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Tanzania, Factor 5: Climate Volatility

Climate Volatility and its Effects on Food Insecurity in the Sub-Saharan Country of Tanzania

1. Introduction to Tanzania:

Tanzania is a Sub-Saharan country in East Africa globally ranked as the 19th most food insecure (Global Food Security Index). This food insecurity results from current agricultural practices that are not adapted to the changing climate trends. The impact is shown on the entirety of the population, yet more so on agricultural households. Food insecurity, created by climate volatility, if left unchecked, will continue to deteriorate the living conditions of Tanzanians.

The average family size in Tanzania is 4.9 people, with rural, agriculture based households averaging 5.4 people; these households are predominantly patriarchies and illiterate, with only 2.6 members being of working age (National Bureau of Statistics 2; World Food Programme 34). The average plot size for a smallholder subsistence farmer is 2.6 hectares (World Food Programme 41). Maize, rice and sorghum are the prominent crops grown (Westengen and Brysting). One-fifth of Tanzanian women and one-tenth of Tanzanian men have no education; about two thirds have had some form of schooling (Tanzania National Bureau of Statistics 2). Access to health care in Tanzania, especially for those under the poverty line, is subpar. Health care professions are severely understaffed, with only 35% of the workers being qualified for the positions they hold (Wong). The facilities themselves often lack proper equipment and supplies (Wong).

Traditional cultural norms add to food insecurity. Often, food is unfairly distributed in a family; those who eat fast eat more, women eat only after the male is satisfied, and children can be fed first or last depending on community norms (Kinabo et al. 17). Common food preparation techniques lead to the destruction and loss of nutrients that are heat sensitive or water soluble, which in turn can lead to poor nutrient intake (Kinabo et al. 17). Nationally, 8.3% of the population is food insecure, but 22% of those who consume their own food are struggling with sustainability (World Food Programme 7, 18). Of those 8.3% under the food poverty line, 94% live in rural areas (World Food Programme 27).

Limits in both employment and food access prevent impoverished people from food security. Those employed as smallholder farmers are disproportionately food insecure, and do not have the resources to start new career paths (World Food Programme 11). Lack of education in rural areas also prevents people in poverty from opportunities to higher earning jobs.

While there are several barriers to agricultural productivity, two major ones are irrigation and tool use. Only 15% of arable land is used for farming (Rowhani et al. 450) and less than 2% is irrigated (Ahmed et al. 2). This lack of irrigation causes farmers to rely on precipitation to fuel their crops, leading to less productive years when rainfall is low, which in turn makes them susceptible to food insecurity. Food insecurity is worsened by the lack of efficient tools used by typical farmers. Only 10% of farmers own a plow, yet 92% own a hoe and farm primarily by hand (World Food Programme 41). The overwhelming amount of primitive tool use leads to lower productivity since people are unable to cultivate the land with the same standards used by wealthier farmers in other countries.

2. Current Impact of Climate Volatility on Farmers:

Climate change has caused significant food deficiencies in agricultural households. From 2010-2011, 20% of households were short of food 3.5 months in a year (World Food Programme 22). In order to conserve food, 3.3% of all Tanzanians had to go a whole day and night without eating, 5.8% wouldn't allow their children to eat and 22.5% ate fewer meals (World Food Programme 68).

Poor farmers are attempting to deter the negative effects of climate volatility before they are struck by climate change. They are changing cropping areas, crop species and livestock as well as shifting seeding and harvesting dates in anticipation of climatic events. (Westengen and Brysting). Unbeknownst to them, it is the expectation of these shocks that can be more damaging than the occurrence itself, which in turn is causing lower productivity (Hertel and Rosch 23). Precipitation, or lack thereof, is a large factor in determining profits. Each drought that devestates a farm's crops can take up to ten years to recover from, during which a family's income is significantly reduced (Hertel and Rosch 27). This pushes those who are food insecure into selling their assets, and leading to an inability to make long term investments (Nelson and Stathers 7).

Past and current trends show increasingly poor crop yields directly related to climate volatility. Lowered rainfall in 2009 and 2011 not only lead to adverse crop production, but negatively affected the global economy as well (World Food Programme 9). The global temperature has already risen a fifth of a degree (Celsius) in the past 50 years (Giorgi and Pistaferri 5). This has risen weather volatility, which has decreased the output of most crops (Giorgi and Pistaferri 6). In a study conducted in the Mvomero District, 78.8% of people reported that major crop yields continuously decrease due to drought (Mkonda 268). Rain and crops in this district fluctuate with one another; as rainfall goes down, so does crop production (Mkonda 269). Climate variability has already reduced maize productivity by 12 Megatonnes per year since 1981 (Rowhani et al. 449).

