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IMPACT OF CLIMATE CHANGE ON FOOD SECURITY

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Abstract

Climate change is often associated with the melting of polar ice caps or the potential extinction of certain species. However, its consequences are much more extensive and ominous than commonly understood. One of the critical implications of climate change is its detrimental effect on food production and supply, posing a significant threat to global food security. As global temperatures rise and weather patterns shift, crop yields and productivity are increasingly compromised. This situation is exacerbated by the heightened likelihood and severity of adverse climate events and natural disasters. Furthermore, air pollution contributes to the decline in crop yields, particularly affecting staple foods like rice, soybeans, and wheat. Additionally, changing weather patterns intensify water scarcity, reduce livestock productivity, and impede food access and distribution. While short-term solutions can alleviate some of the pressure, a sustained global commitment is imperative to mitigate the effect of climate change on our food safety in the long run.

Keywords: climate change, food security, forest ecosystem, agriculture, livestock

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Introduction

The term "food security" was coined at the 1996 World Food Summit and means that people can always afford to eat enough food that is both safe and nutritious to suit their needs and tastes, so they can stay active and healthy (FAO 2015). Here we see four important aspects of food security: first, that food is available; second, that it is affordable and easily accessible; third, that food is used in a way that the human body can absorb it; and last, that these three aspects are stable. Even if the world's food supply is sufficient at the moment, about 800 million people go hungry every day. Mostly because there isn't enough readily available food that is both healthy and inexpensive. According to the International Fund for Agricultural Development (IFAD), around 70% of the world's modest people call rural areas home. Agriculture is the main source of income for these people. The International Federation for Agricultural Development (IFAD) estimates that roughly 2 billion people in developing nations are supported by about 500 million smallholder farms. Little farms like these provide about 80% of the world's food, mostly in Asia and sub-Saharan Africa (2015, FAO). Climate change poses risks that could erode the gains made in the fight against hunger and malnutrition. Those nations and peoples who are already at a disadvantage will feel the effects the worst, including those in semi-arid and dry regions, landlocked countries, and developing governments with small islands. In addition, food markets, trade flows, price stability, and human health are all susceptible to disturbance as a result of climate change. If we are serious about securing food for the world's population, we must act swiftly to combat environment change and strengthen food system resilience.

Climate change threatens food security in multiple ways, and some of the notable effects include:-

Altered Weather Patterns: Climate change disrupts weather patterns, resulting in extreme events like droughts, floods, heatwaves, and storms. These occurrences can damage crops, disrupt food production systems, and decrease agricultural yields.

Decreased Crop Yields: Increasing temperatures, elevated pest and disease prevalence, irregular rainfall, and pollutants in ground level ozone contribute to reduced crop yields. Consequently, this situation can lead to food shortages, price fluctuations, and consequent implications for food security.

Water Scarcity: Climate change has a direct impact on water resources, affecting their availability and quality, which are crucial for agricultural production. Shifts in precipitation patterns and higher evaporation rates can cause water scarcity, thereby affecting irrigation practices for crops and livestock farming.

Livestock Challenges: Rising temperatures, heat stress, and changes in available forage pose challenges for livestock production. These factors can lead to decreased meat and dairy production, thereby impacting the availability and affordability of food.

Food Access and Distribution: Climate change can disrupt transportation routes, damage infrastructure, and hinder market access for food. This disruption poses challenges in distributing and accessing food, particularly in vulnerable communities.

Please keep in mind that there may be additional elements at play in addition to these that influence the ways in which climate change affects food security.

