A Review of New Trends in Sustainable Agriculture and Their Impact on Rural Economic Development

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Abstract

Sustainable agriculture is considered a key strategy for addressing contemporary challenges related to food security, natural resource conservation, and the economic development of rural communities. The main goal of this article is to examine new trends in sustainable agriculture and their impact on rural economic development. Using a scientific literature review method, this article investigates novel trends in sustainable agriculture and analyzes their effects on economic development in rural areas. The findings, derived from the collection and analysis of reliable scientific sources, indicate that the application of new technologies, sustainable agricultural systems, natural resource management methods, and farmers' participation in local decision-making processes leads to increased productivity, improved income, and enhanced livelihoods for rural families. Furthermore, sustainable agriculture can serve as a foundation for stable employment and reduced internal migration. Although this approach offers numerous benefits, challenges such as a lack of investment, insufficient technical knowledge, ineffective policies, and the consequences of climate change hinder its full implementation in developing countries, particularly Afghanistan. By reviewing successful experiences in various countries, this article demonstrates that aligning agricultural policies with sustainability principles, supporting governmental and international institutions, and strengthening local capacities can create a conducive environment for rural economic development. Ultimately, this

research emphasizes the necessity of prioritizing sustainable agriculture as an effective strategy for achieving sustainable development goals.

Keywords: Modern Agricultural Trends، Rural Economic Development, Sustainable Agriculture,

Introduction

Sustainable agriculture is one of the key pillars of economic growth in rural communities, particularly in developing countries, where it plays a crucial role in ensuring food security and the livelihoods of farmers. In Afghanistan, agriculture is the most important economic sector and has a profound impact on the lives of rural populations and the development of rural areas. However, crises such as climate change, water resource depletion, and soil er osion have posed serious threats to the sustainability of agriculture (World Bank, 2020:7). In this regard, the adoption of modern and sustainable agricultural practices can serve as an effective solution to address these challenges and improve the economic status of farmers and rural communities in Afghanistan.
Sustainable agriculture, as a method that aims to continuously increase agricultural production by optimizing natural resources and preserving biodiversity, can contribute to improving the livelihoods of rural populations, increasing farmers' income, and enhancing environmental conditions, particularly in developing countries like Afghanistan (Preti, 2008:465). These practices are recognized not only as a tool for conserving natural resources but also as a factor for economic and social development in rural areas. In Afghanistan, where over 70% of the population lives in rural areas and most of them are engaged in agriculture, there are various issues such as a lack of modern technologies, traditional agricultural methods, diminishing agricultural land, and irrigation challenges (Safi, 2019:5). These problems, in addition to reducing agricultural productivity, have led to environmental degradation and threatened the country’s water and soil resources. In this context, the need for a transformation in agricultural methods and a shift towards sustainable agriculture is more pressing than ever.

Modern trends in sustainable agriculture include practices such as organic farming, precision agriculture, the use of modern technologies in water and soil management, and the development of innovative methods to reduce waste. These trends, aimed at

improving agricultural productivity, reducing costs, and minimizing environmental impacts, could enhance the economic status of rural populations and farmers (FAO, 2018:15). In Afghanistan, with its rich natural resources, the adoption of these methods could create new opportunities for farmers and significantly improve the quality of life for rural communities. The major challenges in implementing sustainable agriculture in Afghanistan include the lack of education and awareness among farmers, the absence of supportive policies for sustainable agriculture, and infrastructural issues such as insufficient equipment and advanced technologies (Jalil, 2021:50). Additionally, economic fluctuations and the country's specific climatic conditions are considered major barriers to the expansion of these trends. However, studies have shown that implementing supportive policies and educating farmers about modern agricultural techniques can significantly increase agricultural productivity in Afghanistan and reduce existing barriers (Hasan, 2022:2346).

This paper will explore modern trends in sustainable agriculture and their impact on rural economic development in Afghanistan, analyzing the challenges and opportunities that exist. In this regard, existing studies and international reports from organizations such as the World Bank and FAO, along with successful examples from similar countries, will serve as the main sources for this research.

