

REVIEW:

Climate Change's Impact on Food and its Ingredients

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ABSTRACT

Three significant issues with the traditional agriculture-based food production system face the world today. The sustainable development goals of the United Nations are a pretty good definition of them. Climate change, nutrition, and food are these three issues. These issues aggravate ecological balance because of the rising global population, shrinking arable land, soil degradation, and a lack of readily available freshwater. Such interrelated concerns are of the utmost importance and can be partially addressed by using climate-smart agricultural methods, such as crop rotation, crop diversification, and organic farming. The urgent requirement, however, is to advance toward cultivating methods that are climate resilient. One such long-term sustainable tactic is the use of soilless indoor farming technologies. Using soilless technology offers a huge potential to produce more with less land under cultivation, more crops per drop of water, reduce the burden of dangerous chemicals, and enhance ecological impact. This review's focus is on the effects of climate change on food and nutrition and how soilless farming technology can lead to a paradigm shift that will close the gap between the security of food and nutrition.

Keywords: *Climate change, Food security, Food Safety, Nutrition Security*

Highlights include:

* The effects of climate change on food systems and diets;

* Climate-smart, nutrition-sensitive mitigation and adaptation to protect nutrition;

* Climate change and food safety;

* Climate change and nutrition;

The conditions under which agricultural activities are carried out are being profoundly altered by climate change.

- Expected effects of climate change on important crop harvests

- Many ways that climate change affects animal production both directly and indirectly

- Climate change and variability have an influence on forests

- Aquaculture growth and catch fisheries also have an impact on climate change

• **Changes in production have economic and societal repercussions that have an impact on food security.**

- At the farm/household level,

- At the national level,

- At the international level,

- There is volatility in food prices.

• **Addressing climate change today can guarantee that everyone will have access to food security in the future.**

INTRODUCTION

The development of a world without hunger could potentially be hampered by climate change. The effects of climate change on agricultural productivity are seen as a strong and consistent global pattern that may have an impact on food availability. The short-term supply volatility brought on by climate change may jeopardize the stability of complete food systems. At regional levels, the potential impact is less evident, perhaps worsening food insecurity in places already at risk of hunger and malnutrition. Likewise, It is possible that loss of access to drinking water and health problems could have a negative impact on food use, which will then have an indirect impact on household and individual incomes. The evidence suggests that significant investments in adaptation and mitigation measures are necessary to create a "climate-smart food system" that is more resistant to the effects of climate change on food security (**Wheeler and von Braun, 2013**).

Climate change's effects on food systems and cuisines

All facets of the food supply chain, from agricultural production to storage, processing, transport, retail and marketing, and household food preparation and consumption, are included in the concept of food systems. Modeling predicts that socioeconomic conditions will have an impact on the extent and variability of climate change's effects on food systems, both geographically and across time. (**Vermeulen et al., 2020**).

All factors that contribute to malnutrition are affected by the effects of climate change. These influences range from more indirect ones like sickness and dietary consumption to more fundamental ones like socioeconomic status and environmental conditions. (**Black et al., 2013**). Depending on affluence and means of subsistence, climate change's effects on nutritional status vary, but overall, undernourishment is expected to deteriorate compared to a scenario in which there is no climate change. (**Grace et al., 2015**).

Nutrition protection through climate-smart adaptation and mitigation

Using "triple-win" scenarios that increase food production and reduce waste, lower agricultural GHG emissions, and implement adaptation measures for the most vulnerable, climate-smart food systems involve producers and consumers in decision-making. (Lipper et al., 2014). Farmers can increase the production of nutrient-dense foods including fruits, vegetables, and legumes while decreasing food waste and reducing greenhouse gas emissions (GHG). Food manufacturers can produce processed foods that are more nutrient-dense. Global consumers may also make better decisions: in middle- and high-income 275 nations, they can buy and consume only what is necessary given that 95 to 115 kg of food is wasted by consumers in Europe and North America, and about one-third of the food produced globally is wasted annually (FAO, 2011), and eat foods with fewer negative effects on the environment (Scherr et al., 2012). Food processing and preservation methods can be used in low-income nations to assure food safety and nutrition while reducing the need for cold storage by both processors and

consumers (FAO, 2016). Among the 102 million people who live in Egypt, 30.6 million are considered to be living in poverty. Egypt's concern with food waste is contrasted with its problems with food insecurity. In Egypt, food waste is a major problem; the average Egyptian discards more than 150 pounds of food each year (Eliason, 2022).

