

Assessing the Impact of Climate Change on Water Resources Management and Food Security

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Abstract: It is challenging to extrapolate the findings to the entire nation due to the intricacy of climate parameters that vary by area. Thus, comprehensive studies that are region-specific are required in order to consider the effects of regional climate conditions as well as the overall impact that these elements have on the nation. It is less clear how environmental change affects food strength and availability, particularly when it comes to quantitative data. More research on food security and environmental change is needed in this area. Differences in financial advancement methods are expected to have a significant impact on long-term food consumption and the ability to handle food instability difficulties, whether they are caused by environmental change or other non-climatic factors. Thus, there is an urgent need for research in this area. Food accessibility is one of several additional elements that can be taken into account in order to determine the precise effects of environmental change on horticulture and food security. A variety of other aspects can also be taken into consideration for climatic contemplations, depending on the information that is available. The primary goal of this study is to quantify how catastrophic occurrences affect food security.

Keywords: Aquaculture; Climate Change; Food Security; Agriculture.

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I. Introduction

Environmental change seriously jeopardizes global food security and a sustainable course of events. By 2050, it is projected that the whole population will have grown by 33%. The most progress would occur in agricultural nations. According to FAO metrics, agricultural production would need to increase by 60% to satisfy the anticipated rise in food and feed demands if current patterns in income and consumption growth continue. All four aspects of food security—accessibility, use, availability, Furthermore, environmental change affects the reliability of food frameworks. (Aldyan, 2023). It affects purchasing power, market trends, food production and distribution routes, human health, and livelihood. Depending on shifting temperatures, precipitation patterns, and extreme occurrences, it can have immediate and long-term effects. Agribusiness and environmental change cycles are intertwined, occurring both domestically and globally. Environmental change impacts farming in a variety of ways, including altered average temperatures, precipitation patterns, and climate extremes (droughts, floods, and heat waves); altered pests and diseases; altered atmospheric carbon dioxide; altered food nutritional value; and altered sea levels (Imran, 2018). Environmental change's effects on farming are dispersed haphazardly over the globe. While changes in pay distribution and development indirectly impact interest in horticulture products, changes in agro-environmental conditions directly impact food production. Future environmental changes are expected to have a negative impact on crop productivity, particularly in developing nations like India. For the most vulnerable, climate change is likely to raise the risk of food security. The conversion of non-agricultural land, such forests, into agricultural land and human-caused greenhouse gas emissions are two other ways that agriculture fuels climate change (Berhane, 2018). While variations in rainfall may have an effect on crop quality and quantity, higher temperatures will affect yields. Environmental change can typically impact food accessibility, openness, and quality. For instance, predicted temperature increases, different precipitation patterns, altered extreme weather occurrences, and decreased water availability could all lead to decreased horticulture productivity.

II. Conceptual Framework of the Study

The buildup of ozone harming substances in the air is the essential driver of the observed increase in mean world temperatures since 1850. The primary sources of greenhouse gas emissions are the expansion of intensive agriculture, which frequently results in deforestation, and the burning of fossil fuels to supply the growing need for electricity. There is no indication that global warming is slowing down, and it will probably result in long-term weather changes. Both rural and urban areas will be affected, as supply chains are broken, market prices increase, assets and livelihood prospects are lost, the general public's purchasing power declines, human health is jeopardized, and those who are most vulnerable are unable to adapt to these changes (Ofori et al., 2021). By releasing greenhouse gases like carbon dioxide and methane into the atmosphere, agriculture not only contributes to but also is impacted by climate change. Changing agricultural methods could help mitigate environmental change by reducing the release of substances that threaten the ozone layer. The execution of the food system is now more impacted by the environment than it was in the past, and areas where agribusiness is the primary source of both food and income are typically the most concerned about the anticipated effects of environmental change on food security. Rising sea levels and an increase in the frequency of extreme storms put residents in affected areas at greater risk. This puts livelihood systems at risk and makes future food security more vulnerable. Temperature increases and changes in rainfall patterns, particularly in developing countries like India, have a devastating effect on agriculture, food security, human income, and standard of living. The primary goal is to examine how natural catastrophes affect food security in order to assess how climate change affects food availability (Behnassi et al., 2019).

