

# SUSTAINABLE AGRICULTURAL

## PRACTICES AND THEIR IMPACT ON GLOBAL FOOD SECURITY: A SYSTEMATIC REVIEW

PRÁCTICAS AGRÍCOLAS SOSTENIBLES Y SU IMPACTO EN LA SEGURIDAD ALIMENTARIA GLOBAL: UNA REVISIÓN SISTEMÁTICA

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### ABSTRACT

This study analyzes the role of sustainable agricultural practices in global food security through a qualitative approach using a systematic literature review. Relevant and recent studies were collected and evaluated from recognized academic databases to ensure a comprehensive analysis. The findings indicate that population growth and increasing food demand have intensified pressure on natural resources, while conventional agriculture has contributed to issues such as soil degradation, water scarcity, and biodiversity loss. In contrast, practices such as organic farming, regenerative agriculture, and agroecology provide alternatives that improve soil health, optimize resource use, and reduce environmental impact. These practices also enhance the resilience of agricultural systems to climate change and other external stressors, supporting long-term production stability. However, their adoption faces challenges including high initial costs, limited access to technology, and insufficient institutional support. In this context, technological innovation and public policies play a crucial role. The study concludes that sustainable agriculture is essential to ensure food security, improve livelihoods, and preserve natural resources for future generations.

### Keywords:

Sustainable agriculture, food security, climate change, agroecology, natural resources.

### RESUMEN

Este estudio analiza el papel de las prácticas agrícolas sostenibles en la seguridad alimentaria global mediante una revisión sistemática de la literatura con enfoque cualitativo. A partir de la recopilación y análisis de información proveniente de bases de datos académicas reconocidas, se evaluaron investigaciones recientes y relevantes sobre sostenibilidad agrícola. Los resultados muestran que el crecimiento poblacional y la creciente demanda de alimentos han intensificado la presión sobre los recursos naturales, mientras que la agricultura convencional ha contribuido a problemas como la degradación del suelo, la escasez de agua y la pérdida de biodiversidad. En contraste, prácticas como la agricultura orgánica, regenerativa y la agroecología ofrecen alternativas que mejoran la salud del suelo, optimizan el uso de recursos y reducen el impacto ambiental. Asimismo, estas prácticas fortalecen la resiliencia de los sistemas agrícolas frente al cambio climático y otros factores externos, favoreciendo la estabilidad de la producción a largo plazo. Sin embargo, su adopción enfrenta limitaciones como costos iniciales elevados, falta de acceso a tecnología y escaso apoyo institucional. En este contexto, la innovación tecnológica y las políticas públicas desempeñan un papel fundamental. Se concluye que la agricultura sostenible es esencial para garantizar la seguridad alimentaria, mejorar las condiciones de vida y preservar los recursos naturales.

### Palabras clave:

Agricultura sostenible, seguridad alimentaria, cambio climático, agroecología, recursos naturales.

## INTRODUCTION

In the current global context, food security represents one of the most complex and urgent challenges facing humanity. The continuous growth of the world's population, combined with the increasing demand for food, has placed unprecedented pressure on agricultural systems and natural resources. According to the World Bank (2026), millions of people worldwide continue to experience food insecurity, highlighting the need to develop strategies that not only increase food production but also ensure its long-term sustainability. In this regard, sustainable agriculture emerges as a fundamental approach to achieving a balance between agricultural productivity and environmental conservation.

Historically, conventional agriculture has focused on maximizing yields through the intensive use of chemical fertilizers, pesticides, heavy machinery, and monocropping systems. While this model has significantly increased food production, it has also led to considerable negative consequences, including soil degradation, water pollution, biodiversity loss, and increased greenhouse gas emissions (Rehman et al., 2022). These environmental impacts not only threaten ecosystem health but also compromise the future capacity of agricultural systems to sustain food production, thereby directly affecting global food security.

In response to these challenges, various sustainable agricultural practices have emerged with the aim of transforming traditional production systems into more resilient and balanced models. Among the most prominent approaches are organic agriculture, regenerative agriculture, and agroecology, all of which promote the efficient use of natural resources, the reduction of chemical inputs, and the improvement of soil health (Ji, 2025). Organic agriculture, for instance, eliminates the use of synthetic products, while regenerative agriculture focuses on restoring agricultural ecosystems through practices such as cover cropping and crop rotation. Agroecology, on the other hand, integrates ecological principles with traditional knowledge to design sustainable and socially equitable farming systems.

