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Review Article

Review: Climate Change's Impact on Food Consumption Trends

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Abstract

Objectives: To examine how climate change affects global food systems, with a focus on food security, dietary patterns, and nutritional outcomes. The review also aims to identify key mitigation and adaptation strategies that enhance the resilience and sustainability of food systems.

Methods: A narrative review approach was used to synthesize recent literature on the interactions among climate change, food production, consumption patterns, and nutrition. Studies addressing food security pillars, vulnerable populations, and climate-related disruptions in agriculture and fisheries were analyzed.

Results: Climate change is altering agricultural productivity, food quality, and dietary practices through rising temperatures, erratic rainfall, and more frequent extreme weather events. These disruptions affect all four pillars of food security-availability, access, utilization, and stability-leading to shifts in consumption patterns and increased nutritional risks. Vulnerable populations, particularly those in low-income and rural regions dependent on rainfed agriculture, experience disproportionate impacts. Climate-induced declines in crop yields and fisheries contribute to price volatility, reduced dietary diversity, and higher rates of micronutrient deficiencies.

Conclusion: Climate change poses significant threats to global food and nutrition security. Strengthening food system resilience requires integrated strategies such as sustainable agricultural practices, dietary shifts toward low-carbon foods, and reductions in post-harvest losses. Coordinated policies and evidence-based interventions are essential to address the interconnected challenges of climate change, food production, and nutrition.

***Keywords**: Food Systems; Dietary Habits; Food Security; Mitigation; Adaptation; Sustainable Nutrition; Climate Change*

Introduction

Global food systems are facing previously unheard-of difficulties due to the accelerating pace of climate change, with ramifications that go well beyond agricultural productivity. Rising global temperatures, unpredictable rainfall, and extreme weather events have already disrupted agricultural output and are expected to worsen in the upcoming decades, according to the Intergovernmental Panel on Climate Change [1]. As the production, distribution, and accessibility of essential commodities become more unpredictable, these disruptions are closely associated with changes in food consumption patterns [2,3].

Food systems encompass the entire spectrum of activities and participants involved in the production, processing, transportation, marketing, and consumption of food [4]. Every element of these systems is impacted by climate variability, from crop yields and soil fertility to market stability and consumer preferences. For instance, heat stress affects fisheries and livestock productivity, altering dietary availability and preferences, while droughts and floods reduce cereal and legume production [5]. Because they alter livelihoods, gender roles, and cultural dietary norms, these changes are not only environmental but also socioeconomic [6].

According to recent research, food consumption both contributes to and is affected by climate change. Nearly one-third of anthropogenic greenhouse gas (GHG) emissions come from the global food system, mostly from food waste, deforestation, and agricultural production [3,7]. However, decades of advancements in nutrition and food security could be jeopardized by climate change, especially in developing nations with limited capacity for adaptation [8]. Malnutrition and diet-related illnesses may result from dietary changes, such as decreased access to fruits, vegetables, and protein sources [9].

Designing resilient and sustainable food systems requires an understanding of how climate change affects food consumption patterns. A comprehensive evaluation of the relationships between production, distribution, and consumption in the context of environmental change is made possible by a food systems perspective [10]. This review identifies major vulnerabilities, examines adaptation and mitigation strategies throughout the food value chain, and summarizes recent scientific data on how climate change affects food consumption and nutrition. The main objective is to highlight ways to change food systems for greater sustainability, equity, and climate change resilience.