Sustainable agriculture, as a fundamental pillar of sustainable development, plays a pivotal role in ensuring food security, conserving natural resources, and enhancing the quality of life in rural communities. In today's world, we are confronted with complex challenges such as climate change, diminishing water resources, soil degradation, and increasing population pressure. These challenges have rendered traditional agricultural systems inefficient and have magnified the need for innovation in the field of agriculture. New trends in sustainable agriculture-which are based on advanced technologies, precision agriculture, optimal resource management, and the application of ecological methods-offer a unique opportunity to increase productivity, reduce detrimental environmental impacts, and improve the economic conditions of rural populations. However, despite their significant potential and importance, the adoption and integration of these approaches in rural areas, particularly in developing countries, face numerous structural, educational, and institutional bar-

riers. These obstacles constrain the process of rural economic development. A thorough investigation and analysis of these new trends and their effects on economic development can pave the way for intelligent policymaking and the formulation of practical solutions to improve livelihoods and elevate the standard of living for rural inhabitants.

Therefore, this research aims to provide a comprehensive review of the new trends in sustainable agriculture and to analyze their impact on the economic development of rural areas. By identifying the challenges and opportunities, this study seeks to highlight the role of these technologies and practices in the sustainable development of the agricultural sector and the rural economy. The goal is to contribute to the generation of applied and strategic knowledge in this domain. The significance of this issue, in terms of ensuring food security, preserving natural resources, and achieving social justice, holds a special place in national and international development policies and can serve as an effective platform for the growth and dynamism of rural communities.

This research answers the question that How do new trends in sustainable agriculture impact the economic development of rural areas?

Sub-Questions

1. What are the most significant new trends in sustainable agriculture that are applicable in rural areas?
2. What effect do new agricultural technologies and methods have on increasing productivity and improving the livelihoods of rural inhabitants?
3. What are the main barriers and challenges to the adoption and implementation of sustainable agriculture in rural communities?

Sustainable agriculture is recognized as a key strategy for addressing the global challenges of food security, poverty reduction, and environmental protection (FAO, 2017:0). Given the growing global population and the increasing demand for food resources, the utilization of modern methods and technologies in agriculture is more critical than ever to optimally manage limited natural resources while simultaneously increasing production yields (Tilman *et al*., 2011:671). Furthermore, the agricultural sector, particularly in the rural communities of developing countries, is one of the most significant sources of income and employment, playing a direct role in the economic and social development of these regions (IFAD, 2019:20). In this context, the

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adoption of new trends in sustainable agriculture can not only improve production performance but also help mitigate the environmental damage caused by traditional methods, thereby fostering sustainable development and enhancing the quality of life for rural inhabitants (Pretty, 2008:465). However, numerous limitations and challenges-such as inadequate infrastructure, a lack of sufficient training, limited financial resources, and weak supportive policies-have hindered the full realization of the benefits of these trends in rural areas (Giller *et al*., 2021:15).

Therefore, the present study, by focusing on the investigation of new trends in sustainable agriculture and analyzing their impacts on the economic development of rural areas, seeks to fill existing scientific and practical gaps. The findings of this research can assist policymakers, planners, and rural development practitioners in adopting more effective strategies to improve agriculture and the rural economy. The importance of this subject is particularly prominent in alignment with the United Nations' Sustainable Development Goals (SDGs), especially Goal 1 (No Poverty) and Goal 2 (Zero Hunger, which includes achieving food security and promoting sustainable agriculture).

The Mean Objective of this research is:

To investigate the impact of new trends in sustainable agriculture on the economic development of rural areas.

Sub-Objective

1. To identify the most important new trends in sustainable agriculture applicable in rural areas.
2. To analyze the role of new agricultural technologies and methods in increasing productivity and improving the livelihood of rural communities.
3. To identify obstacles and challenges to the adoption and implementation of sustainable agriculture in rural communities.

In numerous studies concerning sustainable agriculture and the impact of its modern trends on rural economic development, the importance of using novel technologies to improve agricultural productivity has been clearly highlighted. For instance, Ahmadi *et al*, (2018), aiming to investigate the impact of digital technologies and precision agriculture in rural areas, found that these technologies not only increased crop yields but also significantly enhanced farmers' income and livelihoods. These findings underscore the necessity of integrating new technologies into the agricultural sector.

Jamshidi (2019), in a study evaluating the role of sustainable agriculture in poverty reduction and rural economic development, demonstrated that utilizing sustainable agricultural methods not only preserves natural resources but also has a direct impact on improving the income level and quality of life for rural inhabitants. This research serves as evidence of the close link between agricultural sustainability and the economic development of rural communities.