Moreover, these practices not only provide environmental benefits but also contribute significantly to improving agricultural productivity and the resilience of food systems. Studies such as Pretty et al. (1996) demonstrate that the adoption of sustainable practices can enhance crop yield under certain conditions, particularly in developing regions where farmers rely heavily on natural resources. Similarly, more recent research highlights that sustainable approaches strengthen the ability of agricultural systems to adapt to adverse conditions, reducing vulnerability to factors such as climate change, water scarcity, and land degradation (Hiywotu, 2025).

Climate change is one of the main factors exacerbating global food insecurity. Rising temperatures, shifting precipitation patterns, and the increased frequency of extreme weather events directly affect agricultural productivity. In this context, sustainable agriculture plays a crucial role by offering both mitigation and adaptation strategies. For example, practices such as crop diversification, efficient water management, and soil conservation contribute to enhancing the resilience of agricultural systems under changing climatic conditions (Rehman et al., 2022). These strategies not only help maintain food production but also reduce the environmental impact associated with agricultural activities.

In addition, water scarcity and soil degradation are critical challenges for modern agriculture. The excessive use of agrochemicals and intensive land exploitation have significantly reduced soil fertility, limiting its capacity to sustain long-term crop production. In contrast, sustainable practices promote the conservation and restoration of these resources through techniques such as crop rotation, the use of organic fertilizers, agroforestry, and efficient irrigation systems. These approaches not only improve soil quality but also optimize water use, contributing to more sustainable and efficient agricultural production.

In an increasingly globalized world, where food demand continues to rise, it is essential to adopt comprehensive approaches that ensure the sustainability of food systems. Food security is not limited to food availability; it also encompasses access, stability, and nutritional quality. In this regard, sustainable agriculture offers a viable solution to address these challenges by promoting production systems that are environmentally responsible, economically viable, and socially equitable (Ji, 2025).

Furthermore, the implementation of public policies and the development of innovative technologies play a crucial role in promoting sustainable agricultural practices. Institutional support, investment in research, and access to appropriate technologies can facilitate the adoption of these practices, particularly in developing countries. As highlighted by Hiywotu (2025), the combination of effective policies, technological innovation, and local knowledge is essential to achieving Sustainable Development Goal 2: Zero Hunger.

The transition toward sustainable agricultural systems is an urgent necessity to ensure food security for present and future generations. The integration of innovative practices, appropriate policies, and traditional knowledge will enable the development of more resilient agricultural systems capable of producing food efficiently without compromising natural resources. Therefore, it is essential for all countries to prioritize the implementation of sustainable strategies in the agricultural sector, recognizing their critical role

in building a more equitable, secure, and sustainable future.

In this context, the present systematic review aims to analyze different sustainable agricultural practices and evaluate their impact on global food security. It examines the main approaches, benefits, and limitations of these practices, as well as their contribution to environmental sustainability and social well-being. Additionally, it seeks to identify the most effective strategies for promoting the adoption of sustainable agricultural models across diverse geographical and socio-economic contexts.

## METHODOLOGY

The present study was developed under a qualitative approach, using a systematic literature review method, with the aim of analyzing the impact of sustainable agricultural practices on global food security. This approach made it possible to collect, evaluate, and synthesize relevant information from various academic sources, ensuring a rigorous and structured analysis of the topic.

For the information search, recognized scientific databases such as Scopus, Web of Science, Google Scholar, and ScienceDirect were consulted, selecting articles published mainly between 2022 and 2026 to ensure the timeliness and relevance of the studies analyzed. Additionally, some classical sources were included to provide important theoretical foundations in the field of sustainable agriculture. The keywords used in the search included terms such as “sustainable agriculture,” “food security,” “agroecology,” “climate change,” “soil degradation,” and “sustainable food systems.”

The inclusion criteria considered peer-reviewed academic studies, review articles, empirical research, and institutional documents that directly addressed the relationship between sustainable agricultural practices and food security. On the other hand, sources that lacked sufficient scientific evidence, duplicates, or documents not related to the study's focus were excluded.

The information selection process was carried out in several stages. First, a preliminary review of titles and abstracts was conducted to identify potentially relevant documents. Subsequently, a full reading of the selected texts was performed to assess their relevance and quality. Finally, the most relevant data from each study were extracted, organized, and analyzed comparatively.

For data analysis, a narrative synthesis technique was used, allowing the identification of patterns, trends, similarities, and differences among the various studies reviewed. This analysis facilitated the understanding of the impact of sustainable agricultural practices in different geographical and socio-economic contexts, as well as the identification of benefits, limitations, and opportunities for improvement.