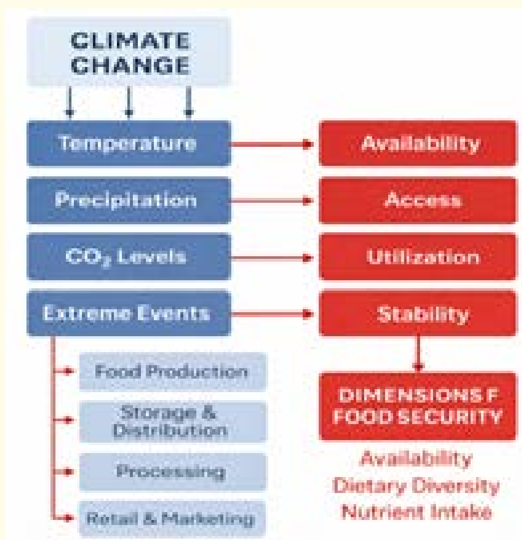

Figure 1: *A conceptual framework of how food systems and consumption patterns are affected by climate change.*

Food systems: Definition and scope

Food production, processing, transportation, distribution, consumption, and waste management are all included in a food system [11,12]. Food production, access, and consumption are influenced by a variety of factors, including biophysical, technological, economic, social, and political aspects. The dynamic and interconnected nature of food systems is emphasized in contemporary interpretations, which connect resilience, equity, health, and environmental sustainability [13,14].

The food systems approach provides a comprehensive lens for examining how climate change impacts every phase of the food value chain. Climate variables affect productivity, distribution efficiency, and consumer choices from pre-production (fertilizer, seed, irrigation) to post-consumption (waste management) [15,16].

Trends and shifts in food consumption

The quantity, quality, and variety of foods that people or populations consume over time are referred to as food consumption patterns [17]. Income, culture, urbanization, food availability, and environmental changes all affect these trends. A "nutrition transition"-a shift from traditional plant-based diets to greater consumption of animal products, processed foods, and sugars-has occurred over the past three decades, driven by globalization and economic growth [18].

These patterns are shaped both directly and indirectly by climate change. Food availability is impacted by crop failures, fishery declines, and livestock stress; affordability is impacted by market volatility and economic shocks. Access to nutrient-rich foods like fruits and vegetables has decreased in many areas due to rising temperatures and water scarcity [9]. On the other hand, consumers in wealthy nations who are concerned about climate change are increasingly embracing sustainable diets, such as the Mediterranean or plant-based diet, in an effort to reduce their environmental impact [10].

Relationships between food systems and climate change

Food systems and climate change are interrelated. On the one hand, climate change alters food safety and nutritional quality, reduces agricultural productivity, and impacts storage and distribution infrastructure [5]. However, about 31% of all anthropogenic greenhouse gas emissions come from the global food system, primarily from agriculture, land-use change, and energy-intensive food processing [3,19].

The necessity for a systems-level understanding of climate-food interactions is highlighted by these interrelated effects. To address them, integrated mitigation and adaptation strategies that lower emissions while maintaining food security are needed, such as sustainable intensification, low-emission livestock systems, and enhanced post-harvest management [7,20].

Resilience through systems thinking

Policymakers can identify leverage points for change through a systems-thinking approach. For instance, implementing the tenets of the circular economy-such as reducing food loss and increasing the value of byproducts-reduces greenhouse gas emissions while improving resource efficiency [27]. Additionally, investing in climate-smart infrastructure, diversifying production and diets, and enabling local actors to engage in adaptive governance are all necessary for resilient food systems [10,19].

Food System Component	Key Activities	Climate-Sensitive Factors	Potential Impacts	Representative Sources (2018-2025)
Pre-production	Seed breeding, fertilizer and pesticide manufacture, irrigation infrastructure, R&D	Rising temperature, erratic rainfall, water scarcity, soil degradation	Decline in seed viability; increased cost of inputs; reduced irrigation efficiency; accelerated soil salinization	[19-22]
Production	Crop cultivation, livestock rearing, aquaculture, forestry	Heat stress, droughts, floods, pest/disease outbreaks	Lower crop yields; livestock mortality; fisheries collapse; loss of forest biomass	[1,5,7,23]
Post-harvest handling	Drying, storage, packaging, processing	Ambient temperature, humidity, pathogen load	Increased microbial spoilage; mycotoxin accumulation; reduced shelf life; food safety risks	[11,24,25]
Distribution and trade	Transportation, logistics, wholesale, retail	Flooding, storms, infrastructure damage, energy cost	Supply-chain disruption; market price spikes; regional food shortages	[3,6,9]