On the other hand, Hosseini *et al*. (2020) examined the barriers to adopting new agricultural trends and discovered that issues such as lack of specialized training and insufficient technological infrastructure are among the most significant impediments to implementing modern methods in rural areas. These findings emphasize the crucial need for focused attention on capacity building and infrastructure development.

Kazemi's (2017) study on the optimal management of natural resources in sustainable agriculture revealed that the correct and efficient use of resources like water and soil, in addition to increasing productivity, leads to a reduction in environmental damage and ultimately provides the foundation for sustainable economic growth in villages. This research reiterates the importance of natural resource management as one of the fundamental pillars of sustainable agriculture.

Maleki (2021), in his comprehensive research on modern trends and emerging technologies in sustainable agriculture, introduced advanced technologies such as precision agriculture, biotechnology, and data management systems, confirming their prominent role in improving agricultural performance and boosting rural economies. His findings indicate that the integration of new knowledge and contemporary technologies serves as a powerful driving force for sustainable agricultural development.

Lastly, Rahimi (2016), focusing on the economic effects of sustainable farming on rural livelihoods, showed that implementing sustainable strategies in agriculture resulted in increased income for rural households and reduced dependence on unsustainable resources. This research clearly illustrates the significance of developing sustainable agriculture in enhancing the quality of life and economic stability of rural communities.

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Research Methodology

This research is conducted as a review paper with the aim of examining modern trends in sustainable agriculture and their impact on rural economic development. To achieve this goal, the researcher has employed various methods, including data collection and reviewing different sources. The first method used is a literature review on sustainable agriculture and its impact on rural economic development. In this section, the researcher has studied and examined scientific articles published in reputable journals, specialized books, and governmental and international reports. This literature review aims to identify the current status, analyze problems and challenges, and examine successful experiences in the field of sustainable agriculture and its impact on rural economic development. Additionally, the research includes a review of case studies and successful projects from various countries where sustainable agriculture and its impact on rural economic development have been a focus. These case studies specifically demonstrate how support programs and policies have promoted sustainable agricultural practices and, in turn, contributed to improving productivity and fostering sustainable development in agricultural communities.

Results & Discussion

Definition of Sustainable Agriculture: Sustainable agriculture refers to an agricultural approach aimed at preserving natural resources and the environment while simultaneously increasing productivity in agricultural production. In this model, farmers (peasants) operate in a way that not only meets the food needs of society but also ensures the conservation of land and water resources without causing harm to the health of the environment (Pretty, 2008:363). In other words, sustainable agriculture seeks to achieve agricultural production that can be sustained in the long term while ensuring that sufficient resources remain for future generations.

According to the United Nations (1992), sustainable agriculture is examined from three distinct dimensions: 1) the economic dimension, which includes improving productivity and the income of farmers, 2) the social dimension, which focuses on improving the living conditions of farming and rural communities, and 3) the environmental dimension, which emphasizes the preservation and enhancement of natural resources such as soil, water, and biodiversity. This approach contrasts with industrial

agriculture, which focuses more on increasing production using chemical and industrial methods. While industrial agriculture may enhance productivity in the short term, it can cause significant long-term damage to the environment and farming communities (Altieri, 2002:15).

The Importance of Sustainable Agriculture: Sustainable agriculture is one of the main approaches to addressing global crises such as climate change, depletion of natural resources, and threats to food security. This approach is not only vital for the preservation of natural resources and the environment, but it can also contribute to increased productivity and the economic development of rural populations. As a result, the significance of sustainable agriculture is notable in ensuring global food security, reducing environmental degradation, and improving the quality of life in rural areas. One of the primary benefits of sustainable agriculture is the enhancement of soil fertility. Agricultural practices such as crop rotation, the use of organic fertilizers, and the protection of vegetation cover help maintain soil structure and reduce erosion (Foley *et al*., 2011:135). These methods also contribute to effective water resource management. In many agricultural regions of the world, improper water use has led to water crises. Sustainable agriculture, through techniques like drip irrigation and moisture conservation methods, can prevent water waste and increase water use efficiency (Lal, 2015:60). From an economic perspective, sustainable agriculture can help farmers increase profitability by reducing dependency on chemical inputs and lowering production costs. Furthermore, it can create new employment opportunities and increase rural incomes (Tully *et al*., 2015:90). Especially in developing countries, where agriculture forms a major part of the rural economy, sustainable agriculture can serve as a means to strengthen rural economies and reduce poverty. Sustainable agriculture also plays a vital role in preserving biodiversity. By promoting crop diversification, it can help prevent biodiversity loss and support natural ecosystems (Benton *et al*., 2016:215). In fact, one of the main objectives of sustainable agriculture is to enhance the positive interaction between agriculture and the environment.