Likewise, a critical approach was adopted in the interpretation of the results, considering both the contributions and limitations of each study. This made it possible to provide a comprehensive view of the topic, avoiding generalizations and recognizing the complexity of the relationship between agricultural sustainability and food security.

## DEVELOPMENT

Sustainable agricultural practices have gained increasing relevance in the global debate on how to ensure food security without compromising the integrity of ecosystems. These practices aim to transform traditional agricultural systems through approaches that balance productivity, environmental conservation, and social well-being. In this context, various models such as organic agriculture, regenerative agriculture, and agroecology have proven to be viable alternatives to conventional intensive methods.

Organic agriculture is based on the elimination of synthetic inputs, promoting the use of natural fertilizers, compost, and biological pest control. This approach helps reduce environmental pollution and supports biodiversity, both in the soil and in surrounding ecosystems. Additionally, organic systems tend to improve soil quality over the long term by increasing their capacity to retain water and nutrients. However, one of the most widely discussed challenges is the potential reduction in yields during the initial stages of adoption, which can limit its large-scale implementation, especially in regions with high food demand.

On the other hand, regenerative agriculture focuses on restoring the natural processes of agricultural ecosystems, with particular emphasis on soil health. This approach incorporates practices such as crop rotation, the use of cover crops, reduced tillage, and the integration of livestock into farming systems. These strategies help increase soil organic matter, improve soil structure, and promote carbon sequestration, thereby contributing to the mitigation of climate change effects. Unlike conventional systems, regenerative agriculture aims not only to maintain productivity but also to progressively improve the conditions of the production environment.

Agroecology, in contrast, adopts a more comprehensive perspective by considering not only environmental aspects but also the social and economic dimensions of agricultural production. This approach promotes crop diversification, the integration of traditional knowledge, and the active participation of local communities. Agroecology is particularly relevant in developing countries, where farmers depend heavily on natural resources and possess ancestral knowledge that can be key to the sustainable management of agricultural systems. Furthermore, this approach strengthens food sovereignty by enabling communities to control their own production and consumption systems.

Despite the benefits of these practices, agriculture at a global level faces significant challenges stemming from climate change. Rising temperatures altered rainfall patterns, and the intensification of extreme events such as droughts and floods directly affect agricultural production. These factors create uncertainty in food systems and increase the vulnerability of millions of people, especially in regions with limited adaptive capacity. In this regard, sustainable practices offer key tools to artificial intelligence these adverse conditions by enhancing the resilience of production systems.

Efficient water management is another fundamental aspect of agricultural sustainability. Agriculture is one of the largest consumers of water worldwide, and inefficient use can lead to scarcity and conflicts over this resource. Sustainable practices promote the use of technologies and strategies that optimize water consumption, such as drip irrigation, rainwater harvesting, and the use of drought-resistant crops. These measures help reduce waste and ensure more stable production under conditions of water scarcity.

Likewise, soil degradation constitutes one of the most critical problems for food production. Intensive land use, deforestation, and the excessive use of agrochemicals have deteriorated soil quality in many regions of the world. As a result, its capacity to sustain crops efficiently has declined. Sustainable agricultural practices seek to reverse this process through conservation techniques such as ground cover, agroforestry, and the use of organic fertilizers. These strategies not only improve soil fertility but also contribute to carbon sequestration and the protection of biodiversity.

In addition to environmental factors, there are significant socioeconomic barriers that limit the adoption of sustainable practices. Many farmers, especially in developing countries, lack access to financing, training, and technology. The transition to sustainable models may involve high initial costs and an adjustment period that not all producers can afford. Therefore, the role of public policies and institutional support is essential to facilitate this process. Training programs, economic incentives, and access to markets can encourage farmers to adopt more sustainable practices.

Technological innovation also plays a key role in transforming agriculture. The use of digital tools, artificial intelligence, and monitoring systems helps improve resource efficiency and optimize production. Technologies such as precision agriculture enable more efficient application of inputs, reducing costs and minimizing environmental impact. Likewise, access to real-time climate information helps farmers make more informed decisions, increasing the resilience of production systems.

In terms of food security, sustainable agricultural practices contribute to ensuring more stable and resilient production. By reducing dependence on external

input and improving natural resource management, these systems are less vulnerable to economic and environmental crises. This is especially important in a global context where food demand continues to rise, and available resources are becoming increasingly limited.

