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Article

Main Directions of Development of The Agro-Industrial Complex in The Conditions of Modernization of The Economy

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Abstract: This article explores the key areas and factors influencing the development of Uzbekistan's agro-industrial complex (AIC) amid the ongoing economic modernization. The study highlights the strategic importance of digitizing agriculture, adopting innovative technologies, improving infrastructure, and enhancing export capabilities. Emphasizing the sector's role in ensuring food security, increasing employment, and supporting rural socio-economic development, the article discusses how modernization efforts can boost the efficiency and competitiveness of the AIC. The government's ongoing initiatives, such as the "Strategy for the Development of the Agro-Industry until 2030" and the "Concept of Digital Transformation in Agriculture," are central to the country's agricultural reforms, with a focus on integrating digital management systems and adopting water-saving technologies. The article also delves into the challenges and opportunities of enhancing resource utilization, expanding production chains, and fostering a green economy. The findings underscore the pivotal role of innovation and investment in modernizing the AIC, transitioning it to a more sustainable, export-oriented system. With an emphasis on technological advancements, this research highlights the significance of increasing high-value-added product production, improving resource management through AI and digital tools, and fostering regional diversification. The article concludes by suggesting further steps for ensuring a sustainable and competitive agro-industrial system in Uzbekistan, aligning with global standards and national economic policies.

Keywords: modernization, agro-industrial complex, innovation, digitalization, efficiency, investment policy, export, infrastructure, green economy, cluster, integration, digital transformation.

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1. Introduction

In recent years, the Republic of Uzbekistan has been consistently implementing processes of modernization of all sectors of the economy, deepening structural changes and transition to the path of innovative development [1], [2]. As a result of these reforms, the country has created broad opportunities for increasing production efficiency, widely introducing modern technologies, producing competitive and export-oriented products, as well as actively participating in the international division of labor [3].

In these processes, the agro-industrial complex (AIC) occupies a special place as the most important supporting sector of the economy, because it plays a decisive role not only in ensuring the country's food security, but also in increasing employment, stimulating the socio-economic development of rural areas, and strengthening export potential [4]. The agro-industrial complex includes agriculture, its processing industries, service systems,

and infrastructure sectors. The integral integration of these systems is an important factor in ensuring the country's economic stability and social well-being [5].

At the same time, in the current context of globalization, increasing the competitiveness of the agro-industrial complex, updating the technological base of production, efficient use of resources, and expanding the production of high-value-added products remain urgent tasks [6]. In particular, the introduction of innovative technologies, the implementation of scientific achievements, the development of digital management systems, and ensuring environmental sustainability are considered important areas of today.

In recent years, the government of Uzbekistan has been implementing a number of programs to diversify agriculture, widely introduce water-saving technologies, and expand the production of export-oriented and import-substituting products. In particular, documents such as the "Strategy for the Development of the Agro-Industry until 2030", the "Concept of Digital Transformation in Agriculture", and the "Strategy for the Transition to a Green Economy" serve to introduce modern approaches to the sector [2].

Thus, in the current period, increasing the efficiency of the agro-industrial complex, rational use of resources, deepening production chains, and improving the science-based management system have become one of the priority areas of Uzbekistan's economic policy. This is an important factor not only in ensuring the country's food security, but also in ensuring sustainable economic growth.

Literature review

In recent years, the development of the agro-industrial complex in the process of economic modernization has attracted the attention of many domestic and foreign researchers. Scientific research in this area is mainly focused on the digitization of agriculture, the introduction of innovative technologies, the improvement of investment policy, and the increase in export potential [7].

A study by the Food and Agriculture Organization of the United Nations (FAO) found that digital transformation and innovation are crucial for the sustainable development of the agro-industrial sector in Central Asian countries [5]. This experience is also relevant for Uzbekistan, as digitalization processes in the country are entering an active phase.

Local scientists A. A. Karimov, analyzing the prospects for the digital transformation of the agro-industrial complex of Uzbekistan, emphasizes the need to automate and analyze the activities of farms through digital platforms [6]. B. B. Yusupov and J. T. Qodirov, on the other hand, deeply analyzed the role of investment policy in the modernization of the agro-industrial complex and the mechanisms for the rational use of financial resources [8].