One of the biggest risks to the economy, environment and public health in the current and future generations is climate change. Among the predicted effects of climate change—many of which are now visible—are:

- An increase in the frequency and severity of hurricanes, floods, heat waves, and other extreme weather conditions
- * More deaths from heat stroke
- Lack of food and water
- Forced relocation due to natural calamities and rising sea levels
- Greater losses due to wildfires and flooding
- Dispersing waterborne and insect-borne illnesses

The reduction of greenhouse gas (GHG) emissions, the improvement of emissions sinks, and the preparation for the anticipated repercussions have all

been urged by scientists and international leaders. One of the areas that most urgently require intervention is the food system.

Climate change and food safety:

The occurrence of food safety problems at many points along the food chain, from primary production to consumption, may be impacted by climate change and variability. Changes in temperature and precipitation patterns, more frequent and intense extreme weather events, ocean warming and acidification, changes in pollutant transport pathways, and other factors are only a few of the many ways that climate-related phenomena may have an impact on food safety. The socioeconomic factors that affect food systems, such as agriculture, animal production, international trade, demographics, and human behavior, may also be impacted by climate change. (Tirado et al., 2010).

Climate change and nutrition:

Climate change is linked to both short-term and long-term nutritional issues. Nutritional quality may be negatively impacted by drought and water constraints. The likelihood of

contracting infectious diseases and dying from them is increased by decreased food supply and the resulting malnutrition. In India, where diets were insufficient in energy and numerous vitamins during the 2000 drought, severe impacts of drought on anthropometric indices have been documented (Harikumar et al., 2005). Poor rural and urban slum children are particularly vulnerable to the morbidity and mortality of diarrheal illness. Even if they survive an acute sickness, they could subsequently pass away from starvation and recurrent diarrhea. Individuals who were malnourished as children confront numerous difficulties as they mature. While they are young, they face a heightened risk of disease and death, struggle in school, and frequently are unable to fully contribute to the social and economic growth of their families, communities, and countries. In 2010, around 1 billion people went hungry. Another billion people are believed to experience "hidden hunger," which is the absence of critical micronutrients (vitamins and minerals) from their diet, increasing their risk of developing physical and mental damage. One

of the main contributing aspects is the impact of the climate on food security and nutrition (Krishnamurthy et al., 2014).

Climate change is significantly altering the circumstances in which agricultural activities are carried out.

Both direct and indirect effects of climate change are seen in agricultural production systems. A change in physical qualities, such as temperature ranges and rainfall patterns, can have direct effects on certain agricultural production systems. Productivity is impacted by indirect effects when pests, disease vectors, invading species, pollinators, and other species change. These unintended consequences may be quite important. Due to a large number of interacting characteristics and links, many of which are yet unknown, they are far more challenging to estimate and project (FAO, 2015).

Effects of expected climate change on major crop harvests

Twenty years of research have resulted in a comprehensive documentation of the consequences of the topic. Globally, positive outcomes are less common than negative ones. Observations of the impacts of

climate change on crop production show that the yields of wheat and maize have already been severely affected locally and globally by climate change. There is an agreement regarding the direction of yield changes in many significant agricultural regions at both low and high latitudes, with strong negative impacts especially at higher levels of warming and at low latitudes, according to findings from significant agricultural model inter-comparison projects, despite uncertainties regarding how models represent the representation of combined carbon dioxide fertilization, ozone stress, and high-temperature effects. Future climate change is anticipated to have a continual negative influence on low-latitude countries' ability to produce food while having either beneficial or negative effects in northern latitudes. According to the IPCC, this is. Although the climate in some high-latitude locations may change, the soil and water conditions in these areas may prevent long-term increases in agricultural output (Gitz et al., 2016).

There are numerous direct and indirect ways that climate

change affects animal productivity.

The health and productivity of animals, as well as the yields of forages and feed crops, are the most significant effects. During severe drought occurrences in the recent past, 20 to 60 percent reductions in animal populations were seen in a number of sub-Saharan African nations. Climate change may cause a 10 to 25% decline in dairy yields in South Africa. Significant decreases in forage production can result from elevated temperatures and decreased precipitation, as evidenced by the 60 percent deficiency of green fodder during the 2003 summer in France (**Dong et al., 2020**). Climate change and variability have an effect on forests' ability to provide a variety of commodities and environmental services, on which an estimated 1.6 billion people wholly or partially rely for their survival. Forests also affect the ability of ecosystems to restore and maintain their health. Evidence suggests that climate change is a factor in a number of environmental issues including decreased tree productivity and dieback due to heat and drought stress, increased wind and water

erosion, increased storm damage, increased frequency of forest fires, pest and disease outbreaks, landslides, and avalanches, changes in the ranges of forest plants and animals, inundation and flood damage, saltwater intrusion and sea level rise, and damage from coastal storms. This could imperil the contribution of forests to the resilience of agricultural systems, including the provision of habitats for significant species like pollinators and the management of water and temperature at the landscape level (**Abram et al., 2021**).