It is not future climate *change* that is inherently negative, but rather the increased frequency, severity, and variability of the changes. As the intensity of the climate varies, the general trend is that crop yields decrease and prices increase (Rowhani et al. 458). The main two factors determining climate volatility are precipitation and temperature. Studies by the Review of Developmental Economics, Agricultural and Forest Meterology (AFM) and The World Bank showed that a hypothetical but probable 2℃ increase in temperature would decrease the yields of maize by 20±7%, sorghum by 11.15±2.35%, rice by 19.3±11.7% and wheat by 13% (Martin et al. 429; Rowhani et al. 457; Ahmed et al. 8). Some regions may see an increase in rainfall by 50%, which would create more severe, frequent floods (Rowhani et al. 450). This same report, conducted by AFM, showed that a 20% increase in intraseasonal precipitation variability decreases average maize yields by 4.2%, sorghum by 7.2% and rice by 7.6% (Rowhani et al. 449). Since it is impossible to predict exact outcomes, a 20% reduction in precipitation was also considered, and was found to increase droughts (Rowhani et al. 449). The predicted rise in greenhouse gases and CO_2 emissions could increase the frequency and intensity of temperature and rain extremes (Hertel and Rosch 5; Ahmed et al. 2).

Every simulation in a study by The World Bank showed a poverty increase due to climate extremes (Ahmed et al. 16). Additionally, a sample of 16 developing countries concluded a 900-2700% rise in the occurrence of extreme events that otherwise only happen once every 30 years (Ahmed, Diffenbaugh and Hertel 2). Tanzania, according to the same once-in-30-year model, will have up to a 21.3% increase in poverty (Ahmed, Diffenbaugh and Hertel 5). The climate situation is clearly getting worse, and if ignored, will only result in higher food insecurity for Tanzanians.

3. Looking Ahead for the Tanzanian Farmer:

By implementing solutions to combat the negative effects of climate volatility, Tanzania can expect a rise in the yields of climate sensitive crops, thus increasing the amount of food available to insecure households. Maize, in particular, has an increase in yield by 115% when farmers use inorganic fertilizers (World Food Programme 41). Since agriculture in Tanzania is primarily composed of climate sensitive crops, and since agriculture is 24.1% of the GDP (World Food Programme 10) and accounts for 85% of exports (Makoye), Tanzania can expect a substantial economic boost by increasing yields. This will naturally lead to a higher absolute number of crops being sold, both within the country and internationally, and thus increase the amount of money being brought in while decreasing the number of food insecure people by having more crops at lower prices (World Food Programme 33). Tanzania will see a reduction in the number of people who do not consume the minimum caloric intake, thereby taking them out of the food poverty line. Not taking any precautions will drive market wages down in the event of climate shocks, putting unskilled workers at a higher risk for food insecurity by forcing them to accept lower wages while simultaneously increasing food prices (Martin et al. 430).

As society delves deeper into the 21st century, several issues will deteriorate the Tanzanian lifestyle. Globally, the energy demand will intensify, further polluting the air with CO_2 emissions. These emissions will exaggerate the impacts of climate volatility by exponentially increasing temperature (Hertel and Rosch 6). The escalation in temperatures will create more frequent, severe droughts, increase water scarcity and cause a weaker economy. Already, there has been a 1% decrease in GDP derived from agriculture because of climate extremes ("Tanzania Needs Over"). The increase in pollution, temperature and water scarcity will no doubt affect the well-being of Tanzanians.

4. Recommendations and Solutions:

Before going into the solutions, a brief overview of topography is needed. Tanzania is split into two main climate regions; unimodel and bimodel (World Food Programme 22). The unimodel region encompasses the south, central and western portion of the country (World Food Programme 22). Its rainy season is from December to April with planting in November and harvesting in June and July (World Food Programme 22). The bimodel region includes the north, northwest, east and northern coastline (World Food Programme 22). It sees two periods of rain a year, with the 'short rains' occurring from October to December and the 'long rains' from March to May (World Food Programme 22). The harvest for the short rains is January and February, and the harvest for the long rains is from July to August (World Food Programme 22). The unimodel region receives less than 500 mm of rain a year while the bimodel receives 750 mm (Our Africa).

There are two types of solutions that should be implemented: adaptation and policy. Adaptation can be further broken down into irrigation and biotechnology. Water scarcity is the utmost concern for many Tanzanians who are affected by both harsh droughts and floods. A way to use these two extremes to their advantage would be to place a system of pipelines along both flood and drought prone areas. Since the bimodel region is more susceptible to extreme precipitation, large drainage pipes should be placed periodically along areas with a history of high floods. Then, a series of pipes should carry collected water to the unimodel, drought prone regions of the country. Introducing this system would allow a more even distribution of water, which is particularly necessary during the growing season. An area can show poor crop production even with high rainfall if the rainfall is unevenly distributed or falls after the crops are irreversibly damaged (Mkonda 267). A 54% increase in crop yield has been shown when rainfall is evenly distributed, thus creating a system of pipes would help eliminate the problem of lowered yields due to uneven rainfall (Mkonda 270).

