



Sustainable Agriculture and Food Security

Agriculture lays the foundation of a country's ability to feed its people and livestock, as well as produce goods with higher value addition. It also supplies vital raw materials to a variety of manufacturing sectors. Agriculture lays the groundwork for economic growth and development within an economy. The agriculture market's backward connections with industries and urban areas, such as farmers' purchases of industrial goods like clothing, furniture, utensils, building materials, fertilizers, pesticides, tools, and implements, are one way that the sector contributes to the economy. One key strategy for growth and development is the net transfer of capital from agriculture to the non-farm economy.

The agriculture industry facilitates the transfer of capital goods and technical experience between developed and developing emergent markets, as well as opening opportunities for international market linkages. With its potential for GDP growth and its capacity to ensure food security for its country and the rest of the globe, it is a significant source of savings and investment. In Pakistan, "the agriculture sector contributes 23% to GDP and employs about 37.4% of the total labor force (FAO, 2023).

Pakistan, a nation renowned for its extensive agricultural history, faces several obstacles in its efforts to maintain its economy and provide food security. It serves as the primary source of food production, significantly contributes to the nation's GDP, and supports a sizable section of the populace. Despite being an agricultural nation, Pakistan has yet to fully realize the potential of the agricultural sector to ensure the food security of over 200 million people in the second decade of the twenty-first century. Given the sector's substantial economic contributions, policymakers should pay more attention to it.

For ages, Pakistan's economy has relied primarily on agriculture. However, numerous issues confront the industry, such as soil erosion, water scarcity, and climate

change, which pose a danger to its long-term viability. Sustainable agriculture offers a viable solution to these pressing problems. It emphasizes methods that maintain food security and economic stability while preserving natural resources, fostering biodiversity, and reducing environmental impacts. Some essential tenets of sustainable agriculture, along with potential benefits for Pakistan, include diversified cropping systems, organic farming, effective water management, sustainable land use practices, and the promotion of agroforestry.

Sustainable agriculture aims to improve the environment and resource base essential for agriculture, fulfill basic human nutritional needs, remain economically viable, and enhance the living standards of farmers and society. It involves managing natural resources in a balanced manner, yielding outcomes comparable to conventional farming practices over time, rather than resorting to unsustainable shortcuts. By adopting sustainable agriculture practices, farmers can sustain their operations for an extended period and utilize scarce resources more effectively. Moreover, sustainable agriculture is more suitable for the local environment compared to traditional methods, offering farmers opportunities to collaborate with governmental bodies and other groups to address the world's growing population through sustainable means.

The Sustainable Development Goals (SDGs) established by the United Nations aim to combat poverty, injustice, inequality, and climate change by 2030. Pakistan, as a member of the UN, aligns with these goals, addressing both current challenges and future needs.



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The agriculture sector in Pakistan is closely linked to more than six of the SDGs, including hunger, poverty, malnutrition, unemployment, sustainable growth, and conservation of natural resources. Challenges in achieving sustainable agricultural growth are discussed in the context of food security amid the nation's expanding population, along with the concept of the fourth green revolution in agriculture and its implications for farmer education and literacy.

According to a recent credible assessment, Pakistan faces significant vulnerabilities in terms of food security, ranking 102nd out of 125 countries in the 2023 Global Hunger Index (GHI). With a score of 26.6, the country's hunger level is classified as "serious."

It has been observed that an increasing number of Pakistanis are facing food insecurity due to the country's double-digit food price hike over the last three years coupled with declining incomes. Estimates from the World Food Programme (WFP) indicate that more than 43% of Pakistanis are affected by food insecurity, with 18% experiencing severe food insecurity.

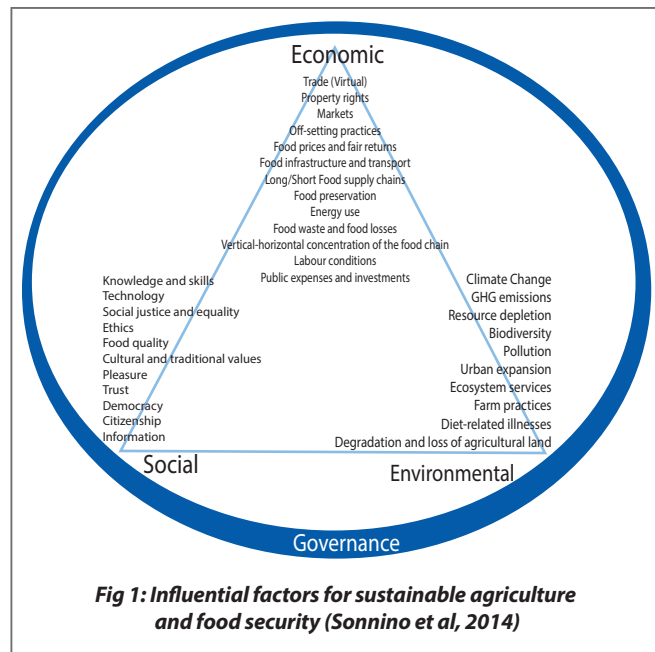
How Does Food Security Get Promoted by Sustainable Agriculture?