Climate change also has an impact on catch fisheries and aquaculture development; in freshwater and marine habitats.

Both chemical (changes in salinity content, oxygen concentration, and acidity) and physical (changes in sea and inland water surface temperature, ocean circulation, waves, and storm systems) alterations are caused by the gradual atmospheric warming of the aquatic environment. One out of every four marine species' habitats is in danger due to the rising frequency of coral reef bleaching. The "tropicalization" of systems at mid-and high latitudes has been

expedited by the polarization of a number of fish species. With a loss of up to 40% in the tropics and an increase of 30–70% in high-latitude regions, the future marine fish catch is anticipated to vary considerably. One fresh entry of an invasive species from a lower-latitude zone has been observed every four weeks in the Mediterranean in recent years. The abundance and variety of fish species found in rivers make them particularly vulnerable to variations in water flow quantity and timing, and especially to dips in water levels during dry seasons. River flows may be under more pressure as a result of human efforts to store water in reservoirs and irrigation channels. (FAO, 2018).

Effects on production have economic and societal repercussions that have an impact on food security.

A variety of additional risks are brought about by the availability of food, access to food, and utilization of food, as well as the stability of these characteristics, for both farm and non-farm households. These risks translate from climate to environment, to the productive sphere, to economic and social

dimensions (Matthews et al., 2021).

Climate change impacts farms and households

This may result in lower income levels and less stability due to changes in productivity, production costs, or prices. Such changes can cause the sale of productive capital, such as cattle, which lowers the long-term potential for household production. Risk exposure reduces the incentives for investing in production systems, which frequently has negative effects on sustainability, long-term productivity, and returns. It has also been demonstrated that agricultural revenue reductions and hazards affect the household's ability and willingness to spend on health and education. The effects are largest for the poorest farmers, according to evidence from recent evaluations of the effects of various forms of weather anomalies on farm revenue. (Matthews et al., 2021).

- **At the national level**

Exposure to climate risks can cause shocks to agricultural production and food

availability, with risks of market disruptions, effects on supply and storage systems, as well as price increases for agricultural commodities (food and feed). This can affect the accessibility and stability of food supplies for the entire population, especially in countries where significant shares of the population spend a large portion of their income on food. This has macroeconomic effects on countries where agriculture is a big employer and/or contributes considerably to the GDP. Climate worries might potentially obstruct the development of agriculture by discouraging investments. (Matthews et al., 2021).

- **Global climatic shocks**

That affects regions crucial to the world's food supply and can have indirect effects through effects on supply flows and spikes in food prices, leading to increased market volatility; and (ii) impacts on bilateral agreements and/or import/export behavior, leading to disruptions in trade patterns. (Matthews et al., 2021).

- **Climate change is likely**

To make the volatility of food prices worse. In order to adapt to changes in agricultural and food production patterns brought on by climate change, trade is projected to play a significant role. Recent evidence suggests that domestic regulations, including export restrictions, have a significant impact on how volatile food prices are affected by climate change. Without sufficient purchasing power, the poorest populations and countries will ultimately not have access to global markets. (Birgani et al., 2022).

Addressing climate change today can guarantee that everyone will have access to food security in the future.

Climate change poses a range of risks, including physical effects on ecosystems, agroecosystems, agricultural production, food chains, earnings, and trade, as well as economic and social effects on livelihoods, food security, and nutrition, as was previously demonstrated. Communities that rely on the agricultural sectors in climate-sensitive areas for their means of survival are the most vulnerable and are expected to face climate change's harshest and

earliest effects. Understanding the chain of risks and the susceptibility to these risks is crucial for developing adaptation strategies. Vulnerabilities must be minimized in order to lessen the overall effects on nutrition and food security as well as the long-term repercussions. To strengthen food security's resilience in the face of climate change, numerous measures are needed, including social protection, agricultural practices, and risk management. **(Cheng et al., 2022).**

