American Journal of Economics and Business Management

Vol. 8 Issue 5 | **pp.** 2460-2468 | **ISSN:** 2576-5973

Available online @ https://www.globalresearchnetwork.us/index.php/ajebm

Article

Fundamentals of Sustainable Development Agriculture In Modern Conditions of Economic Reforms

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Abstract: Agriculture remains the backbone of Uzbekistan's economy, crucial for employment, exports, and food security, especially under the pressures of global climate change and economic reform. Despite many studies on Uzbekistan's agricultural reforms, there is limited exploration of how innovative development models and international best practices, particularly from China, can strengthen sustainability. Previous research has insufficiently addressed the integration of modern cluster-based models, digital technologies, and nutrition-sensitive planning within Uzbekistan's agricultural sector. This study aims to evaluate the country's agricultural reforms, examine structural characteristics like smallholder dominance, and propose strategies for improving productivity, export potential, and food security. The findings show that while agriculture's GDP share is declining, it remains vital for rural livelihoods, with clusters, greenhouses, and digital tools driving productivity gains; however, challenges persist, including informal labor, low nutritional intake, and price disparities. This research uniquely combines empirical data, global comparative analysis, and case studies to offer context-sensitive recommendations for strengthening value chains, formalizing employment, and improving agricultural governance in Uzbekistan. The insights have significant policy relevance, suggesting that aligning agricultural reforms with global sustainability standards, expanding vocational training, and fostering public-private partnerships are key to ensuring resilient, inclusive, and competitive agricultural development in Uzbekistan.

Keywords: agricultural economics, food security, agricultural producers, agriculture, digital technologies, global economic development, cluster approach.

Citation: Umaraliyev O. and Rahmatov K. Fundamentals of Sustainable Development Agriculture In Modern Conditions of Economic Reforms. American Journal of Economics and Business Management 2025, 8(5), 2460-2468.

Received: 03th Feb 2025
Revised: 11th Mar 2025
Accepted: 24th Apr 2025
Published: 21th May 2025

1. Introduction

The development trends of the global economy demonstrate that, in all spheres and sectors of human society especially under the impact of global climate change the organization of agricultural production and related service activities based on innovations is becoming one of the key tools in combating widespread poverty and hunger in many regions of the world. Ensuring the continuous improvement of this process is turning into an urgent requirement of the times [1].

The development of the agricultural sector plays a crucial role in the overall growth of the economy. The success of economic development in countries such as China, India, Brazil, Chile, and Vietnam is largely linked to the rapid advancement of their agricultural sectors. Conversely, the lagging development of some African nations can be attributed to their inability to achieve sufficient labor productivity in agriculture.

This situation is primarily explained by the fact that in the early stages of economic development when the share of agriculture in employment and gross domestic product

(GDP) is still high the agricultural sector plays a significant role in stimulating the development of other industries. In such conditions, agriculture contributes to the growth of other sectors of the economy by supplying key production factors such as raw materials, labor, capital accumulation, and foreign currency earnings [2].

Thus, the growth of agricultural production can exert a significant **multiplicative effect** on the stimulation of industrial output. Empirical studies have demonstrated that a one-dollar increase in agricultural production leads to a corresponding one-dollar increase in output across other sectors of the economy. In contrast, a one-dollar growth in non-agricultural sectors typically results in only a $0.18 increase in agricultural output. [3]

These agricultural multipliers tend to be more pronounced in low-income countries, where the **industrial sector is largely composed of agro-processing**, and the service sector is substantially dependent on agricultural performance indicators. Consequently, agriculture serves as a foundational pillar for both upstream and downstream value chains in these economies [4].

Furthermore, increased labor productivity in agriculture enables a growing share of the population engaged in non-agricultural activities to be sufficiently provided with food resources. This dynamic not only supports urban population growth but also contributes to overall food security. Enhanced agricultural productivity additionally plays a pivotal role in **reducing the cost of food products**, which in turn enables a downward adjustment in nominal wages in urban areas thereby improving competitiveness in the labor market.