Ultimately, sustainable agriculture is recognized as a comprehensive and effective solution for improving agricultural conditions and the global environment. By enhancing productivity, reducing environmental damage, and improving the quality of life for farmers-particularly in rural communities-it contributes to the achievement of sustainable development.

Principles of Sustainable Agriculture

Sustainable agriculture is a set of principles and practices designed to ensure food security, protect the environment, and improve farmers' livelihoods. These principles emphasize not only the efficient use of natural resources but also the economic and social sustainability of rural communities (Springmann *et al*., 2021:25). Sustainable agriculture is grounded in a set of interconnected principles that collectively aim to preserve the environment, ensure food security, and enhance the livelihoods of farmers. The first principle emphasizes the importance of maintaining and restoring soil fertility through practices such as crop rotation, the cultivation of nitrogen-fixing plants, and the use of compost. These methods contribute to the enhancement of soil organic matter and reduce erosion, thereby supporting long-term agricultural productivity (Rasmussen *et al*., 2020:45). The second principle involves the effective management of water resources, which has become increasingly critical due to climate change and water scarcity. Techniques such as drip irrigation, rainwater harvesting, and soil moisture control are prioritized, with digital technologies further enhancing water-use efficiency (Fan *et al*., 2022:78). The third principle focuses on reducing dependence on chemical inputs; by balancing pesticide use, adopting organic fertilizers, and applying integrated pest management (IPM), farmers can promote biodiversity and safeguard human health (González-Chávez *et al*., 2021:112). The fourth principle highlights the need for diversification within farming systems, including the cultivation of varied crops, integrating livestock and agriculture, and building local supply chains, all of which contribute to economic resilience and lower production risks (van Zonneveld *et al*., 2021:145). Finally, the fifth principle addresses resilience to climate change, advocating for agricultural systems that can endure environmental and market fluctuations. The integration of indigenous knowledge with modern technologies has shown significant promise in strengthening this resilience (Thornton *et al*., 2022:165). In summary, the principles of sustainable agriculture serve as a comprehensive framework for achieving ecological sustainability, economic viability, and social stability. Their effective implementation, however, necessitates collaborative efforts among governments, farmers, researchers, and international stakeholders committed to sustainable development.

Emerging Trends in Sustainable Agriculture

1. **Digital Agriculture:**Digitalization of agriculture is one of the most important emerging trends in sustainable farming, transforming agricultural practices through the application of technologies such as the Internet of Things (IoT), Artificial Intelligence (AI), Geographic Information Systems (GIS), and Big Data. Using sensors and digital tools, farmers can obtain real-time information about soil conditions, moisture levels, temperature, and the nutritional needs of plants, enabling precise decision-making. For example, smart irrigation systems help reduce water consumption while increasing irrigation efficiency, which aligns with one of the fundamental principles of sustainable agriculture. Furthermore, data-driven platforms and predictive algorithms assist in early detection of agricultural risks such as pest and disease outbreaks, allowing for timely interventions before widespread damage occurs. In developed countries, analysis of climate and market data supports farmers in selecting appropriate crops and optimal planting times. In developing countries, successful pilot programs have introduced mobile phone-based advisory services to provide timely agricultural information to farmers. Thus, digital agriculture not only reduces input usage and increases productivity but also enhances management precision and ensures the sustainability of natural resources (Kamilaris *et al*., 2022:22; Wolfert *et al*., 2021:52).