Consumption	Purchasing, cooking, dietary choices	Food price volatility, reduced availability of fruits, vegetables, animal protein	Dietary simplification; nutritional deficiencies; increased dependence on processed foods	[10,16,18]
Waste management	Food collection, composting, recycling, disposal	Temperature rise, decomposition rate, methane emission	Higher GHG emissions from landfills; nutrient loss; reduced recycling efficiency	[3,9,19]

Table 1: *Food system components and their sensitivity to climate change.*

Climate change's effects on food production and agriculture

Warming, altered precipitation, CO_2 fertilization with nutrient dilution, sea level rise/salinity, extreme events, and biotic pressures (pests, pathogens) are among the many interrelated factors that impact agricultural productivity due to climate change. These spread throughout the food system (production → prices → diets), ultimately influencing food availability, access, utilization, and stability-the four pillars of food security that your draft emphasizes.

Vegetables

- **Thermal and water stress:** Without adaptation, multi-model assessments show mean global yield losses of ≈ −3-7% for wheat, -5-7% for maize, and −0-3% for rice for every additional °C of warming [7,23]. Grain set is disproportionately reduced by heat extremes during flowering and anthesis.
- **Trade-offs between CO_2 and nutrients:** Although CO_2 can increase biomass, it dilutes iron, zinc, and protein in staples like wheat, rice, and legumes. This has implications for micronutrient adequacy at the population level [5].
- **Diseases and pests:** Warmer winters increase overwintering ranges; degree-day accumulation speeds up the generations of migratory pests (like fall armyworm), which increases losses [27].
- **Inundation and salinity:** Storm surges and sea level rise increase soil salinity in coastal plains and deltas, lowering rice yields in the absence of salt-tolerant cultivars and drainage improvements.

Animals

- **Heat stress:** Reproduction and immunity are compromised, and feed intake and milk yield decrease above species-specific thermal humidity indices; meta-analyses reveal −0.2 to −0.9 kg milk/cow/day per THI unit above threshold [28,29].
- **Rangelands and feed:** Dependence on irrigated fodder increases competition for water, while drought lowers pasture biomass. Additionally, enteric methane intensity per unit product is exacerbated by heat [30].
- **Vector-borne illnesses:** Rift valley fever and bluetongue zones become less suitable due to shifting isotherms [31].

Aquaculture and fisheries

- **Changing stocks and yields:** In tropical EEZs, ocean warming and deoxygenation cause poleward shifts and declines in maximum sustainable yield (MSY); under high emissions in equatorial regions, projections indicate −20-40% MSY by mid-century [32].
- **Coral reef degradation:** According to Hughes., *et al.* [32], heat-induced bleaching lowers nearshore fisheries productivity and habitat complexity.
- **Aquaculture sensitivity:** Brackish systems are impacted by salinity intrusion, and pond temperature spikes increase FCR and disease risk [33].

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Perennial systems and forestry

- **Drought and fire regimes:** A greater vapor-pressure deficit increases the risk of megafires and tree mortality, limiting the production of agroforestry and non-timber foods [34].
- **Phenology and chilling:** Fruit and nut yields and quality are at risk due to insufficient winter chill hours [35].

Safety and post-harvest

- **Spoilage and contaminants:** Mycotoxins (aflatoxins, fumonisins) and fungal growth are increased during warmer, more humid storage seasons, which have an impact on trade and downstream nutrition [24]. These mechanisms are directly related to your framework's utilization and stability dimensions.