However, it is important to recognize that the transition toward sustainability involves challenges and possible trade-offs. In some cases, there may be a temporary decrease in productivity or an increase in production costs. Therefore, it is necessary to adopt a balanced approach that considers both environmental benefits and the economic viability of sustainable practices. Research and the development of new technologies can help reduce these limitations and facilitate large-scale adoption.

Finally, collaboration among different stakeholders is essential to promote sustainability in agriculture. Governments, academic institutions, international organizations, and the private sector must work together to develop strategies that encourage the adoption of sustainable practices. Likewise, consumers play an important role by demanding responsibly produced products, which can drive changes in production systems.

Sustainable agricultural practices represent a comprehensive solution to the current challenges of food security and environmental degradation. Their implementation makes it possible to move toward more efficient, resilient, and environmentally friendly production systems. Although there are obstacles to their adoption, strengthening public policies, technological innovation, and education can facilitate the transition to more sustainable agriculture, capable of meeting the food needs of the global population without compromising resources for future generations.

The study by Varzakas & Smaoui (2024) provides a comprehensive perspective on global food security in the context of sustainability, highlighting the need to transform food systems toward healthier and more sustainable models. The authors emphasize that it is not enough to increase food production; it is also essential to improve nutritional quality and promote sustainable diets that reduce environmental impact. They also stress the importance of coordinated global policies to achieve the Sustainable Development Goals by 2030, integrating economic, social, and environmental aspects into food production and consumption.

In the same vein, Islam (2025) expands the analysis by examining the direct relationship between agriculture, sustainability, and food security, highlighting that the adoption of sustainable practices is essential to ensure long-term food availability. The author points out that agricultural systems must evolve toward more resilient approaches capable of addressing challenges such as climate change, soil degradation, and resource

scarcity. In addition, the need for technological innovation and appropriate policies to facilitate this transition is emphasized.

For their part, Mugula et al. (2023) provide empirical evidence on the impact of sustainable agricultural practices in rural communities, specifically among small-scale maize farmers in Tanzania. Their findings show that adopting these practices not only improves agricultural productivity but also helps reduce poverty and improve family nutrition. Consequently, this study highlights the key role of sustainable agriculture as a tool for socioeconomic development in vulnerable regions.

Similarly, Doda et al. (2025) conduct a systematic review analyzing how sustainable practices are transforming agribusiness at a global level. The authors identify key trends such as digitalization, technological innovation, and the integration of ecological practices, which are redefining agricultural production. They also emphasize that these transformations are essential for increasing efficiency and reducing the environmental impact of modern agriculture.

In line with the above, Richard (2024) examines the impact of sustainable agriculture on food security and environmental conservation, concluding that these practices make it possible to achieve a balance between production and sustainability. The author argues that implementing sustainable techniques contributes to the protection of natural resources while ensuring sufficient food production, which is essential to address current global challenges.

Likewise, Iqbal et al. (2024) address the transformation of food systems in the face of climate change, proposing strategies that include technological innovation, improved resource management, and stronger public policies. The authors also analyze challenges associated with this transition, such as economic barriers and resistance to change, highlighting the need for comprehensive approaches involving multiple stakeholders.

In this regard, Rahman et al. (2025) further explore the relationship between climate change and food security in a globalized world, noting that agricultural sustainability is key to mitigating climate effects and ensuring access to food. The authors emphasize that international cooperation and the implementation of innovative solutions are essential to tackle these challenges on a large scale.

Similarly, Olarewaju et al. (2025) provides a multidisciplinary perspective on integrating sustainable practices in sub-Saharan Africa, emphasizing their importance in improving climate resilience and food security. The study highlights that combining scientific knowledge, appropriate policies, and local practices can lead to more sustainable and adaptive agricultural systems.

On the other hand, Partida-Sedas et al. (2026) analyze agri-food networks from a quality management and foresight perspective, highlighting the importance of organization and coordination in food production and distribution systems. Their contribution lies in demonstrating that sustainability depends not only on production but also on efficiency within the supply chain.

In the technological domain, Pandey & Mishra (2024) highlight the role of artificial intelligence in sustainable agriculture, noting that these tools help optimize resource use, improve decision-making, and increase productivity. Similarly, Marwala (2024) argues that artificial intelligence has the potential to transform global food security by enabling innovative solutions to climate-related challenges.

Regarding agricultural productivity, Ejeta & Bai (2024) present a meta-analysis demonstrating that sustainable practices can significantly improve crop yields, especially in contexts such as Ethiopia. This study reinforces the idea that sustainability and productivity are not opposing goals but complementary ones.