2. **Regenerative Agriculture**: Regenerative agriculture is a novel approach that goes beyond the conventional goals of sustainable agriculture, aiming to restore degraded ecological systems, preserve soil health, and enhance carbon sequestration in the soil. Unlike traditional methods that focus merely on maintaining the status quo, regenerative agriculture seeks to actively improve and rebuild natural structures. Techniques such as no-till farming, cover cropping, crop diversification in rotations, and agroforestry systems are key strategies that promote microbial activity in the soil, improve soil structure, and reduce erosion. In addition, recent studies have shown that these methods significantly enhance the soil's carbon sequestration capacity and play an important role in mitigating climate change. For instance, lands managed under regenerative systems for several years have demonstrated not only better soil quality but also more stable crop yields. These methods also reduce dependence on chemical inputs, thus ensuring long-term food and economic security for farmers. This approach positions agriculture not merely as an

economic activity but as an ecological process (Rhodes, 2022:70; FAO, 2023:18).

3. **Urban and Vertical Farming**: In response to increasing urbanization and the decline of arable land in urban areas, urban and vertical farming have emerged as innovative and modern agricultural trends. These methods utilize limited spaces such as rooftops, walls, shipping containers, or multi-story buildings to bring agriculture into urban settings. Through technologies like hydroponic systems (soilless farming), LED lighting for photosynthesis, and closed-loop irrigation, it becomes possible to produce fresh and healthy food near consumers. This method has seen rapid growth in industrial countries such as the United States, Japan, and the Netherlands. Vertical farming eliminates the need for traditional soil and reduces water usage by up to 90%, making it highly suitable for arid regions. Moreover, it helps reduce transportation-related waste, provides better environmental control, decreases reliance on pesticides and chemical fertilizers, and enables year-round production. Urban and vertical farming also contribute to urban food security and create new employment opportunities. Although initial costs may be high, in the long term, this approach can effectively complement traditional farming (Benke & Tomkins, 2022:75).

4. **Sustainable Biotechnology**: Agricultural biotechnology represents a significant scientific advancement toward sustainability. By utilizing techniques such as genetic modification (GMOs), gene editing (e.g., CRISPR-Cas9), and the development of bio-fertilizers and bio-pesticides, this approach increases productivity while reducing environmental harm. These technologies have led to the development of crop varieties resistant to drought, salinity, pests, and diseases, thus lowering the need for water, fertilizers, and pesticides. A prominent application of biotechnology is the production of improved seeds with higher yields, shorter growing periods, and reduced dependence on chemical inputs. Particularly in resource-constrained areas, these seeds offer notable performance. In addition, the development of biofertilizers and nitrogen-fixing bacteria has contributed to improved soil health and reduced reliance on synthetic fertilizers. From both ecological and economic perspectives, this approach is more sustainable than conventional methods (Nass, 2021:115).

5. **Impact of Sustainable Agriculture on Rural Economic Development**

Sustainable agriculture not only contributes to the preservation of natural resources but can also act as a primary driver of

economic development in rural areas. By utilizing agricultural methods that prioritize environmental health, it is possible to increase crop production, maintain continuous land use, and improve the quality of life for rural populations. Sustainable agriculture helps rural communities optimally manage their resources and utilize natural resources in a way that ensures future generations will benefit as well. For example, the adoption of organic farming methods, hydroponics, and smart irrigation systems increases agricultural output while reducing the consumption of water and soil resources. In addition, sustainable agriculture fosters job creation, local business growth, and the strengthening of the rural economy (Hickson *et al*., 2023:2).

Impact of Sustainable Agriculture on Improving Livelihoods and Increasing Income

One of the most significant impacts of sustainable agriculture on rural economic development is the improvement of livelihoods and income levels of rural communities. Through the use of effective methods such as carbon-based farming and circular agriculture, more products can be produced with fewer resources, leading to higher incomes for farmers and better living conditions. Furthermore, sustainable agriculture can provide rural populations with diversified income sources. For example, farmers can capitalize on the sale of organic produce, develop local markets, and use modern techniques such as online marketplaces. These methods can help reduce the dependence of rural communities on external markets and foster economic growth within rural areas (Pretty & Bharucha, 2024:4).

Connection Between Sustainable Agriculture and Job Creation in Rural Areas

Sustainable agriculture not only helps conserve natural resources but also plays a crucial role in generating employment in rural areas. Modern sustainable farming practices such as agroforestry and organic farming create new job opportunities for rural populations. These opportunities include the production and packaging of organic products, jobs related to land maintenance and restoration, and services linked to smart irrigation and solar energy systems. As a result, sustainable agriculture can contribute to reducing poverty and increasing job opportunities in rural regions. For instance, in sustainable agricultural development

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programs in India, these methods have significantly reduced unemployment rates in rural areas and provided additional income for rural communities (Müller *et al*., 2023:6).