III. Sustainable Aquaculture Systems in Abiotic Scenario

The phrase "environmental change" refers to a shift in the surroundings that may be identified (by factual analysis) by differences in the typical and fluctuating characteristics that persist for a considerable amount of time, usually several years or more (Ringler & Zhu, 2015). Environmental change may be caused by natural inward cycles or external forcings such as variations in solar cycles, volcanic emissions, and ongoing human-induced changes in the air or land use (IPCC, Amalgamation Report, 2014). More precisely, it occurs when modifications to the global environmental framework result in novel weather patterns that persist for several years. The environment framework receives energy from the sun, despite a negligible quantity coming from the inside of the world. Furthermore, some of this energy is released into space as radiation. Earth's energy finance plan is determined by the balance of incoming and active energy as well as the energy flow through the environmental framework (Kiani Ghalehsard et al., 2021). When the amount of energy entering the earth exceeds the amount leaving it, the world's energy spending plan is positive and the air is warming. The weather on Earth and the long-term weather averages known as "climate" are produced by this energy as it passes through the climate system. "Climate change" refers to changes in the long-term average. Although there are notable regional variations, the researchers' compilation and analysis of meteorological data from the previous century indicates that the world is warming at an alarming rate. The concentration of the earth's atmosphere has been said to have changed in ways never seen before due to human activity since the start of the industrial revolution. Global warming is mostly caused by the atmospheric concentration of carbon dioxide, one of the main greenhouse gases (GHGs). Similarly, methane and nitrous oxides, two additional significant GHGs, have become much more prevalent in the atmosphere. Anthropogenic greenhouse gas emissions are most likely to blame for the majority of the observed increase in global average temperatures since the middle of the 20th century, according to the IPCC's fourth assessment report.

Effect on Agriculture and Vulnerability

The climate is a natural resource that contributes to a region's economic development and progress. Temperature variations, soil erosion, wind speed, precipitation, tropical cyclones, and the intensity of extreme events (drought and flood) have put several economic sectors, including agriculture, rural residents' means of subsistence, farmer income, etc., at risk on a global scale. Compared to other economic sectors,

agriculture is more susceptible with the impacts of environmental change. The primary drivers of a more delicate environment incorporate urbanization, deforestation, industry, the use of modern technologies, and growing population pressure. Farming activities, crop production management, weather, human resources, and natural resources are all quite diverse across India's large geographic area. India is among the world's most vulnerable nations. Several studies conducted in India have found a negative correlation between climate change and the productivity of commercial crops and food grains (Gohar & Cashman, 2016). In figure 1 displays the Food Security Framework below.