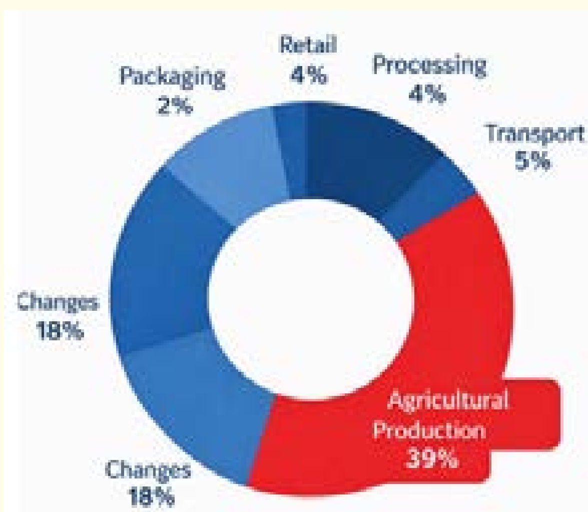

Figure 2: *Global greenhouse gas emissions from food-system sectors. Agricultural production contributes the largest share, followed by land-use change, processing, transport, retail, and packaging.*

Sector	Primary climate drivers	Mechanism	Quantitative impact (illustrative ranges)	Regions most at risk	Key references (2018-2025)
Wheat	Heat waves; drought; pests	Pollen sterility; shortened grain filling; pest pressure	−3-7% yield per +1°C globally (no adaptation)	S. Asia, MENA, Australia	[7,23]
Maize	Heat extremes; rainfall variability	Kernel abortion; C4 heat sensitivity at flowering	−5-7% per +1 °C; severe losses under concurrent heat-drought	Sub-Saharan Africa, C. America	[1,7,23]
Rice	Night-time warming; salinity	Spikelet sterility; Na^+ toxicity in coastal deltas	−0-3% per +1 °C (mean); >−20% episodic under salinity floods	Ganges-Brahmaputra, Mekong, Nile deltas	[1,35]
Legumes	Heat/drought; CO_2 dilution	Flower/pod abortion; protein dilution	Yield losses −5-20% in heat/drought years; protein ↓ 3-8% at high CO_2	S. Asia, SSA drylands	[1,5]
Horticulture	Heat; water scarcity; extremes	Sunscald; quality downgrades; residues	Quality downgrades 10-30%; higher rejection rates	Mediterranean, Gulf, SW US	[19,36]
Dairy	Heat/humidity stress	Intake ↓; lactation curve suppression	−0.2 to −0.9 kg milk/cow/day per THI unit > threshold	Tropics, subtropics	[28,29]
Beef/Small ruminants	Drought; pasture loss	Body-condition loss; mortality in droughts	Off-take ↑; weight ↓ 5-15% in drought clusters	Horn of Africa, Sahel, Australia	[1,37]
Poultry	Heat stress	Mortality spikes; FCR worsening	Mortality +1-4% per +1°C above comfort in heatwaves	South Asia, MENA	[38]
Capture fisheries	Ocean warming; deoxygenation	Range shifts; MSY decline	MSY −20-40% by 2050 in tropics (SSP5-8.5)	Tropical EEZs, small islands	[32,39]
Aquaculture	Heat; salinity; disease	Pathogen loads; FCR ↑	Outbreak frequency ↑; FCR ↑ 5-15% in heatwaves	Bangladesh, Vietnam, Egypt	[33]
Agroforestry/perennials	Drought; fire; chill loss	Mortality; fruit set declines	Chill hour deficits reduce yield/quality; fire losses episodic	Mediterranean, California, Australia	[34,35]
Post-harvest	Heat; humidity	Mycotoxins; spoilage; safety	Aflatoxin risk season length ↑; losses +2-5 pp	SSA, S. Asia	[11,22]

Table 2: *Major sectoral climate impacts in food production (mechanisms, quantitative ranges, and regions).*

Notes: Ranges are central tendencies from multi-study syntheses where available; realized impacts depend on cultivar, management, CO_2, soils, and adaptation level. "pp" = Percentage Points.