Next focusing on biotechnology, there are a few prevalent technological advances that should be considered. Biofortification is the process of breeding crops with the intention of adding micronutrients to foods (World Food Programme 48). By making plants that have gone through the biofortification process more available to farmers, both them and those who purchase their products will have higher quality diets. Another form of biotechnology that could substantially help farmers are improved varieties of seeds. Most farmers do not buy seeds from reputable plant breeding facilities, but rather use local varieties (Westengen and Brysting). Local varieties of maize and sorghum often have maturation periods of 3 months and 5-7 months, respectively (Westengen and Brysting). This is proving to be a problem for farmers, as local varieties are prone to day-length sensitivity and the rainy season continues to get shorter

(Westengen and Brysting). Some farmers are already adapting by using a combination of improved varieties, which only take up to 90 days for maturation, with local varieties, which are still valuable as drought-tolerant crops. If more farmers used a combination local and improved varieties, they would have crops that prosper even in periods of short rains, yet still have drought-tolerant ones in case of weather extremes (Westengen and Brysting). By dedicating research facilities for these fields of biotechnology, the long term benefits would be plants that are overall more resistant to disease and drought.

The second type of solution, policy, can be diversified into three main sections: insurance, seed aid and CO_2 emission incentives. Subsistence farmers are usually distrustful of insurance schemes offered to them, even when subsidized (Hertel and Rosch 45). This is in large part because there are many barriers to receiving insurance, however, insurance plays a key part in the recovery of farmers struck with disaster (Ahmed, Diffenbaugh and Hertel 7). The payouts from insurance companies can determine whether or not a household will recover from climate shock. One way to implement effective insurance coverage programs would be to provide public weather index insurance, which pays out in the event of certain weather conditions (Hertel and Rosch 31).

The Tanzanian government is now utilizing seed aid in an attempt to help poor farmers. This aid includes subsidizing and distributing certain drought-resistant seed varieties of maize and sorghum (Westengen and Brysting). If this program was expanded, higher quantities of advanced seeds could be distributed, which would increase the yields of those who otherwise would use less effective seeds. After farmers use the seed aid for a few years, and are satisfied with the results, they are more likely to take it upon themselves to practice better seed usage.

Lastly, CO_2 emission incentives need to be put in place. Human CO_2 emissions are a major factor into the escalation of temperature, not only in Tanzania, but throughout the world (“Tanzania Wants Single EAC”). The Tanzanian government should put a stamp system in place so that every time a household saves a predetermined amount of CO_2 from being released, they receive subsidized food, or for wealthier families, subsidized health care. This recommendation goes to directly combat climate change, and if other countries achieve similar policies, could delay or minimize the temporal effects of CO_2 emission. Controlling temperature increases caused by humans would help ensure Goal 13 of the Sustainable Development Goals: take urgent action to combat climate change and its impacts. ("Sustainable Development Goals").

Altogether, these recommendations work toward eradicating extreme hunger and poverty in Tanzania, aligning with Sustainable Development Goal One: end poverty in all its forms everywhere ("Sustainable Development Goals").

There are a few organizations to consider involving when pushing the issue of food insecurity. The National Nutrition Strategy (NNS) focuses their efforts on food sustainability in Tanzania’s mainland (Ministry of Health and Social Welfare). The United Nations Development Assistance Plan (UNDAP) is already active in Tanzania, and is working not only toward curbing the effects of climate change, but other reform issues as well ("United Nations in Tanzania”). The entity most involved would be the Tanzanian government, who must create and enforce innovative policies to see progress. They are already starting to do so with programs such as the Irrigation Development Fund, aimed at aiding food insecure people (Makoye).

5. Conclusion:

Participatory Integrated Climate Services for Agriculture is a small, local program piloted in November 2014, and is working to inform village farmers of productive planting techniques (Schubert). They have already targeted three communities, and have had success in persuading farmers to use different strategies to suit the climate they live in (Schubert). If this project was extended to reach out to more farms and a notable portion of households decided to use their services, there could be a substantial rise in the total volume of crops. Once learning about the detrimental effects of climate volatility on agriculture, either through this program or others, Tanzanian farmers should be encouraged to inform other farmers, as well as be involved in lessening climate impacts by attending meetings, updating farming techniques, and even lobbying to policy makers.

Undoubtedly, climate volatility has serious impacts on food availability. Up to 70% of the labor force earns their livelihood in the agricultural industry, and so the effects of climate variability will be pronounced in this portion of the population (World Food Programme 10). A probable 2-4℃ rise in temperature is shown to decrease crop productivity (Rowhani et al. 450). By mid-century, a 25-35% maize yield reduction will occur, given a possible 15% decrease in rains ("Tanzania Needs Over"). The lowered crop yields will push up to 1.17 million more people in poverty, making them more prone to food insecurity (Ahmed et al. 14). Although the economy is declining, there are measures Tanzanians can take to create stability. While irrigation and seed management are perhaps the most critical ways to improve yield productivity and adapt to climate change, CO_2 emission incentives have the most direct impact in minimizing climate volatility. Biotechnology, alongside public weather index insurance and seed aid provide invaluable ways for smallholder farmers to adapt to an unpreventable situation. Those with the most to gain are the ones currently below the food poverty line; ultimately it is their voice that must be heard in order for Tanzania to combat climate volatility and increase food sustainability.

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