The theory of competitive advantage put forward by M. E. Porter serves as an important theoretical basis for the formation of an innovative development model in the agro-industrial complex [7]. According to him, the creation of a system integrated with the production of high value-added products and science increases the competitiveness of the country.

D. Sh. Rasulov studied the ways to increase the economic efficiency of agro-industrial clusters and substantiated the possibility of increasing export potential by integrating production and logistics chains [9].

2. Materials and Methods

This study used statistical, analytical, comparative, and economic-mathematical methods to study the processes of modernization of the agro-industrial complex of Uzbekistan.

3. Results and Discussion

In the context of economic modernization, the issue of developing the agro-industrial complex is currently one of the most important directions of Uzbekistan's economic policy. Because the agro-industrial complex plays a decisive role in ensuring the country's food security, strengthening the economic stability of regions, expanding export potential, and providing employment [1]. Therefore, modernizing this sector in accordance with the

requirements of modern economic reforms means not only increasing agricultural efficiency, but also transitioning to an innovative development model in the entire economic system [3].

In recent years, the volume of production and economic efficiency in the agro-industrial complex of Uzbekistan has increased significantly. Table 1 below presents the main indicators of the sector for the period 2020–2024 [3].

Table 1. Key indicators of the agro-industrial complex of Uzbekistan (2020–2024)

Year	Gross agricultural product (trillion soums)	Growth rate, %	Export volume (billion USD)	Share of recycled products, %	Share of employed population, %
2020	245.3	101.8	1.4	28.5	26.7
2021	266.7	104.3	1.8	31.2	26.4
2022	283.9	103.8	2.1	33.7	26.0
2023	302.4	104.5	2.6	36.9	25.5
2024	327.5	105.2	3.1	40.4	25.1

Source: State Statistics Committee of the Republic of Uzbekistan, 2024 [3].

Analysis of the table shows that over the past five years, gross agricultural product has grown by 33.5 percent, and exports have doubled. One of the most important changes is the increase in the share of processed products from 28.5 percent to 40.4 percent, which indicates a transition to deeper stages of production, that is, an increase in **the process of vertical integration**. At the same time, the share of the employed population has slightly decreased, which indicates an increase in labor productivity as a result of technological innovation and digitalization [4].

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The growth of agro-industrial exports has been an important indicator of the results of modernization in recent years. In our country, exports increased from $1.4 billion to $3.1 billion between 2020 and 2024. This growth is mainly explained by the activity of agro-clusters, the development of fruit and vegetable storage infrastructure, and the opening of new export routes [10]. At the same time, the share of products with international quality certificates has also increased, ensuring competitiveness in foreign markets [5].

Technological modernization plays a crucial role in increasing the efficiency of the agro-industrial complex. In recent years, there has been an increase in the use of water-saving technologies, agrodrone systems, digital monitoring tools, and processing plants. The table 2 below shows these changes [4].

Table 2. Indicators of technological modernization in the agro-industrial complex (2020–2024)

Indicator	2020	2021	2022	2023	2024	change,%
Area with modern irrigation technologies (thousand hectares)	325	410	530	670	810	+149
Coverage (%) with Agrodrone and	5	9	15	22	31	+520

digital monitoring systems						
Number of recycling plants (pcs)	520	580	640	715	800	+53.8
Farmers registered on digital platforms (%)	12	20	32	45	59	+391

Source: Data from the Ministry of Agriculture of the Republic of Uzbekistan, 2024 [4].

This table 3 shows that the area under water-saving technologies has expanded more than 2.5 times, and the coverage of agrodrones and digital monitoring systems has increased from 5 to 31 percent [8]. **This leads to increased productivity, more efficient use of water resources, and reduced production costs** [5].

The internal structure of the agro-industrial complex is also undergoing significant changes in the modernization process. Table 3 below shows the sectoral structure of the agro-industrial complex as of 2024 [3].