Impact on crops

Crop yields are vulnerable to climate change, which includes changes in temperature and atmospheric CO2 levels as well as the frequency and rigorousness of extreme weather events. The effects of hot weather on different crops will depend on the ideal temperatures such crops need to thrive and reproduce (EPA 2016). In certain regions, warmer conditions may prove advantageous for the cultivation of crops that are well-suited to those areas or enable farmers to transition to crops typically grown in warmer climates. Conversely, when temperatures surpass a crop's optimum threshold, there will be a decrease in yields. Experiments in the lab have shown that plants can grow faster when exposed to higher concentrations of CO2. Potential increases in yield could be offset by other reasons such shifting temperatures, ozone, water and fertilizer restrictions, and so on. For instance, crop yields can be negatively affected or even reversed if environmental conditions such as excessive heat, lack of water, and nutrients are not ideal. There is evidence that increased CO2 levels cause alfalfa and soybean plants to produce lower-quality crops with lower protein and nitrogen content. The capacity of rangelands and pastures to sustain grazing animals can be diminished when the quality of grain and forage is diminished (Hatfield 2014). While the increase in carbon dioxide (CO2) levels can promote plant growth, it concurrently diminishes the nutritional quality of various food crops. The elevated atmospheric CO2 levels have been observed to decrease protein and essential mineral concentrations in numerous plant species, such as soybeans, wheat, and rice. This direct consequence of CO2 rise poses a potential risk to human well-being, as it impacts the nutritional value of crops. Additionally, human health faces threats from amplified pesticide usage necessitated by heightened pest pressures and reduced effectiveness of pesticides (Ziska 2016). Further, the main pollutant which impacts crop yields is ground level ozone, also known as O3 gas. It is a short-lived pollutant that is formed when Nitrogen oxides from vehicle and power station emissions react with air pollutants. O3 attacks crops by damaging their cell membranes thus affecting the flowering and growth of crops and is widely considered as the most notorious pollutant affecting crop productivity. Ozone pollutions are a global problem and will require investments from industry and governments for a viable long-term solution. But there are several short-term solutions which can certainly help ease the pressure on our food supply.

Impact on livestock

Direct and indirect effects of climate change on animals are possible. Heat stress is the biggest problem that animal production faces among the direct affects. Livestock farmers bear a heavy financial burden due to heat stress, which diminishes milk components and production, decreases meat production, hinders reproductive efficiency, and negatively impacts animal health. Hence, some climate change models predict that animals' performance can be directly affected by an increase in air temperature. Indirect effects, such as diminished or inadequate access to water and feed resources, account for the vast bulk of climate change-related output losses. Changes in the global climate may impact the amount, consistency, and quality of fodder production, in addition to the amount of water needed to grow forage crops. It can also cause patterns in rangeland vegetation on a wide scale to be disturbed. As a result of shifting precipitation patterns, crops and forage plants will face more heat waves, higher levels of carbon dioxide, and unpredictable water supply in the decades to come. Not only can these changes affect the overall ecological functions of grasslands, but they can also have a negative impact on productivity, species mix, and quality. The scarcity of water profoundly disrupts animal physiological balance, leading to weight loss, decreased reproductive rates, and heightened vulnerability to diseases. Additionally, climate change may contribute to the emergence of new diseases, including vector-borne illnesses, resulting in substantial economic losses. Livestock reared in tropical environments often experience multiple stressors concurrently, which significantly impact their production, reproduction, and immune status. Animals' development and reproductive performance are less negatively affected by heat stress and nutritional stress when these stressors are experienced independently rather than simultaneously (Sejian et al., 2011). Changes to growth and reproduction characteristics are most noticeable when all of these stresses are present at once. Furthermore, when these animals are confronted with single stresses, such as heat, their adaptive processes are different than when they are confronted with combined stresses, such as dietary variables and heat (Sejian et al., 2010). The impact on the basic biological functions needed for adaptation and maintenance during stressful periods can be substantial when many stressors occur at the same time. Continuing to strive for or maintain current production levels in an environment that is becoming increasingly challenging is not a viable long-term solution. Instead, it may be more prudent to consider utilizing adapted animal breeds, even if they exhibit lower production levels (alongside reduced input costs), rather than attempting to introduce "stress tolerance" genes into non-adapted breeds (Gaughan, 2015).

Steps to ensure food security in a volatile environment

To guarantee food security and promote adequate nutrition in the face of a changing climate, it is essential to employ a diverse array of measures that address various levels. This entails implementing a comprehensive range of instruments that span from social protection initiatives to international agreements. By adopting this approach, the aim is to enhance the resilience of households as well as agricultural and food systems. This can be done in several ways.

Social protection programs- play an essential role in this endeavor to address the challenges of poverty and hunger in the context of a changing climate. Social protection encompasses a wide range of instruments and objectives, encompassing both safety nets and mechanisms that empower the poor and vulnerable to generate income and access opportunities. Well-designed and adequate social protection initiatives can help mitigate the vulnerabilities faced by households in relation to climate risks. By providing income to individuals experiencing poverty and hunger, with the help of social protection, they are able to purchase enough food to fulfill their nutritional needs without jeopardizing the future success of their jobs. Targeting such actions to the specific needs of women can significantly enhance their efficiency and impact.