Region	Dominant climate risks in food system	Expected consumption shifts (near-mid term)	Key linkage to pillars
MENA (incl. Gulf)	Heat waves; chronic water scarcity; import-heavy supply chains vulnerable to price shocks and port disruptions	↑ reliance on imported cereals; ↓ fresh produce and dairy during heat peaks; ↑ bottled/processed items	Availability (domestic); Access (price/ports); Stability (heat/energy)
Sub-Saharan Africa	Rainfed yield variability; storage in warm/humid seasons; flood-damaged rural roads	Seasonal diet simplification; ↑ mycotoxin exposure risk; ↓ animal-source foods; meal skipping in lean seasons	Availability; Utilization; Access; Stability
South Asia	Heat + humidity extremes; salinity intrusion in deltas; urban flood risks	Rice quality/availability volatility; ↓ fish/veg in floods; ↑ refined grains/ cheap fats	Availability; Access; Stability
Small Island States	Cyclones; sea-level rise; fish stock shifts; high import dependence	↓ local fish after storms; ↑ processed imports; micronutrient gaps	Availability; Stability; Access
Europe (Mediterranean)	Drought/heat; horticulture quality downgrades; wildfire risk	↑ price/↓ availability of fruits/veg; substitution toward shelf-stable foods in heatwaves	Availability; Access

Table 3: *Regional climate risks and likely consumption shifts (illustrative).*

Climate change and the four food-security dimensions

Climate change disrupts the food chain at every stage, from production to processing to distribution to consumption, and this article presents food security as a result.

Below, we provide a detailed climate pathway map for each dimension, as well as for observable changes in consumption (nutrient adequacy, meal frequency, substitution, and diet diversification) [40].

Availability (Production and supply)

- **Pathways:** Heat/drought yield loss; fisheries MSY decline; extreme events disrupting harvests; salinity intrusion in deltas.
- **Implications for diets:** Reduced local supplies of perishables (vegetables, milk, fish) → seasonal scarcity; increased reliance on starchy staples and shelf-stable ultra-processed foods.
- **Evidence link:** Your draft's list of production stressors (water availability, season length, salinization) aligns with these mechanisms.

Access (Economic and physical)

- **Pathways:** Climate shocks → price spikes and supply chain breaks (flood-damaged roads, port closures) → reduced market access, especially for the poor and rural households.
- **Diet effects:** Cutbacks in animal-source foods and fruits/vegetables; cheaper calorie substitution (refined grains, sugars, fats); fewer meals/day.

Utilization (Food safety and nutrition)

- **Pathways:** Higher ambient temperature and humidity elevate spoilage and mycotoxin risks in storage and transport; food-borne pathogens increase under warm/wet conditions.
- **Diet effects:** Avoidance of fresh items during hot/rainy seasons; micronutrient shortfalls (iron, zinc, vitamin A) when perishables become scarce or unsafe.

Stability (Time dimension of risk)

- **Pathways:** Greater inter-annual variability in yields, repeated shocks from extremes; conflict and poverty can sever distribution even when national availability is adequate-your draft's cassava example captures this perfectly.
- **Diet effects:** Erratic diet diversity across seasons/years; prolonged recovery time after disasters.

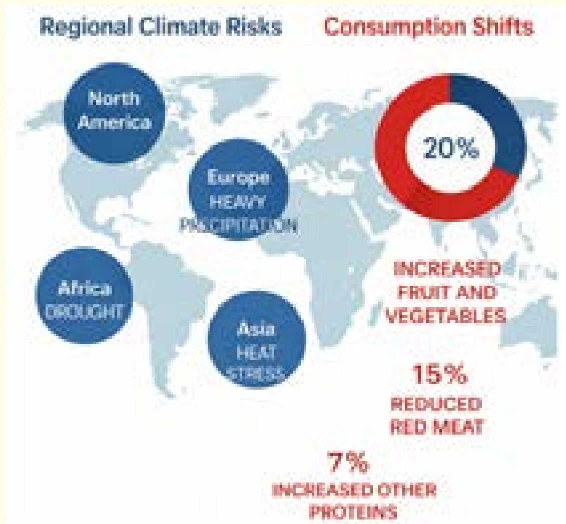

Figure 3: *Regional climate risks and consumption shifts under climate change. Different regions face distinct stressors such as drought in Africa, heat stress in Asia, and heavy precipitation in Europe, driving shifts toward more plant-based and diversified diets.*

Impacts on patterns of food consumption

Through four interconnected channels, climate change affects what people eat, how often they eat it, and how nutritious it is:

(i) Production shocks → availability changes.

