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Review Article

# The interrelationship among sustainability and food security: A review

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## Abstract

Unexpected environmental issues that might endanger human life emerged around the turn of the century. The planet's food system, already in delicate balance with its ecology, is further strained by climate change, energy and water shortages, environmental degradation, changing global population demographics, food safety, and an increase in disease pandemics. These issues, whether man-made or natural, encourage the scientific community to aggressively seek out innovative, ground-breaking approaches to food and nutrition that will ensure future global food sustainability and nutrition security. In order the address these issues and produce notable changes in the food supply, nutrition, and health status, creative solutions must be explored throughout the whole food chain, including food choices and eating habits.

**Keywords:** Nutrition, Sustainable development, Malnutrition.

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## 1. Introduction

The article emphasizes the importance of adapting to current trends and long-term developments in science, technology, society, politics, economics, and demography to develop ideas for the near and far future. It highlights the challenges faced by the agricultural and food sectors in addressing food safety, health, and the environment, as well as the need for long-term agricultural production and systemic transformation. The assessment aims to define future strategies for food security, safety, sufficiency, sustainable foods, alternative protein sources, and factors influencing food and nutrition security and agriculture. It also explores promising food systems like functional foods, novel foods, synthetic biology, and 3D food printing.

Additionally, it offers a crucial viewpoint on sustainability. Significant obstacles to a sustainable economy and environment include population growth, shifting demographics, climate change, resource depletion, unequal food distribution, declining food quality and sufficiency, food waste, economic and ecological disruption, water shortages, land degradation, vulnerability to natural disasters, insecurity, environmental and public health, and resource constraints. The global food production systems are under threat from ecological, soil, and water degradation, water loss, nutrient loss, soil erosion, air pollution, biodiversity loss, and climate change.[1,2] Current food production systems are not operating at their best, as evidenced by their detrimental effects on the environment, vulnerability to threats to food security,[3] climate change,[4] and water security,[5] and more. Recent occurrences have shown that even sophisticated technology and control systems cannot ensure the safety and quality of food.

The modern world faces challenges in creating a sustainable food system to feed a growing population while preserving ecosystems and natural resources. Sustainable aims involve providing safe, nourishing, accessible, and environmentally sustainable food for everyone. Educating people about sustainability in the food business is essential. Food in the future aims to address issues related to nutrition, health, global food supply, and food security by providing safer, healthier, and more palatable food.[6,7] The current long supply chain-based food system is inadequate to feed the world's population and leads to major ecological,

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environmental, logistical, and nutritional constraints.[8] New and effective sustainable food systems are required to satisfy climate, diversity, and health goals while ensuring nutrition and food security.[9,10] To increase food production while consuming fewer resources and decreasing food waste, food systems will need to undergo significant modifications. Genetics, conjugates, functional materials, microbes, nanoparticles, nanoemulsions, and modified biopolymers are becoming significant topics in food science.[11] The creation of new foods and food businesses, the advancement of functional meals, and the use of nanotechnology are growing trends in the food industry.[12] Feeding India's expanding population is a significant concern in the coming years. With over 17% of the world's population living in India, and 60 crores Indians expected to reside in urban areas by 2030, a steady supply of wholesome food from the countryside is needed. Natural resources are becoming scarcer and of lower quality, and climate change poses an additional problem.[13]

## 2. Discussion

The food systems around the world are changing quickly. Obesity and overweight rates have increased dramatically as dietary systems change. A global campaign to enhance diet quality and nutrition is currently underway, calling for radical changes to food systems. The issues are serious. It is anticipated that food systems will reduce various types of hunger while preserving natural resources. The difficulties of creating sustainable food systems are evaluated in this study, along with the consequences for creating effective plans. For current and future generations, the United Nations' seventeen Sustainable Development Goals provide a roadmap for long-term global development.[14] To achieve zero hunger, ensure food security, eradicate all kinds of malnutrition, and advance sustainable agriculture, the second Sustainable Development Goal focuses on nutrition and food security. Goal 12 of the Sustainable Development Agenda encourages conscientious production and consumption. The world nutrition, health, and food production, both present and future should be taken into consideration, in order to accomplish these goals. The article examines obstacles and limitations related to food system safety, conservation, nutrition, sensory perception, and welfare, and suggests new methods, innovative interpretations, technological advancements, and prospects to address these issues. It also makes recommendations for food trends and more research, covering future sustainable foods, substitute protein sources, innovative food systems, scientific and technological developments, and new research areas.