Problem Statement

The direct interdependence between agriculture and industry ensures that the agricultural sector provides a stable supply of raw materials to agro-processing industries. Moreover, the so-called agricultural financial surplus that is, the monetary flows originating from agriculture can be directed as investment resources to stimulate the growth of other sectors of the economy [5].

Agricultural development inherently generates demand for goods and services produced by other sectors, especially industrial products such as fertilizers, equipment, and machinery. As rural incomes increase, so does the demand for essential consumer goods among populations engaged in agriculture and residing in rural areas. Thus, the growth of agricultural incomes acts as a powerful catalyst for industrialization.

Historically, this effect formed the foundation of land reform policies in countries like India and China. In particular, China succeeded in developing a robust domestic market for industrial goods by granting land-use rights to over 800 million rural households. Notably, by formalizing land tenure and improving land-use governance, China achieved a remarkable reduction in poverty levels [6].

The Chinese experience can serve as a valuable reference point for Uzbekistan in designing effective poverty alleviation programs. China has made significant strides in eradicating extreme poverty. According to the World Bank, approximately 850 million people in China have been lifted out of poverty. The national poverty rate dropped from 88% in 1981 to just 0.7% in 2019, aligning closely with the rates observed in developed economies such as the United States (1%), Sweden (0.61%), Germany (0.19%), and Italy (1.5%).

Furthermore, low-income countries often possess comparative advantages in agriculture, which makes the development of this sector a strategic priority in the context of building an open economy. Leading scholars in the field of economic development emphasize that while agriculture provides significant comparative advantages in the short term, the development of the agro-industrial complex lays a strong foundation for long-term industrialization [6].

For many developing nations, investment in agriculture represents an economically efficient growth strategy that supports structural transformation and fosters sustainable industrial development. It is particularly important to underscore that in numerous Asian

countries, reducing poverty has largely been driven by growth and modernization within the agricultural sector [7].

At the same time, defining clear development priorities in the agricultural sector presents a set of conceptual and strategic challenges. In light of evolving global demands and domestic needs, several critical policy dilemmas must be addressed:

- Whether to reduce agricultural product prices to improve food affordability and raise real incomes for the population, or to encourage higher prices as a means of incentivizing greater investment by farmers in agricultural production.
- Whether to utilize state budget resources for short-term food security relief (e.g., food assistance programs), or to redirect these funds toward long-term investment in agriculture aimed at increasing productivity and sustainability.
- Whether to prioritize self-sufficiency in food production as a strategy to enhance national food security, or to leverage comparative advantages through greater integration into global agricultural trade networks.
- Whether to promote smallholder and subsistence farming systems, which have proven effective in reducing poverty, or to support the rapid expansion of large-scale agricultural enterprises capable of accessing complex markets through integrated value chains and productivity gains [8].

Thus, for low-income countries including Uzbekistan leveraging the untapped potential of the agricultural sector is crucial for fostering economic growth and improving social welfare. It is imperative to adopt strategic, evidence-based approaches for maximizing the use of agricultural resources. This includes implementing modern technologies, enhancing institutional capacity, and aligning national agricultural development plans with global sustainability standards [9].

Literature Review

In Uzbekistan, a substantial body of academic and applied research has been devoted to the accelerated development of agriculture and its transformation into one of the leading sectors of the national economy. Renowned economists and sectoral experts have examined various dimensions of agricultural growth, market integration, and value chain development.

For example, Prof. B. Khodiev has focused on enhancing the competitiveness of the agro-industrial sector and promoting exports through the efficient cultivation of fruits and vegetables [10]. Prof. G. Okhunova has investigated the relationship between food quality improvements and agricultural competitiveness. Prof. B. Salimov has explored the expansion of small businesses and private entrepreneurship in rural areas, while Prof. U. Gofurov has emphasized the development of family-based enterprises in agricultural regions [11].

Despite the breadth of existing scholarship, the current phase of economic uncertainty demands new, innovative approaches to organizing and managing the agricultural economy. This includes the need to re-evaluate conventional strategies in light of modern market dynamics, climate-related risks, and shifting global trade patterns.