To support the changes in agriculture and food systems needed to adapt to climate change for food security and nutrition, a range of investments, policies, and institutions will be needed. For maximum effectiveness, such interventions must be a component of all-encompassing strategies and plans. It is necessary to use gender-sensitive, multi-scale, multi-sector, and multi-stakeholder methods. They must consider the several time frames that the changes will need to be supported and accomplished within as well as the various components of the difficulties (social, economic, and environmental). They must be founded on assessments of risks

and vulnerabilities, incorporate lessons learned from mistakes and technological improvements, and go through routine reviews, evaluations, and updates. The frequency of routine assessments is rising in middle- and high-income nations, whereas countries lacking these capacities will need particular help. Food security and nutrition can be made a top priority through the UNFCCC's National Adaptation Plan process. To support such national activities and objectives, increased regional and international cooperation is also necessary. Many parties must act right away in order to enable solutions in the short, medium, and long terms. For instance, medium- and long-term solutions like forestry, livestock breeding, seed multiplication, innovation, and information transfer to aid in adaptation would require right away allowing action and planning, as well as the implementation of expenditures. **(Raj et al., 2022).**

CONCLUSION

For the world's poor, addressing climate change and maintaining food security go hand in hand.

- A paradigm shift must occur in favor of food and agricultural

systems that are more resilient, productive, and sustainable.

- The moment to act is right now:
 - To end famine and malnutrition
 - To enable agriculture-related industries to adjust to climate change
- Limiting climate change to levels that can still be achieved to ensure and safeguard everyone's access to food and nutrition
- Agriculture can contribute to the endeavor to provide food security, which is the main priority.

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دراسة مرجعية:

تأثير تغير المناخ على الغذاء ومكوناته

نهله علي عبد الرحمن محمد

قسم الدراسات والبحوث الميدانية-المعهد القومي للتغذية- القاهرة – مصر

الملخص العربي

يتحقق الأمن الغذائي عندما يتاح لجميع الافراد في جميع الأوقات الوصول المادي والاقتصادي إلى أغذية كافية وأمنة ومغذية تلبي احتياجاتهم الغذائية من أجل حياة نشطة وصحية". يؤدي هذا التعريف إلى ظهور ثلاث أبعاد للأمن الغذائي: (1) توافر الغذاء ، (2) إمكانية الوصول (اقتصاديًا وجسديًا) ، (3) الاستفادة (طريقة استخدامه واستيعابها من قبل جسم الإنسان) واستقرار هذه الأبعاد الثلاثة ، على الصعيد العالمي هناك ثلاثة تحديات رئيسية تواجه العالم اليوم ثلاث قضايا مهمة تتعلق بنظام الإنتاج الغذائي التقليدي القائم على الزراعة. إن أهداف التنمية المستدامة للأمم المتحدة هي تعريف جيد لها. هذه القضايا الثلاث هي (1) تغير المناخ و(2) التغذية و(3) الغذاء. تؤدي هذه المشكلات إلى تفاقم التوازن البيئي بسبب ارتفاع عدد سكان العالم ، وتقلص الأراضي الصالحة للزراعة وتدهور التربة ، ونقص المياه العذبة المتاحة بسهولة. هذه المخاوف المترابطة لها أهمية قصوى ويمكن معالجتها جزئيًا باستخدام أساليب زراعية ذكية مناخيًا ، مثل تناوب المحاصيل وتنويع المحاصيل والزراعة العضوية. ومع ذلك ، فإن المطلب الملح هو التقدم نحو زراعة أساليب مقاومة للمناخ. أحد هذه الأساليب المستدامة طويلة الأجل هو استخدام تقنيات الزراعة الداخلية بدون تربة. يوفر استخدام التكنولوجيا بدون تربة إمكانات هائلة لإنتاج المزيد باستخدام مساحة أقل من الأراضي المزروعة ، والمزيد من المحاصيل لكل قطرة ماء وتقليل عبء المواد الكيميائية الخطرة وتعزيز التأثير البيئي. تركز هذه المراجعة على آثار تغير المناخ على الغذاء والتغذية وكيف يمكن أن تؤدي تكنولوجيا الزراعة الخالية من التربة إلى تحول نموذجي من شأنه سد الفجوة بين أمن الغذاء والتغذية.

الكلمات المفتاحية : تغير المناخ ، الأمن الغذائي ، سلامة الغذاء ، الأمن الغذائي