A guaranteed supply of wholesome food to meet the needs of domestic populations, including all the groups that comprise those people, is known as food security, which is synonymous with food sovereignty. Sustainable agriculture ensures food availability by utilizing locally available resources. This is achieved through:

- 1) **Regional Manufacturing:** Employing sustainable agriculture in regional production contributes to the growth of employment prospects in the economy. Sustainable farming methods also contribute to poverty reduction by generating higher farming incomes for both commercial and small-scale farmers.
- 2) **Increased Productivity:** Adopting sustainable agriculture practices can increase the amount of food produced per acre, allowing for the cultivation of more crops on a piece of land and the growth of more nutrient-dense vegetables, thereby increasing food availability. Organized farmers practicing sustainable agriculture can also free up more land, potentially leading to even higher productivity.
- 3) **Consistent Availability:** Crops grown using organic agricultural methods tend to be more nutritious and flavorful, thereby increasing the availability of food. By applying conventional procedures, farmers can maintain crop quality and output while ensuring crop rotation and selection.

For the 80% of the world's poor who reside in rural regions and predominantly work on agriculture farms, sustainable agriculture can help alleviate poverty, enhance earnings, and improve food security (World Bank, 2024). The term "sustainability" refers to the capacity to endure indefinitely, primarily signifying the coexistence of human civilization with the environment in the 21st century.

Sustainable development is influenced by social, political, and economic factors, as well as sound governance (Fig. 1). Addressing these issues is crucial to achieving food security through the adoption of sustainable development goals. Agricultural systems must be made more productive and efficient in a sustainable manner, especially for those more vulnerable to hunger and poverty, to achieve the Sustainable Development Goals (FAO 2023, Rai et al., 2015).



Sustainable agriculture practices, as stated by the National Institute of Food and Agriculture, USA, aim to preserve and enhance soil fertility, broaden the Earth's natural resource base, and safeguard the environment. Numerous studies suggest that an effective transition toward more sustainable agricultural production systems should be implemented to provide inexpensive, nutrient-dense food for the world's population, predicted to exceed 9.7 billion people by 2050 (FAO, 2017). Approximately 95% of our food is either directly or indirectly generated from our soils, according to several studies. Unfortunately, deforestation, excessive grazing, salinization, erosion, and nitrogen loss have already damaged 33% of the planet's soil, and by 2050, that percentage could exceed 90%.

According to the FAO, appropriate measures are required to strengthen the resilience of food systems and human livelihoods, including policies, programs, and practices that integrate disaster management and climate change adaptation with a short-, medium-, and long-term perspective.

Is Sustainable Agriculture Entirely Effective?

Research, technology, and education are all essential for continuously refining and enhancing sustainable agriculture as a practice. Technology has the potential to improve methods such as increasing crop density to boost output. Moreover, the development of new crops and improved farming management tools can contribute significantly to sustainable agriculture. For instance, greenhouse technology allows farmers to grow plants without soil or water. Additionally, small adjustments like water recycling by neighboring farms can reduce the water needed for crop growth and increase food production.

Future of Sustainable Agriculture and Food Security

Implementing farming practices that safeguard ecosystems, the environment, and human health while simultaneously producing enough grains, animals, plants, or other agricultural goods for societal welfare is known as sustainable agriculture. Humans face complex issues in the modern world, including vulnerability to sustainability, the pursuit of a healthy lifestyle, and concerns about agriculture, food, and natural resources. Food security has taken precedence due to the world's population growth, with inadequate food production and food waste at the farm level during storage and transportation being primary causes of food insecurity. The future of human life depends on sustainable agriculture, which calls for long-term, comprehensive land management. Positive advances in agricultural productivity are brought about by the sustainable expansion of the agricultural system through the application of novel and inventive techniques like nanotechnology.

An emerging option for creating safer and more effective nano-formulated agrochemicals, such as fertilizers and insecticides, is nanotechnology (Prasad et al., 2017). Nanotechnology also plays a significant role in mitigating the major problem of food product spoilage by utilizing nano sensors that are extremely sensitive to food spoilage and can detect even the smallest changes in the storage environment, such as humidity, temperature, and microbial contamination.

Reducing hunger and enhancing food security presents growing challenges for policymakers, analysts, and civil



society. To meet the demand for food, agricultural productivity must rise by 60% by 2050. Achieving this objective will require widespread support for sustainable agriculture and food accessibility, encouraging equitable access to markets, technology, and land to increase the productivity and income of small-scale farmers. Global agriculture systems need to become less wasteful and more productive.

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