Table 3. Structure of the agro-industrial complex by sector (2024, %)

Agro-industrial complex sector	Share (%)
Crop growing	48
Livestock breeding	27
Processing industry	17
Logistics and services	8

Structural analysis shows that crop production is still the dominant sector in the agro-industrial complex. However, the share of the processing industry has reached 17 percent, and logistics services have reached 8 percent, indicating that production is moving to a modern stage of integration [10]. This means that the agro-industrial complex is becoming a system that is not a "raw material supplier", but a "finished product manufacturer".

The rational use of financial resources also plays an important role in the sustainable development of the sector. The provision of preferential loans, subsidies, and measures to support investment projects by the state allow for the expansion of production [11]. However, in order to increase the efficiency of these funds, it is necessary to improve the mechanisms for their targeted analysis, monitoring, and reinvestment [12].

The issue of environmental sustainability is also becoming an integral part of agro-industrial policy. In the context of climate change, water scarcity, and land degradation, it is important to introduce environmentally friendly production systems, develop waste-free processing technologies, and implement the principles of the "green economy" [13].
Regional diversification and specialization are also important aspects of agro-industrial modernization. Since the country's natural and climatic conditions are diverse, it is advisable to develop a separate agro-industrial strategy for each region [14]. For example, the development of intensive gardening and vegetable growing in the Fergana Valley, the expansion of greenhouse farms in Kashkadarya and Surkhandarya, and the development of livestock breeding in Karakalpakstan and Bukhara are promising.

International experience also shows that for the effective functioning of the agro-industrial complex, close cooperation between the state, the private sector and scientific institutions is necessary [15]. For example, in the Netherlands, thanks to the combination of innovative technologies, scientific research and state policy, agricultural exports account for 20% of total exports [7]. For Uzbekistan, implementing such a model — that is, strengthening the integration of "science - production - market" — will ensure the long-term competitiveness of the sector.

Israel's experience is also instructive in the efficient use of resources in conditions of water scarcity. Drip irrigation technologies have been introduced in the country on more

than 90 percent of the land, as a result of which productivity has increased by 1.5-2 times. The Israeli government controls each farm through satellite monitoring through the "smart agriculture" system, which automates the process of water distribution and fertilization.
In the United States, the development of the agro-industrial complex is based on the policy of uniting large cooperative systems and farmers on a cluster basis. In American agriculture, crop forecasts are made using digital technologies - drones, IoT (Internet of Things) sensors and "big data" analysis. This approach allows farmers to optimally use resources and maintain stable product quality.

In the experience of South Korea, the combination of agricultural production with urbanization is noteworthy. The country has created digital management systems, automated warehouses and logistics networks based on the "smart village" concept. Thanks to this, Korea has managed to increase the export share of agro-industrial products by 25% in a short time.

In general, the above analysis shows that modernization processes are being consistently implemented in the agro-industrial complex of Uzbekistan. Statistical data, technological indicators and export dynamics confirm that this sector is moving towards a stage of efficiency, innovative activity and digital transformation [4]. At the same time, in the future, further deepening of digitalization, efficient use of resources, environmentally sustainable production and the production of high value-added products will remain a decisive factor in the sustainable development of the sector.

4. Conclusion

In the process of modernization of the economy of Uzbekistan, the agro-industrial complex plays a crucial role in ensuring the country's food security, increasing export potential, and strengthening the economic stability of the regions. The results of the study show that during 2020-2024, the agro-industrial complex showed significant growth in production volumes, the level of technological innovation, and export indicators.

Today, the preferential loans, subsidies, and investment support provided by the state ensure the financial stability of the sector. At the same time, it is necessary to rationally use these funds, monitor their effectiveness, and strengthen the system of reinvestment.
To continue effective modernization processes and raise them to a higher level, it is necessary to focus on the following priority areas:

1. Improving yield forecasting and resource management mechanisms using artificial intelligence and "big data" technologies.
2. Supporting startups in the development of agrodrones, sensors and monitoring tools for local producers.
3. Diversifying exports by bringing products into line with international quality certificates.
4. Expand the use of renewable energy sources and create waste processing infrastructure.
5. Establish training programs for farmers and specialists in digital literacy and innovative technologies.

Through the consistent implementation of these proposals and recommendations, it will be possible to form a sustainable, competitive and export-oriented agro-industrial system in the country.

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