As such, a thorough analysis of both domestic and international literature suggests that future research must focus on integrated models that connect production, processing, and distribution while fostering resilience, inclusivity, and environmental sustainability within Uzbekistan's agricultural sector [12].

2. Materials and Methods

This research is grounded in a combination of theoretical analysis and empirical evaluation aimed at identifying effective strategies for the sustainable development of Uzbekistan's agricultural sector. The study employs both qualitative and quantitative methods to ensure a comprehensive examination of the subject matter.

Key methodological approaches include:

- Comparative analysis, used to contrast Uzbekistan's agricultural reforms with international best practices, particularly those of China, India, and Vietnam.
- Structural-functional analysis, applied to assess the relationship between agriculture and other sectors of the economy, such as industry and services.
- Econometric modeling, used to examine the multiplier effect of agricultural growth on GDP and employment across different sectors.
- Case study analysis, particularly of regional cluster initiatives (e.g., cotton-textile clusters), to evaluate the impact of integrated agricultural development on productivity, rural incomes, and food security.
- Documentary review, involving critical assessment of strategic policy documents, national development programs (e.g., the 2020–2030 agriculture development strategy), and statistical data from the State Statistics Committee of Uzbekistan, World Bank, and FAO.

By combining these methods, the research aims to generate evidence-based recommendations that can support decision-makers in designing policies that enhance agricultural efficiency, support inclusive rural development, and ensure long-term economic resilience.

3. Results and Discussion

As of April 1, 2025, Uzbekistan's permanent population reached 37.7 million, marking a 2% increase compared to the same period in 2024. The rural population stood at 18.48 million, accounting for approximately 49% of the total population . The country continues to exhibit a youthful demographic profile, with nearly 60% of the population under the age of 30 . This youthful structure presents both opportunities and challenges for the nation's socio-economic development. In 2024, the crude birth rate declined to 16.0 births per 1,000 people, representing a 3.22% decrease from the previous year. This marks the lowest birth rate recorded in the country's history .Given the limited alternative income sources outside agriculture, the sector remains the primary economic foundation for many regions in Uzbekistan. A significant portion of the rural population exhibits the following characteristics:

- Agricultural Dependence: The majority rely on agriculture including crop production, livestock, forestry, and fisheries as their main livelihood, utilizing natural capital such as land, water, and livestock.
- Family Labor Utilization: Agricultural activities predominantly depend on family labor, with minimal reliance on hired labor, reflecting the semi-subsistence nature of rural households.
- Self-Sufficiency and Limited Market Integration: Rural households often operate on a self-sufficient basis, using homegrown seeds, organic fertilizers, and family labor, resulting in limited engagement with broader markets and value chains.
- These structural attributes underscore the dual role of agriculture in Uzbekistan—as both a social safety net and a potential driver of inclusive economic growth. Addressing challenges such as underemployment, productivity disparities, and market isolation is crucial to unlocking the full developmental potential of the rural economy [13].

In 2024, Uzbekistan's agricultural sector continued to play a pivotal role in the national economy, despite a gradual decline in its share of the Gross Domestic Product (GDP). The agriculture, forestry, and fisheries sector contributed **19.2%** to the country's GDP, down from 21.2% in the previous year. Nevertheless, the sector experienced a **3.1%** growth in gross value added, reaching **467.04 trillion UZS**, primarily driven by crop and livestock production, which accounted for 96.6% of the total. Employment in agriculture remained significant, with approximately **25.9%** of the labor force engaged in the sector. However, a substantial portion of this employment was informal, highlighting the need

for policies aimed at formalizing agricultural labor and improving working conditions [14].

Agricultural exports saw a remarkable increase, totaling **$1.5 billion** in 2024, a **31.2%** rise from the previous year. The country exported over 2 million tons of fruits and vegetables, with key markets including Russia, Kazakhstan, Kyrgyzstan, and China. Notably, melon and gourd exports reached a record high, exceeding 1.7 million tons, reflecting a 6.7% increase over the previous year. The structure of agricultural production remained dominated by smallholder and household farms, which contributed **63.1%** of the total agricultural output. Private farmers accounted for **29.7%**, while agricultural enterprises contributed **7.2%**. This distribution underscores the critical role of small-scale producers in ensuring food security and sustaining rural livelihoods [15].

