015). However, this is being done at a minimalized scale, which is why the government will have to work together with reforestation-focused voluntary aid agencies like Projet de Conservation et de Valorisation de la Biodiversité au Tchad and Association de Développement et de Secours in order to effectively provide land and end conflicts between pastoralists and farmers (Global Environment Facility, n.d.; United Nations Development, n.d.). The low-cost project requires little funding from local governments, civic organizations, and even less out-of-pocket from farmers. Because natural disasters may impede progress, regions must be rehabilitated extremely efficiently. It is very important to emphasize that this solution is a temporary placeholder until the primary constructive solution has been implemented over the course of five years.

Chad currently faces strenuous challenges in many sectors springing from climate change. However, it is important to recognize that these challenges only add on to the difficulty of raising a 9-person family. Droughts have affected nearly 2.4 million people, impacting farmlands and livestock grazing while floods destroyed 465,000 hectares of agricultural land and deprived 430,130 students of a continuous education ("Chad," n.d.; "When the desert," n.d.; "WFP Chad," n.d.). Yet, the land is still full of possibility with numerous solutions looming over in the form of canal construction, genetically modified crops, adaptable hydroponic systems, and even rehabilitation of degraded land. Chad is a country in an acute state of food insecurity caused by extremely different problems that all stem from climate change, but it is also a country full of promise with local and international cooperation holding the key to bringing the nation back into a state of food security.

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