In the future, we will need to meet the food demands of a growing population while using the same amount of land and a dwindling labour base, which presents tremendous problems for those studying agricultural practices. To keep up with population growth, agriculture is anticipated to continue reducing malnutrition by increasing food supply and improving food access. Effective, sustainable farming methods must raise incomes, especially for the impoverished in rural areas, operate as a major employer, increase agricultural output, preserve natural resources, and improve nutrition and food security. Significant improvements in food security, nutrition, poverty alleviation, employment, and general development have been brought about by agricultural advancements, especially biotechnology.[15] Average calorie availability has increased by 40% since 1945, while total food production has tripled.[16] Increased food availability and major public health benefits, including a notable decrease in protein/calorie malnutrition, have been brought about by these advancements, which are referred to as the Green Revolution.[17]

However, the ecology and agricultural resources have suffered because of these advancements. They have significantly increased greenhouse gas emissions and negatively affected land and water resources.[18] Massive increases in obesity and related comorbidities indicate a rise in several public health hazards.[19] Furthermore, a significant section of the global population still suffers from vitamin insufficiency.[20] Starting a "greener green revolution" that preserves natural resources while improving public health and agricultural productivity is the task at hand. Success in the fields of agriculture, public health, and the environment will require a new paradigm of candid, open, and cooperative cross-disciplinary communication and interaction that is not merely prescriptive.[21] It will be essential to define constraints and measures for determining success or failure. Discussions on responsible manufacturing and consumption cannot be examined separately, and trade-offs between sustainable production and a healthy diet must be considered. This unique collection's purpose and scope are to support these important conversations.

One may argue that sustainability is a prerequisite for long-term food security. Food availability and biodiversity preservation depend on the environment, particularly the climate and the availability of natural resources. For everyone to have access to food, social and economic sustainability are required. The use of food is also influenced by social sustainability. The social, economic, and environmental aspects of sustainability work together to guarantee the stability of the systems that support the other aspects of food security. However, as food security is increasingly seen as a need for sustainability, the linkages are mutually reinforcing **Figure 1**

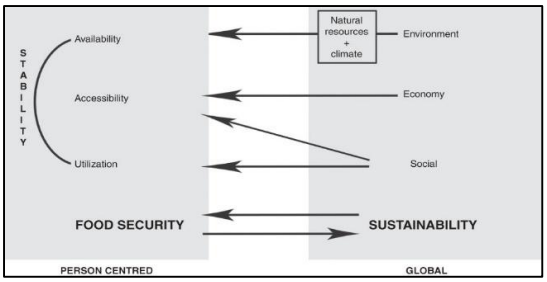


**Figure 1**: Association between sustainability and food security by Barry *et al.* (2015)[22]

Many smallholder economies in Africa, South and Southeast Asia can learn from India's successful transformation of its food infrastructure, which took it from extreme poverty in the middle of the 1960s to self-sufficiency and moderate surplus today. The world's top producer of milk, spices, cotton, and pulses, second in terms of wheat, rice, fruits, and vegetables, third in terms of eggs, and fifth in terms of chicken meats is now India. In addition, it is the biggest exporter of meat, spices, and rice. The use of new technologies, creative institutional architecture, and appropriate incentives made all this feasible. However, India's food system confronts several issues as it looks to thirty years from now and beyond, such as rising rates of child malnutrition, land fragmentation, climate change, and the demand for natural resources (soils, water, air, and forests). India requires a well-rounded set of policies to effectively address these issues, including price and income policies, investment and subsidy-driven policies, and promotion of agricultural diversification toward more nutrient-dense foods. Furthermore, it has to provide incentives for its private sector to create fair and effective value chains that support environmental sustainability. Manufacturing more from less will require more advanced technologies, including green-to-gene, increased digitization, the Internet of Things, and artificial intelligence, to sustainably feed the world's most populated nation by the decade of 2030.

## 3. Conclusion

The food system faces numerous challenges, including sustainability, environmental deterioration, chronic poverty, vulnerability, hunger, and malnutrition. A holistic approach is needed to address these issues, focusing on policies and legal frameworks that address economic inequalities, promote livelihoods, and ensure resilience. Sustainable meals must balance dietary requirements, expenses, and cultural acceptance while adhering to social and environmental norms. The current governance paradigm assigns food insecurity to agriculture and malnutrition to the health sector, leading to a fragmented and chaotic system. Priority-based policies are necessary, with decisions made by manufacturers, consumers, and governments. An integrated framework will be needed to support consumer choice, environmental and economic sustainability, and optimal health. Sustainable food value chains can benefit millions of underprivileged households in developing countries throughout Asia Pacific. However, identifying the root causes of unsustainable systems is challenging due to their complexity. To end the cycle of poverty, a high level of alignment and proactive collaboration among all value chain actors, including farmers, agribusinesses, governments, and civil society organizations, is required.

Farming is an essential part of the rural economy, accounting for 29% of GDP and 65% of employment opportunities. Supporting sustainable agricultural practices, particularly for smallholder farms, is crucial for safeguarding livelihoods, generating income, and providing a basis for equitable growth. Sustainable, resource-efficient agricultural practices enable farmers to adapt to change, support their livelihoods, and reduce greenhouse gas emissions. Moreover, reducing food waste is an important component of sustainable food systems, as approximately one-third of global food is wasted. Significant advancements have been made in income, nutrition, and food security over the past 50 years, but further progress is needed. India's economic growth, agricultural output, and nutrition must be investigated to improve food security and reduce environmental impact.

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## 5. Conflict of Interest

None.

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