(ii) Trade/logistics disruptions → physical access constraints.

(iii) Price volatility → economic access constraints; and

(iv) Safety/quality degradation (e.g. mycotoxins, nutrient dilution) → utilization challenges.

These channels precisely correspond to the four pillars of food security and the nodes of the food system described in your draft [41-43].

Price and affordability pathways → simplification of the diet

According to multi-country assessments, supply-chain risks (such as floods, storms, and port closures) and climate-related production shocks result in higher prices for nutrient-dense perishables (such as fruits, vegetables, fish, and dairy), particularly in areas that rely heavily on imports. According to SOFI-2024, more than one-third of the world's population cannot afford a healthy diet, and affordability is especially vulnerable to market shocks and climate change that drive up the prices of nutrient-dense foods. UNICEF DATA+1.

Changes in the diversity and composition of diets

Modeling and observational research converge on dietary simplification under stress: households cut back on fresh produce and animal-source foods in favor of less expensive, shelf-stable staples like refined grains, sugars, and oils. Transitions to plant-forward, varied diets (when accessible and affordable) may improve health and reduce emissions, according to complementary evidence; however, equity and access remain important limitations.

Risks to nutrition quality (utilization)

There are two main nutrition pathways that are sensitive to climate change:

- **Food safety and quality:** In line with your post-harvest focus, warmer, more humid storage seasons increase the risk of spoiling and mycotoxins (aflatoxins, fumonisins), which lowers consumption of fresh staples and legumes.
- **Nutrient dilution under elevated CO_2:** Meta-analyses reveal lower concentrations of iron, zinc, and protein in important crops, suggesting a higher intake needed for the same micronutrient adequacy. pmc.ncbi.nlm.nih.gov+1.

Regional heterogeneity and equity

Households experience seasonal diet fluctuations (lean-season meal skipping, decreased diet diversity) in areas where rainfed agriculture predominates and cold-chain capacity is constrained. Similar to the access and stability pillars in your manuscript, import-dependent regions (such as the Gulf/MENA) undergo price-mediated shifts during heatwaves and port disruptions.

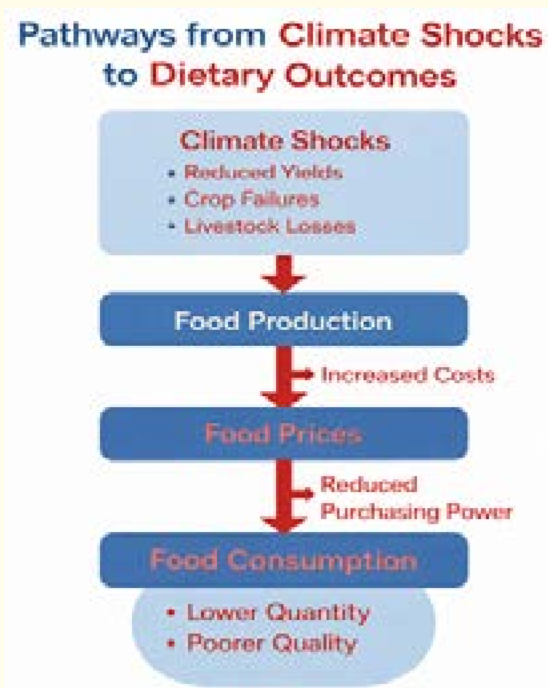

Figure 4: *Pathways linking climate shocks to dietary outcomes. Temperature extremes, droughts, and floods reduce yields and increase costs, raising food prices and lowering affordability, leading to poorer diet quality and quantity.*

Figure 5: *Mitigation-adaptation synergies across the food system. Integrating interventions across production, processing, distribution, and consumption can simultaneously reduce emissions, enhance resource efficiency, and improve food security.*

Conclusion

By affecting agricultural productivity, changing food availability, and raising market volatility, climate change is changing patterns of food consumption worldwide. All four of the pillars of food security-availability, access, utilization, and stability-are weakened by these effects, which ultimately reduce dietary diversity, increase reliance on processed foods, and raise nutritional risks, particularly for vulnerable populations. Food systems will need coordinated, forward-thinking strategies that tackle both environmental and nutritional issues as climate pressures increase.

