

The Impact of Climate Change on African Food Security and Economy

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Abstract: On the African continent, climate change severely challenges agriculture and livestock. Agriculture in many African countries is stuck at the rain-fed stage due to a lack of irrigation technology, so reduced rainfall and frequent droughts in recent years have drastically reduced crop yield. A similar problem also happens to animal husbandry, which shrinks the quantity and quality of livestock. Since agriculture and livestock are the primary sources of income in most African nations, many Africans are also suffering from a severe economic crisis. Poverty and food insecurity in Africa still cannot be underestimated even today, despite local people actively adopting adaptive policies to mitigate the threats posed by climate change. Fortunately, some African governments have begun to popularize technology and education to deal with extreme environments, and some potential industries can also be used to revitalize the economy. Although these projects have insufficient support, Africa's climate problems can still be improved in the future if African governments, non-government organizations (NGOs), and international societies plan carefully. This article focuses on the impact of climate change on food production on the African continent, as well as some potential solutions. In general, the effects of climate change on livestock and agriculture in Africa are more severe and complex than they are in other regions. Though African governments are trying to find a way out through education, technology, or new industries, climate change is still an issue that needs to be treated with caution in Africa, given the shortcomings of poverty and backward development.

Keywords: Africa, climate, agriculture, livestock

1. Introduction

In recent years, the effect of climate change has been puzzling governments. In Africa, the threat posed by climate change is even greater and more serious. Although most African states have faced persistent social problems since the wave of colonial independence movements in the 20th century, what climate change has brought is more rigorous as it threatens the survival of African citizens. Phenomena such as droughts caused by climate change make the environment less conducive to food production. The extreme climate has negatively affected the food production of Africa to varying degrees each year but generally lower yields of crops and livestock to a large extent. According to a report by the African Union, about 346 million African people suffer from chronic starvation. More importantly, most African countries stay in the third-world phase, with over 50 percent of people relying on agriculture or pastoralism and seeing them as the primary source of

Gross Domestic Product (GDP). Therefore, many local people have to endure economic pressure when the quantity and quality of crops or livestock decrease. In this statement, the overall purpose of this paper is to examine the impact of climate change on the African region, discuss the adaptative strategies employed by local citizens, and propose some relatively viable solutions. It is hoped that this article can improve readers' understanding of the dilemma faced by African residents and improve food production in Africa to a certain extent.

2. The Impact of Climate Change on the Agriculture of Africa

Climate change has a heavy influence on agriculture in Africa. With a savannah environment, the land in most African countries is actually not as fertile as that in Asian countries, so it is not suitable for planting crops, which is why African people have suffered from food insecurity for millennia. Before climate change, African agriculture was concerned with several risks, such as water scarcity, soil degradation, and recurring droughts. With a rapid rise in global temperature, the food insecurity crisis continues to deepen. One of the notable changes that climate issues have brought to Africa is water scarcity. Unstable precipitation patterns lead to unpredictable rainfall in many regions, so drought is becoming more frequent, affecting soil moisture levels. In the Sahel, there has been on average a 25% decrease in rainfall over the past 30 years [1]. The situation in East Africa is also not optimistic. Since there is no advanced agricultural technology, many states in East Africa, including Tanzania, Rwanda, and Somalia, depend highly on rainfall to supply water. According to the Standardized Precipitation Index, most of the region has seen less rainfall for 12 months since May 2010. Correspondingly, crop yields in East Africa also fell sharply that year. In Kenya, harvests in agricultural areas were only around 20 percent of normal during the dry season in 2011. Crop yields in southern Somalia were similarly poor, with the lowest production of sorghum and maize in 15 years [2]. For most African countries that rely on agricultural income, this level of production reduction is unacceptable. Therefore, to make up for economic losses, an increase in the food price is inevitable, leaving people in many regions such as sub-Saharan in a dilemma. Food affordability of these people is vulnerable due to low average income, widespread poverty, and heavy reliance on expensive food imports [3]. Between 1981 and 2010, as many as 500,000 Africans died due to a lack of food. In 2012, 239 million people suffered from hunger in sub-Saharan Africa [4]. As global temperatures continue to rise, yields from rain-fed agriculture will keep reducing, and Africa may face a rigorous development challenge.