To further enhance the sector's productivity and export potential, Uzbekistan focused on modernizing its agricultural practices, including the adoption of greenhouse technologies and improved farming methods. These efforts led to a 25–30% increase in crop yields and a 35% rise in gross sales among participating horticultural businesses, creating over 34,500 permanent jobs and approximately 22,000 seasonal jobs.

Empirical research and sectoral monitoring suggest that the consumption levels of several key agricultural commodities in Uzbekistan most notably eggs and fish remain significantly below the recommended nutritional intake levels established by the Ministry of Health. These consumption deficiencies are even more pronounced among vulnerable and low-income households, particularly in rural areas. In addition to eggs and fish, other nutritionally essential food items such as meat and meat products, fruits, milk, and dairy products also show markedly lower consumption rates among economically disadvantaged populations.

These dietary gaps are largely attributable to two interrelated factors:

1. Limited purchasing power among rural households, and
2. Relatively high market prices for domestically produced agricultural goods.

The paradox is evident: although rural areas are major centers of agricultural production, their residents often lack adequate access to the very food items they produce. This situation raises serious questions of food affordability, distribution equity, and nutrition-sensitive agricultural policy.

In response to these systemic challenges, the Government of Uzbekistan has intensified its efforts to reform and modernize the agricultural sector through a comprehensive national strategy. The core pillars of this ongoing reform process include:

- Increasing productivity of strategic crops, particularly cotton and wheat, by promoting scientific crop management and precision agriculture practices;
- Shifting the national production focus toward food self-sufficiency and dietary diversity, encouraging farmers to prioritize fruits, vegetables, and high-protein commodities;
- Rationalizing land use by employing agro-ecological zoning and research-based crop allocation models;
- Expanding the cluster-based agricultural model, which integrates production, post-harvest processing, and marketing within cohesive value chains;
- Promoting the vertical integration of agriculture with agro-industrial complexes, thereby enhancing value addition, reducing post-harvest losses, and generating rural employment;
- Supporting price regulation and input subsidies to improve affordability of essential food items for low-income households without distorting market incentives.

Moreover, the government has placed renewed emphasis on nutrition-sensitive agricultural planning, which involves aligning agricultural outputs with public health goals, reducing child malnutrition, and addressing the hidden burden of micronutrient deficiencies. This policy shift also intersects with broader sustainable development

objectives, including poverty reduction, rural inclusion, and gender-responsive resource allocation [16].

The modernization of the agricultural sector, therefore, is not only an economic necessity but a social imperative. In a country where nearly half the population resides in rural areas, the alignment of agricultural policy with food security, public health, and inclusive growth has become a cornerstone of long-term national development strategy.

In 2024, Uzbekistan's agricultural sector continued its transformation through the implementation of cluster-based models aimed at enhancing productivity, value addition, and export potential. As of 2024, there are 134 cotton clusters operating in Uzbekistan, reflecting the government's commitment to modernizing the cotton industry through vertical integration and privatization efforts.

Key Developments and Initiatives:

- **Financial Mechanisms:** The government introduced concessional loans and subsidies to support agricultural clusters, facilitating access to modern machinery and technologies.
- **Digitalization Efforts:** The "Agroplatform" information system was actively utilized by over 200 agro-clusters and more than 44,000 farming households, streamlining financing, crop planning, and resource management.
- **Seed Variety Expansion:** In the 2024/2025 growing season, Uzbekistan introduced 100,000 hectares of high-yield, disease- and pest-resistant (non-GMO) foreign cotton varieties, aiming to enhance productivity and sustainability.