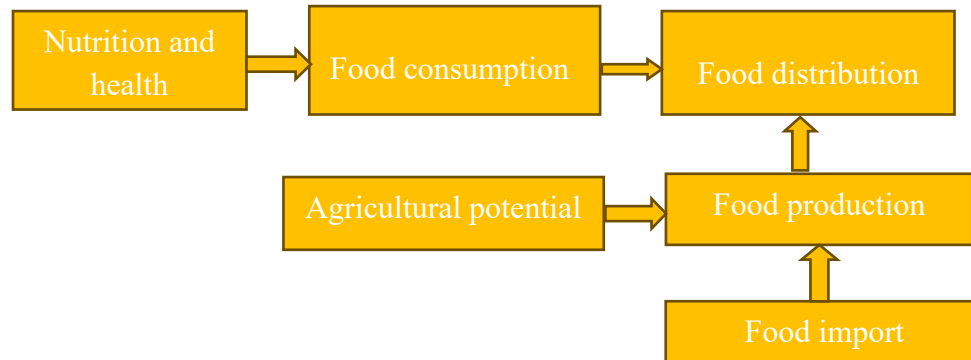


Figure 1: Food Security Framework

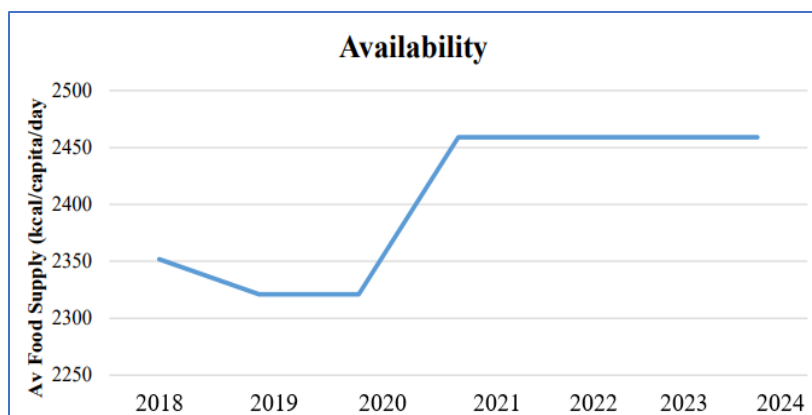
Environmental change likewise brings down ranchers' pay, as per certain examinations that assessed the effect of environment changes on farming creation in money related terms. Environmental change is anticipated to affect each of the four elements of food security: food accessibility (creation and exchange), food supply steadiness, food access, and food use. The impacts of environmental change on food accessibility and creation will contrast by district. The weight of food uncertainty in emerging countries situated in tropical areas might increment as their creation possible downfalls. The stability and accessibility of food supply will be impacted by shifts in the patterns of catastrophic events like floods and droughts. The loss of farmed land due to coastal erosion in low-lying places would exacerbate food poverty and loss of livelihood. The use of food is also impacted by climate change. People's ability to efficiently use food is reduced when they are exposed to more vector-borne (like malaria) and water-borne (like cholera) illnesses (McLaughlin & Kinzelbach, 2015).

IV. Multi-Dimensional Approach to Food Security

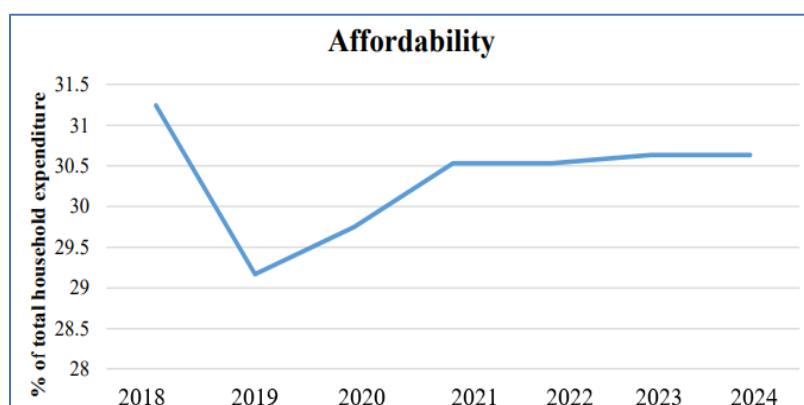
The concept of food security is complex. In studies where sub-nutrition is the main emphasis, it results in qualitative, if not quantitative, comparisons. Additionally, the connections between inadequate food consumption and sub nutrition are thoroughly examined (FAO, Food Security: Concept and Measurement, n.d.). Among the factors taken into account are:

- Dietary energy supply sources.
- Short-term nutritional deficiencies and instability are caused by climate uncertainty.
- The general public's health, particularly the prevalence of infectious and climate-related illnesses.
- The types of food insecurity and the geographical distribution of food within nations

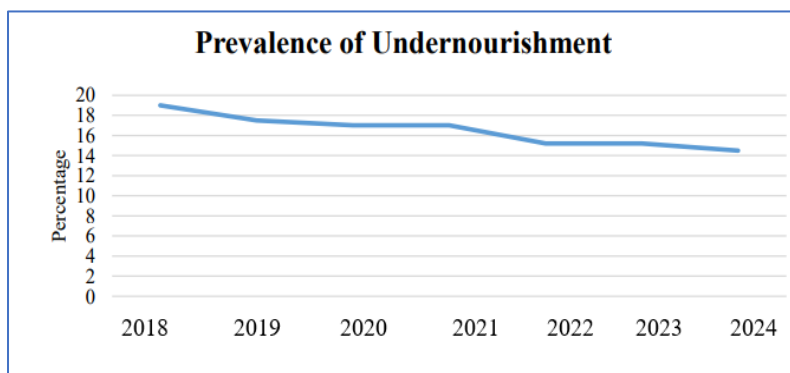
Food balance sheets, national income distribution, and consumer spending are typically used as the basis for indirect measures of food security. Food insecurity is measured in terms of the availability and consumption of staple foods by connecting hunger and sub nutrition with insufficient food intake. Cross-sectional patterns and changes in food production, along with the addition of staple foods (cereals) as reported in national food balance sheets, are reflected in the comparison of country estimates of chronic food insecurity. Poor biological use and/or poor absorption of ingested nutrients are included in the evaluation of sub nutrition in figure 2 (Misra, 2014).