Several high-priority initiatives emerge to support more equitable and resilient food systems. Food supplies can be stabilized by bolstering climate-resilient agriculture, enhancing distribution and storage to lower post-harvest losses, and encouraging sustainable fisheries. Affordability and nutritional outcomes can be improved by promoting dietary changes toward wholesome, low-carbon foods and expanding market access. Protecting at-risk communities will require investing in early warning and data monitoring systems, growing social protection programs, and incorporating climate and nutrition concerns into national policies. Lastly, to better understand changing consumption trends and direct evidence-based interventions, more interdisciplinary research is required.

When taken as a whole, these actions can promote healthier, more sustainable diets for future generations while protecting global food and nutrition security in a warming world.

Author Contributions

Abdel Moneim Sulieman: Conceptualization, methodology, investigation, data curation, writing-original draft preparation. Soheir Shommo: Supervision, validation, formal analysis, writing-reviewing and editing, corresponding author. Safa Mustafa: Methodology, resources, biochemical analysis, investigation.

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Data Availability

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Ethical Approval

Not applicable as this study did not involve human or animal subjects.

Consent to Participate

Not applicable.

Consent for Publication

All authors have read and approved the final version of the manuscript and consent to its publication.

Conflict of Interest

The authors declare no conflict of interest.

Bibliography

1. Hossain A., *et al*. "Cereals production under changing climate". In Challenges and solutions of climate impact on agriculture. Academic Press (2025): 63-83.
2. Savary S., *et al*. "Mapping disruption and resilience mechanisms in food systems". *Food Security* 12.4 (2020): 695-717.
3. Crippa M., *et al*. "Food systems are responsible for a third of global anthropogenic GHG emissions". *Nature Food* 2 (2021): 198-209.
4. Munialo CD and Mellor DD. "A review of the impact of social disruptions on food security and food choice". *Food Science and Nutrition* 12.1 (2024): 13-23.
5. Myers SS., *et al*. "Climate change and nutritional quality of food". *Annual Review of Public Health* 43 (2022): 283-302.
6. Zurek M., *et al*. "Climate change and the urgency to transform food systems". *Science* 376.6600 (2022): 1416-1421.
7. Rosenzweig C., *et al*. "Climate change challenges for agriculture". *Nature Food* 3 (2022): 1-10.
8. Loboguerrero AM., *et al*. "Food and earth systems: priorities for climate change adaptation and mitigation for agriculture and food systems". *Sustainability* 11.5 (2019): 1372.
9. Owino V., *et al*. "The impact of climate change on food systems, diet quality, nutrition, and health outcomes: A narrative review". *Frontiers in Climate* 4 (2022): 941842.
10. Li X., *et al*. "Neglected and underutilized crop species: the key to improving dietary diversity and fighting hunger and malnutrition in Asia and the Pacific". *Frontiers in Nutrition* 7 (2020): 593711.
11. Despoudi S., *et al*. "Food waste management, valorization, and sustainability in the food industry". In Food waste recovery. Academic Press (2021): 3-19.
12. Experts HLP. "Food security and nutrition: building a global narrative towards 2030". Committee on World Food Security, Rome, Italy, HLPE Report (2020).