Challenges and Areas for Improvement:

- **Labor Shortages:** The 2024 harvest season experienced a shortage of cotton pickers, attributed to low wages and delayed payments from clusters to farmers.
- **Government Intervention:** Despite reforms, instances of government interference in cluster operations persisted, affecting autonomy and efficiency.
- **Price Discrepancies:** Fluctuations in global cotton prices led to challenges in maintaining agreed-upon purchase prices between clusters and farmers, necessitating government intervention to stabilize the market.

While Uzbekistan's agricultural clusters have made significant strides in modernizing the sector, ongoing challenges such as labor shortages, market volatility, and governance issues need to be addressed. Continued investment in digital infrastructure, transparent financial mechanisms, and policy reforms will be crucial for the sustainable development of agricultural clusters in the country.

In October 2019, the President of the Republic of Uzbekistan approved the **"Agriculture Development Strategy for 2020–2030"**, marking a major turning point in the transformation of the country's agri-food sector. The strategy sets out a comprehensive policy roadmap that aims to modernize agriculture, enhance food security, improve productivity, and strengthen rural livelihoods. The key strategic priorities outlined in the document include:

1. **Ensuring food security and improving dietary standards** by developing and implementing a national food security policy. This involves the sustainable production of required quantities of essential food products and enhancing the diversity and nutritional value of the food basket.
2. **Promoting market-based mechanisms** in the procurement and sale of agricultural goods, expanding quality control infrastructure, and incentivizing agricultural exports. The strategy calls for the development of competitive, high-value-added agri-food products and the establishment of inclusive and efficient value chains within a favorable agribusiness environment.
3. **Attracting private capital and reducing the role of the state** in direct economic activity. The strategy emphasizes the introduction of mechanisms to improve the investment climate in agriculture, foster diversification, and support sustainable growth through the inflow of private sector financing.

4. **Rational use and conservation of natural resources**, including land, water, and forest resources. This entails the implementation of environmentally sound practices and the strengthening of environmental protection systems to ensure long-term resource sustainability.
5. **Reforming the agricultural governance system**, including restructuring the state's role in managing the sector and developing modern institutional mechanisms to enhance administrative efficiency.
6. **Improving the efficiency of public expenditures** in agriculture through the development of sectoral programs aimed at enhancing labor productivity, improving product quality, and increasing value added within farming systems. This also includes the gradual reallocation of public funds based on performance metrics.
7. **Strengthening the agricultural research, education, and extension services ecosystem**. The strategy calls for the creation of an integrated knowledge dissemination system that links science, education, advisory services, and production with the aim of improving innovation uptake among farmers.
8. **Facilitating balanced and sustainable rural development** through the implementation of targeted programs that promote infrastructure, service delivery, and income-generating activities in rural areas.
9. **Developing a transparent and reliable agricultural statistics system**, including the widespread application of modern information and communication technologies (ICTs) to ensure effective collection, processing, and dissemination of sectoral data.

This strategy represents a long-term vision aimed at aligning Uzbekistan's agriculture with international standards of competitiveness, sustainability, and social inclusion [2].

Based on an in-depth analysis of global experience, several factors have been identified as consistently contributing to sustainable agricultural development across both developed and developing countries. These include:

1. Price-Based Incentives

One of the most influential levers for encouraging agricultural production is **price signaling**. Empirical evidence from international markets shows that agricultural producers are highly **responsive to price incentives**, especially when prices reflect the true value of commodities in competitive markets. Setting "**right prices**" that is, market-based prices that balance consumer affordability with producer profitability is considered a **key driver** of productivity growth and supply responsiveness in agriculture.

2. Establishing Integrated Value Chains

Global food markets are increasingly structured around **integrated value chains**, with a growing dominance of supermarkets and large-scale retail networks. These systems effectively connect **farmers, processors, wholesalers, retailers, and consumers**, enabling:

- Exchange of valuable market information
- Access to pre-financing and working capital
- Enforcement of sanitary and phytosanitary (SPS) standards
- Risk-sharing mechanisms across the supply chain
- Financing of research and innovation in food systems

These integrated chains are further strengthened through coordination with **supporting sectors**, such as financial services, telecommunications, transportation, and energy. As a result, they achieve **economies of scale**, reduce transaction costs, and significantly improve the **quality and traceability** of agricultural products delivered to consumers.