(a)



(b)



(c)

Figure 2: Food Security Dimensions Trend

Future Risks Caused by a Changing Climate

For both human and environmental systems, climate change will increase existing dangers and generate new ones. In nations at all stages of development, risks are not evenly distributed and are typically higher for marginalized individuals and communities. The interplay between climate-related hazards (dangerous events and trends) and the susceptibility and sensitivity of natural and human systems leads to the risk of climate-related consequences. Ocean acidification and other climate system changes, along with rising warming rates, raise the possibility of serious, long-lasting, and often irreversible negative effects. While certain hazards are worldwide, some are more pertinent to specific geographical areas shows in figure 3.

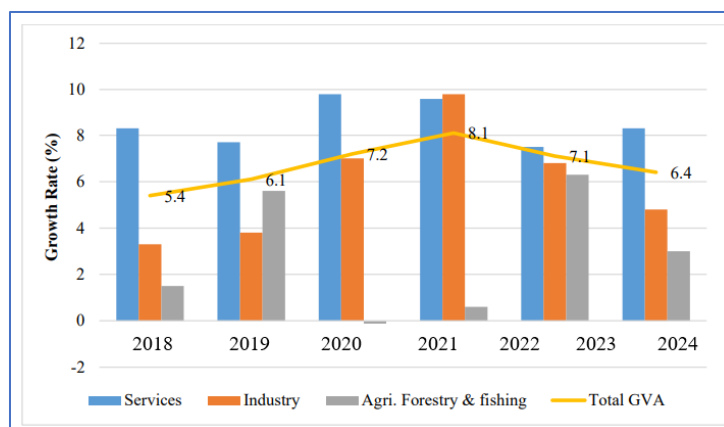


Figure 3: Rate of Growth of GVA in Different Sectors

Risks for Food Production

As indicated by gauges, the essential way that environmental change will influence human wellbeing until the center of the century is by fueling previous circumstances. As per the RCP 8.5 situation, high temperatures and dampness in certain spots are anticipated to obstruct ordinary human tasks, including as the development of food, by 2100. As per a few examinations, environmental change is supposed to adversely affect the creation of wheat, rice, and maize in tropical and mild districts when nearby temperatures climb by 2°C or more. Worldwide food security would be truly undermined by temperature increments of 4°C or more over late twentieth century levels, combined with rising food interest. Water accessibility, food security, and horticultural livelihoods — remembering shifts for the worldwide creation areas of food and non-food crops — are expected to be most impacted in provincial regions. It is guessed that the impacts of environmental change will thwart monetary extension and make annihilating neediness really testing. Future greenhouse gas emissions are predicted to result from extremely complex dynamic systems and be influenced by factors including technological advancement, socioeconomic development, and demographic growth. It is really unclear how they will develop in the future. The IPCC takes into account several emission scenarios when predicting climate change. A suitable technique for analyzing how driving forces may affect future emission outcomes and evaluating the associated uncertainties are scenarios, which are various depictions of how the future might reveal. They aid in the analysis of climate change, which includes creating climate models and evaluating its effects, adaptation, and mitigation. It is quite unlikely that a single emissions path will materialize as depicted in scenarios.

V. Conclusion

The public distribution system (PDS), buffer stock maintenance, and purchase at minimum support prices are the three key components that make up the food management system and food price policy. Access to food grains and other necessities is guaranteed by the PDS. State governments are solely responsible for managing the nation's public distribution system (PDS), which distributes available goods both food and non-food—to eligible consumers. The Central Government firmly supports it by keeping supplies on hand and acquiring food grains from surplus regions. The goal of this Central Government program is to protect and encourage farmers. Additionally, it worked to increase food grain output and, thus, self-sufficiency. In the event of an unanticipated decline in production, which primarily occurs as a result of climatic conditions like drought and flood, the preservation of buffer stocks is meant to protect against the volatility of basic food grain prices and achieve the necessary moderation in food grain prices on the open market. A fifth of the world's undernourished people still reside in the nation, despite the attainment of macro-level food security and a notable improvement in per capita consumption. With around 16 million new residents added annually to the already sizable population of over 1.2 billion, this particular circumstance may be the result of intense and growing population pressure. Issues with food distribution

and financial access are equally responsible for this situation of hunger and malnutrition. This has a negative impact on food insecurity at the household and individual levels.

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