3. The Impact of Climate Change on the Livestock of Africa

Moreover, climate change also brings trials to livestock. Water scarcity is particularly hazardous for large livestock that require large amounts of water to drink and cool themselves. At the same time, livestock are also facing starvation due to the lack of irrigation technology, and the feed production of pastures in many African regions is also dependent on rainfall. Thus, the livestock in Africa frequently suffer from hydration or nutrient deficiencies. In the Borana zone of Ethiopia, since pastoral areas experience drought every 1-2 years, there has been a decline in the quality of livestock: the size has been reduced by 315%. Due to insufficient nutrients, many cows, goats, and camels produce far less milk, putting the nutrition status of local infants and lactating mothers at risk. Meanwhile, rising temperatures also increase the death rate of livestock by spreading disease and heat stress. Warm and humid conditions can also lead to the breeding of disease vectors such as mosquitoes and ticks, which increases the risk of disease transmission among livestock. In the example of Ethiopia, the nation with the largest livestock population in Africa, arid and semi-arid pastures cover more than 62% of the country's land area, keeping over eleven million heads of livestock [5]. Cattle are the most numerous and critical animals as there are about 65 million cattle

in Ethiopia, so it is also considered a country with a prospective cattle resource. However, large animals like cattle are pretty vulnerable to drought, as roughly 68% of livestock killed by drought were cattle. A family Bogado could own 30 cattle and 25 sheep prior to the drought, but only two frail cows were left afterward [6]. The severe simultaneous decline in livestock quality and quantity has left many people living in Central and East Africa in economic turmoil.

4. Hidden Risks in the Response of Africans to Climate Change

Beyond climate change itself, the way African inhabitants deal with this environmental catastrophe is also a hidden risk. In fact, most people have little awareness of climate change as they never receive related education. In a survey of 130 Tanzanian herders' cognizance of climate change, only 64 participants understood that climate change refers to changes in rainfall patterns; only about four people realized the connection between climate change and environmental changes, natural variance, or factories [7]. At the same time, the backward technology in African countries also makes it impossible for people to deal with the interference of natural disasters effectively. With undeveloped surface water and groundwater supplies for irrigation, desolate pastures cannot be recovered in a short period. Most African herders use a more primitive method, migration, which makes livestock health deteriorate. The unique ecology of Africa makes the internal regions have specific differences, and frequent migration will make livestock unable to adapt and more susceptible to local diseases. For example, there is a unique kind of mosquito called the tsetse fly, which is inhabited in the northern part of Borana, and livestock migrating from the south area are easily infected and can even die because of trypanosomiasis. Some herders make up for financial losses by selling timber. However, this method has caused environmental problems to fall into a vicious circle: selling wood means more deforestation, ultimately accelerating local global warming and intensifying the plight of agriculture and livestock. Many people have also realized the harm of cutting down trees to the environment but have not taken corresponding measures. Perhaps for deeply impoverished residents, profits gained from cutting trees are more important than invisible threats.

5. Adaptive Strategies

Although the climate issue is a calamity for Africa, some feasible adaptive strategies remain. In the agricultural aspect, farmers can pick some early-maturing and drought-tolerant species as main crops, such as sweet potatoes, beetroots, and cabbages. Seeds of these plants are cheap and readily available, making them ideal for small-scale farmers in poverty. Breeding new varieties with higher productivity is also the choice of many African countries. Zimbabwe and Kenya's national agricultural research systems achieved major breakthroughs and increased yields in hybrid maize in the 1960s [8]. Mixed cropping is also an efficient method to increase overall productivity: different crops have varying rooting depths and nutrient requirements. Farmers can make more competent use of soil nutrients and water by mixing crops with complementary characteristics. In West Africa, experts successfully advance soil fertility by paying attention to alley cropping and crop rotations, including legumes. A similar method can also be employed for livestock. Compared with cattle, goats or camels are more tolerant of droughts. From the profit viewpoint, goats are a good substitute for cattle due to their high reproductive frequency, low feeding cost, low purchase cost, and convenient management. Thus, Africans could increase their food production with species that are better adapted to extreme environments. Nevertheless, such adaptive strategies can only reduce farmers' losses due to climate but do not really solve environmental problems. The fundamental problem of Africa's food production and associated economic crisis lies mainly in the dependence of small farmers on rain-fed agriculture and a lack of infrastructure. Furthermore, the rapid increase

in population is also putting pressure on available resources and agricultural land. Even with increased productivity through adaptive strategies, a growing demand for food can outstrip supply. Africa's plight will only worsen as less land is available for grazing or planting, and temperatures rise unless fundamental technical and equipment issues are addressed.