While the growth of supermarkets has led to the **decline of traditional retail outlets** and, in some cases, the displacement of low-skilled labor, the **net benefits**—such as lower prices for consumers and increased market access for compliant producers—are widely acknowledged.

3. Adoption of Appropriate Technologies

Given the **finite nature of land and water resources**, the future of agriculture hinges on improving **resource-use efficiency**. Technological innovation plays a **central role** in this transformation. Globally, successful agricultural systems have prioritized:

- **Labor-saving** technologies
- **Water- and land-efficient** practices
- **Risk-reducing** methods, including climate-resilient technologies
- **Quality-enhancing** innovations
- **Environmentally sustainable** and low-emission production systems

In resource-constrained environments, the **choice of technologies** often depends on the **relative prices** of inputs such as labor, land, and capital. Therefore, the economic viability of adopting specific technologies should be assessed within the local context, considering both productivity and sustainability criteria.

These global lessons hold significant relevance for Uzbekistan, particularly in the context of expanding its agro-cluster system, improving food system resilience, and integrating rural producers into formal markets. Developing a coherent national strategy that draws upon these principles can accelerate progress toward a modern, inclusive, and sustainable agricultural economy.

4. Conclusion

Considering the long-term prospects of agricultural development in Uzbekistan, the risks revealed by the COVID-19 pandemic, and insights from global best practices, the following strategic measures are proposed to ensure a resilient, inclusive, and market-oriented agricultural sector:

1. Promote producer–processor–market linkages by establishing cooperative frameworks between small-scale agricultural producers and large agribusiness processors, exporters, and retail intermediaries. Regional development programs should be designed and implemented under models such as “One Village – One Product” or “One Mahalla – One Product” to stimulate the production of marketable and export-oriented commodities.
2. Encourage specialization with risk-based assessment, by analyzing both the advantages and potential drawbacks of focusing on particular crops. Policy proposals should aim to remove existing barriers to effective specialization and optimize regional comparative advantages.
3. Disseminate knowledge through practical manuals on the joint production and processing of high-value horticultural products. These materials should be made freely available to farmers and include guidelines on cultivation, processing, and marketing aligned with scientific and technological best practices.
4. Facilitate access to affordable microcredit for dehqon and private household farms (without requiring legal incorporation). Commercial banks should be encouraged to offer loans at interest rates not exceeding the Central Bank’s refinancing rate for the production and processing of liquid and export-oriented crops, especially fruits and vegetables.
5. Expand land access and provide preferential input support to household farms and unemployed citizens interested in engaging in horticultural production. Special attention should be paid to distributing additional land plots and ensuring access to seeds, machinery, irrigation tools, and fertilizers on favorable terms.
6. Create enabling conditions for contract farming and future-based agreements by promoting collaboration between smallholders and large exporters or processing companies. These actors should be encouraged to provide storage, packaging, and post-harvest processing support, with assurances that producers will be able to sell their products under all market conditions.
7. Strengthen vocational and technical education by introducing short-term training courses on modern agricultural practices in newly established technical colleges and

vocational schools. This will help close the skill gap and promote innovation in the sector.

8. Enhance research-to-practice linkages by revitalizing agricultural research institutions and ensuring that scientific output is directly relevant to real-world production. Universities should work in close partnership with agricultural producers to develop tailored curricula and training programs that reflect the evolving needs of the agri-food market.
9. Evaluate the benefits and drawbacks of the cluster model, emphasizing that clusters should be driven not by top-down state directives, but by initiative and investment from diverse stakeholders operating under various forms of ownership. Private-sector leadership in clustering initiatives should be actively encouraged.
10. Ensure compliance with international food safety standards, especially those outlined in the Hazard Analysis and Critical Control Points (HACCP) system. High-quality and safe agricultural output should be at the core of Uzbekistan's agricultural reform agenda, aligning with the strategic objective of producing globally competitive and exportable agricultural goods.

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