13. Ericksen PJ. "Conceptualizing food systems for global environmental change research". *Global Environmental Change* 18.1 (2008): 234-245.
14. Ingram, 2020.
15. Vermeulen SJ., *et al*. "Climate change and food systems: Interactions, impacts and priorities". *Annual Review of Environment and Resources* 45 (2020): 173-202.
16. Fanzo J., *et al*. "Integrating nutrition and climate change policy". *Nature Food* 3.6 (2022): 409-418.
17. Tilman D and Clark M. "Global diets link environmental sustainability and human health". *Nature* 515 (2018): 518-522.
18. Popkin BM., *et al*. "Towards universal healthy sustainable diets". *Nature Food* 1 (2020): 233-239.
19. Milne E., *et al*. "Update on scientific findings on the interactions between agriculture, food systems and climate change". Food and Agriculture Organization (2025).
20. Campbell BM., *et al*. "Reducing risks to food security from climate change". *Global Food Security* 11 (2018): 34-43.
21. Deryng., *et al*. "Modeling study on temperature-driven seed productivity decline". *Nature Communications* 11 (2020): 4548.
22. Shukla., *et al*. "Impacts of variable rainfall on irrigation reliability". *Environmental Research Letters* 17 (2022): 094007.
23. Zhao C., *et al*. "Temperature increase reduces global yields". *Proceedings of the National Academy of Sciences* 117.21 (2020): 32771-32779.
24. Miraglia M., *et al*. "Climate change and mycotoxins". *Food Research International* 139 (2021): 109962.
25. Grace. "Overview of food-borne pathogen risks from climate variability". *Annual Review of Food Science and Technology* 11 (2020): 1-22.
26. Searchinger T., *et al*. "Creating a sustainable food future: A menu of solutions to feed nearly 10 billion people by 2050". Final report (2019).
27. Deutsch CA., *et al*. "Increase in crop losses to insect pests in a warming climate". *Science* 361.6405 (2018): 916-919.
28. Rojas-Downing MM., *et al*. "Climate change and livestock". *Climate Risk Management* 16 (2018): 145-163.
29. Polsky L and von Keyserlingk MAG. "Invited review: Heat stress in dairy". *Journal of Dairy Science* 100.11 (2017): 8645-8657.
30. Niu M., *et al*. "Heat stress and enteric methane intensity". *Journal of Dairy Science* 101.7 (2018): 6428-6441.
31. Ryan SJ., *et al*. "Climate change and vector-borne diseases". *Annual Review of Public Health* 40 (2019): 261-277.
32. Hughes TP., *et al*. "Global warming transforms coral reef assemblages". *Nature* 556 (2018): 492-496.
33. Handisyde N., *et al*. "Climate risks to aquaculture". *Reviews in Aquaculture* 13.4 (2021): 1923-1943.
34. Williams AP., *et al*. "Warming and wildfire risk". *Earth's Future* 7.6 (2019): 892-910.
35. van Oort PAJ., *et al*. "Salinity and rice yield under SLR". *Agricultural Systems* 190 (2021): 103117.
36. Santillán D., *et al*. "Climate change risks to horticulture". *Environmental Research Letters* 15.12 (2020): 123004.
37. Thornton PK., *et al*. "Livestock and climate change". *Global Food Security* 28 (2021): 100493.

38. Lara LJ and Rostagno MH. "Heat stress in poultry". *Animals* 3.2 (2013): 356-369.

39. Golden CD., *et al*. "Nutrition and health benefits of fisheries in a changing climate". *Nature Food* 2 (2021): 367-376.

40. El Bilali H., *et al*. "Climate change and food security". *Agriculture and Forestry/Poljoprivreda i Šumarstv* 66.3 (2020).

41. Carlsson-Kanyama A and González AD. "Potential contributions of food consumption patterns to climate change". *The American Journal of Clinical Nutrition* 89.5 (2009): 1704S-1709S.

42. Fanzo J., *et al*. "The effect of climate change across food systems: Implications for nutrition outcomes". *Global Food Security* 18 (2018): 12-19.

43. World Health Organization. "The state of food security and nutrition in the world 2020: transforming food systems for affordable healthy diets". (Volume 2020) Food and Agriculture Org (2020).

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