6. Possible Solutions

In order to cope with the challenges brought by extreme environments, the first thing African countries need to do is to develop and popularize corresponding technologies. Small-scale irrigation is a representative case. This technology can allow farmers to employ simple equipment, treadle pumps, to access water. Such low-cost technology could effectively increase the productivity of people living in sub-Saharan regions. The government can also cooperate with NGOs to distribute some assistance in equipment, such as water supply tankers or water pumps, to areas that are deeply affected by climate change. Still, what African governments can offer to support these proposals is limited. For many years, frequent civil wars, military coups, and corruption have made the political situation in Africa unstable. Many governments need to allow citizens to enjoy equal rights and interests equally. For example, people in Msinga of South Africa once complained that government institutions favor community members they are politically affiliated with and often do not follow through with their management decisions [9]. Oppositely, some NGOs actively provide services to residents, but because of a lack of government support, the efficiency of popularizing formal equipment and technology is always low.

Another method is to develop some new industries, such as the fish sector. Fish is an essential source of food in Africa, providing around 19% of animal protein intake and uniquely providing a range of micronutrients. More significantly, there are many large lakes and rivers in Africa, such as Lake Victoria and the Nile, which provide enormous resources for inland fisheries, making it an important factor in Africa's economic development. Small-scale fisheries play an important role in African economies, providing livelihoods for millions of people, especially in remote rural areas [10]. Even though fishery has considerable potential in Africa, it also faces similar problems as agriculture and livestock: technological backwardness. African fishers still use traditional capture fisheries rather than aquaculture. This method severely limits the growth potential of the fishery, making it difficult to compete with Asian fisheries with improved fish species, feed, and training in farming techniques. More fish and trade data are also one of the significant constraints facing the aquaculture sector. Therefore, African fisheries still need more detailed policies and inputs to thrive.

At last, education is also a part that cannot be ignored. Setting up curricula in African schools for later education to ensure that people have a sound understanding of climate change could allow farming communities to respond more quickly. Politicians in Africa also realize the importance of education. For instance, Rwanda's environmental education for sustainable development strategy aims to create environmental awareness, complemented with ecological topics embedded in all its K-12 curricula to foster eco-friendly attitudes [11]. Many African young people have shown more significant concern and willingness to act on climate issues. They may support climate education in schools to better understand and engage in environmental action. Local teachers are also in favor of being set up to teach courses related to climate change. Some educators even consider combining climate-related knowledge with local knowledge systems so that local students can better understand it. In general, there is growing awareness of the importance of climate issues and support for climate-related education in schools. The disadvantage of this project is that the education system in Africa needs to be more advanced. Many teachers need to be more trained about climate change and they need more resources to teach the subject. Therefore, this project also needs much time to integrate relevant knowledge, the education system, and related occupations.

7. Conclusion

In conclusion, climate change is an unavoidable problem for the whole world, and its impact is undeniable in Africa. The fundamental reason why this kind of environmental problem can cause considerable losses to African animal husbandry and agriculture is that the backward technological development and the education level in African states make residents lack the means to deal with it. Although African governments have begun to popularize corresponding technology and education, and these investments can effectively improve Africans' understanding of climate change and relieve a certain degree of poverty, the efficiency is not high, mainly because many African countries have their unstable political environment or the long-standing deficiencies in African society, so the African people are likely to need more assistance from NGOs or international organizations to alleviate the current shortage of economic and food needs. This article is only to help readers have a general understanding of some of the climate impacts in Africa without detailed data display. Some of the solutions discussed are also vague frameworks; the specific development of these options requires a more thorough investigation. For example, in terms of the fishery, how to learn from the successful aquaculture cases in some countries, such as Egypt, and apply them to the fishery sector operations in other states can be further discussed. These ideas still need more research and practice.

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