Examining the Relationship Between Sustainable Agriculture and Rural Economic Policies

Sustainable agriculture must align with rural economic policies to effectively improve livelihoods and foster economic development. Economic policies such as supporting farmers to adopt new technologies, creating sustainable markets for agricultural products, and promoting organic farming can significantly influence the success of sustainable agriculture in rural areas. Policymakers should provide tax programs and economic incentives to encourage farmers to use sustainable practices in production. Additionally, the development of market infrastructure, education, and the promotion of sustainable agriculture can help farmers fully exploit the potential of these practices. For example, in African countries such as Kenya, government support for sustainable agriculture has led to increased production of organic products and a greater share of agriculture in the gross domestic product (FAO, 2023:8).

Challenges and Barriers to Implementing Sustainable Agriculture in Afghanistan

In Afghanistan, the implementation of sustainable agriculture faces numerous challenges, including infrastructural limitations, lack of financial resources, the impacts of climate change, and weak supportive policies. The absence of modern irrigation systems, inefficient transportation networks, and inadequate market access are among the primary obstacles hindering the productivity of sustainable agriculture (Adroit Associates, 2024:6). Additionally, natural disasters such as frequent floods and droughts-largely driven by climate change-have led to the degradation of agricultural lands and a decline in crop yields. Moreover, deficiencies in educational programs and a lack of technical skills among farmers have prevented them from adopting modern agricultural techniques (Adroit Associates, 2024:6). Compounding these issues is the limited access to low-interest loans and agricultural investments, which has perpetuated the use of traditional, low-efficiency farming methods (World Bank, 2024:9). Furthermore, the absence of coherent and participatory policies from the government has slowed the progress toward achieving sustaina-

ble agricultural development (Mazloum Yar, 2024:10). Together, these factors constitute major barriers to the realization of sustainable agriculture in Afghanistan and call for urgent attention from both national and international institutions.

Conclusion

Sustainable agriculture, as one of the fundamental pillars of rural economic growth and development, plays a pivotal role in improving farmers' livelihoods, ensuring the efficient use of natural resources, protecting the environment, and guaranteeing food security. The findings of this article indicate that the adoption of modern trends in sustainable agriculture not only enhances productivity and farmers' income but also increases employment opportunities in rural communities, thereby reducing poverty and migration. On the other hand, implementing such approaches requires the formulation of effective policies, support from governmental and international institutions, provision of essential infrastructure, investment in farmer education, and the development of suitable markets for agricultural products. Moreover, active and informed participation of local communities in all stages of planning and implementation is crucial to ensure the sustainability and success of these efforts. Despite existing challenges such as limited financial resources, lack of advanced technologies, climate change, and weak local institutions, the outlook for sustainable agriculture in Afghanistan-especially in rural areas—offers the promise of balanced, inclusive, and justice-oriented development. Therefore, by providing a systematic and scholarly review of the concepts, principles, benefits, modern trends, and challenges of sustainable agriculture, this article can serve as a valuable resource for researchers, policymakers, development agencies, and agricultural stakeholders in designing and implementing effective rural economic development programs.

Recommendations

The Afghan government and policymaking institutions should prioritize the development and implementation of training and awareness programs on sustainable agriculture for rural farmers. Research findings indicate that a lack of technical knowledge and limited familiarity with modern agricultural trends are fundamental barriers to the successful implementation of these models

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at the village level. Therefore, establishing practical training centers for sustainable agriculture, preparing educational guides in local languages, and creating consultative networks among researchers, farmers, and supporting institutions can strengthen local capacities and pave the way for better adoption of these methods.

To achieve sustainable economic development in rural areas, it is suggested that governmental and international organizations facilitate investment in sustainable agriculture by designing targeted supportive policies. This support can include providing low-interest loans, supplying modern agricultural equipment, and establishing sales markets for organic and sustainable products. The experience of successful countries demonstrates that a combination of financial support, market access, and economic incentives for farmers leads to increased income, reduced internal migration, and an improved quality of life in rural communities.

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