Increasing the efficiency of scarce resource- use in productive systems, Water plays a crucial role in establishing robust livelihoods. The shifting precipitation and water availability patterns caused by climate change necessitate the ability to manage both water scarcity and excess, in order to sustain productivity. To address these challenges, adaptation strategies encompass practices like water collection and storage, facilitating irrigation access, adopting advanced irrigation technologies, and employing agronomic techniques that enhance soil water retaining, such as slightest tillage, while also promoting soil carbon and organic matter enrichment, among other approaches.

Adaption strategies to enhance crop resilience can be implemented. These measures involve utilizing adapted varieties or breeds that possess different environmental preferences and wider tolerance ranges. This includes exploring lesser-utilized crops, recognizing that diversifying varieties or crops can mitigate the risks associated with individual crop failures. Additionally, adaptive modifications in crop management, such as adjusting planting schedules, selecting appropriate cultivars, and occasionally increasing irrigation, have been examined to varying degrees. On average, these adjustments are projected to potentially increase yields by approximately 7%, although the outcomes depend heavily on the specific region and crop under consideration. Furthermore, post-harvest practices can also be modified, such as the drying requirements for grains and the storage methods employed after harvest.

Diverse forest ecosystems exhibit higher levels of resilience, enabling them to effectively manage stress, recover from damage, and autonomously adapt to environmental shifts. In comparison, ecosystems experiencing stress and impaired ecological processes are more vulnerable to negative impacts from living organisms and non-living factors. Successful forest fire management, integrated pest management, prevention of diseases, reduced impact logging in production forests, reasonable amounts of non-wood timber product gathering, grazing by livestock in forests, and adhering to forest laws are all essential best practices that must be employed to promote resilience. Restoring damaged woods to a state of health and reintroducing important ecological processes is another important tactic for increasing resilience.

In addition to stop-gap solutions we also need comprehensive investment in longer term sustainable solutions.

Resilient agricultural development and related investment- Ensuring food security also relies on private sector support and government assistance for farmers, fisherfolk, and forest residents.

Resolving the threat that climate change poses to food security requires, it is important to consider redirecting or supplementing rural and research and development (R&D) investments. By integrating climate change adaptation investments with existing agricultural investment programs, the effectiveness of these initiatives can be amplified. Public investments play a crucial role in guiding, facilitating, and enhancing the returns on private investments. For example, public investment can be allocated towards research, supporting water management infrastructure and user associations, land restoration efforts, and extension services. This collaborative approach can help optimize the impact of investments and ensure a comprehensive response to climate change challenges in the agricultural sector.

Managing genetic resources is a vital strategy for adaptation. It involves substantial collective investments in preserving, characterizing, and utilizing genetic resources, as well as reevaluating the objectives of breeding programs. Given the time required for breeding programs to achieve their goals, they must be started at least a few years in advance. The introduction of new breeds and variants may be required in some areas. Domesticated species, their wild relatives, and other important agricultural and food-related wild genetic resources must immediately have their in-situ and ex-situ conservation initiatives strengthened. In addition, policies that encourage their sustainable use are absolutely necessary for their survival in the long run.

Conclusion

Agricultural output, food chains, ecosystems, agro-ecosystems, incomes, and trade are just a few of the many areas that could be negatively impacted by climate change. The effects on people's ability to make a living, their access to nutritious food, and other social and economic issues are substantial. It is anticipated that the most susceptible communities, especially those reliant on agriculture in areas prone to climate change, will experience the most severe consequences as a result. In order to adapt successfully, one must understand the interrelated climate change risks and vulnerabilities. If we want to lessen the blow to nutrition, food security, and the avoidance of long-term repercussions, we must prioritize reducing vulnerabilities. Social protection measures, agricultural techniques, and risk management strategies are all part of the puzzle when it comes to making food security more resilient to climate change. There has to be cross-sectoral investment, policy, and institutional support to bring about the practical reforms in agriculture and food systems that are required to guarantee nutrition and food security. The ability to respond in the short, medium, and long term depends on the swift activities of various stakeholders. In order to address some issues in the medium to long term, it is necessary to move quickly with enabling activities, plans, and investments. Longer development and implementation timelines are necessary for projects that assist adaptation efforts, and this is especially true for forestry, cattle breeding, seed multiplication, R&D, innovation, and knowledge transfer.

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