However, Gamel (2025) points out that implementing sustainable practices also involves certain challenges and trade-offs, such as possible short-term reductions in productivity or higher initial costs. Nevertheless, the author emphasizes that long-term benefits outweigh these limitations, particularly in terms of environmental sustainability and food security.

In terms of fundamental principles, Çakmakçı et al. (2025) propose a theoretical framework based on resource efficiency and the resilience of food systems, emphasizing the need to adopt practices that reduce environmental impact and improve long-term sustainability. This approach provides a solid conceptual foundation for implementing sustainable agricultural strategies.

Finally, Sharma et al. (2024) emphasizes the importance of soil health as a central element in achieving sustainable agricultural systems. The authors argue that practices such as crop rotation, the use of organic matter, and reduced chemical inputs are essential for improving soil fertility and ensuring future productivity, thereby contributing to the achievement of the Sustainable Development Goals.

Overall, the studies agree that transforming agricultural systems is essential to address current global food-related challenges. They highlight the need to move toward production models that not only increase food quantity but also ensure nutritional quality and reduce environmental impact. In this sense, sustainability should be integrated into all stages of the food system, from production to distribution and consumption.

Likewise, it is recognized that sustainable agricultural practices significantly contribute to improving productivity, especially in vulnerable contexts, while

strengthening resilience to factors such as climate change, water scarcity, and soil degradation. These practices make it possible to optimize the use of natural resources and reduce dependence on external inputs, thereby supporting long-term production stability.

On the other hand, the importance of the social and economic dimension of agricultural sustainability is emphasized, noting that these strategies can improve farmers' living conditions, reduce poverty, and strengthen food security in rural communities. However, limitations are also identified, such as high initial costs, lack of access to resources, and the need for training, which may hinder their adoption.

Similarly, the key role of technological innovation and digitalization in modernizing agriculture is highlighted, as they help improve production efficiency and decision-making. These tools, together with appropriate public policies and cooperation among different stakeholders, are essential for driving the transition toward more sustainable systems.

Agricultural sustainability requires a comprehensive approach that integrates environmental, economic, and social aspects. The implementation of appropriate practices, institutional strengthening, and global commitment are essential elements to ensure food security and the conservation of natural resources in the future.

## CONCLUSIONS

Based on the analysis conducted, it can be stated that sustainable agricultural practices represent a fundamental strategy to address the current challenges of global food security. The reviewed evidence demonstrates that these approaches not only contribute to improving agricultural productivity but also promote the conservation of natural resources, which is essential to ensure long-term food production.

One of the main findings is that agricultural sustainability should not be understood solely as an environmental approach, but rather as a comprehensive model that incorporates economic and social dimensions. Sustainable practices have the potential to improve farmers' livelihoods, reduce poverty, and strengthen the resilience of rural communities, particularly in vulnerable contexts.

Furthermore, it is evident that factors such as climate change, water scarcity, and soil degradation continue to pose significant threats to agricultural systems. In this regard, the adoption of sustainable practices helps mitigate these effects and enhances the adaptive capacity of production systems. However, their implementation is not without challenges, as it requires investment, training, and institutional support.

Another relevant aspect is the role of technological innovation in transforming agriculture. Tools such as artificial intelligence, precision agriculture, and climate

monitoring systems offer important opportunities to optimize resource use and increase production efficiency. Nevertheless, it is necessary to ensure equitable access to these technologies to prevent widening existing gaps between regions and producers.

Likewise, the importance of public policies and international cooperation in promoting sustainable agricultural systems is highlighted. The implementation of effective strategies requires the coordinated participation of governments, institutions, the private sector, and local communities, as well as the development of regulatory frameworks that encourage responsible practices.

The transition toward sustainable agriculture is both an urgent necessity and a global commitment. Although there are obstacles that must be overcome, the long-term benefits in terms of food security, environmental sustainability, and social development fully justify its adoption. Therefore, it is essential to continue promoting research, innovation, and the implementation of sustainable agricultural practices as a foundation for ensuring a more secure, equitable, and sustainable food future for future generations.

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### Conflicts of Interest:

The author declares no conflicts of interest.

### Author Contributions:

Shahriar Nessabian: Conceptualization, data curation, formal analysis, investigation, methodology, supervision, validation, visualization, original draft writing, and writing, review, and editing.

### Ethical statement:

The study was based on the analysis of documentary sources and publicly available data, and therefore did not involve the direct participation of human subjects. No personally identifiable information was handled.