Improving and Effectively Managing the Agro-Industrial Complex in Central Asia: A Priority Direction Towards Sustainable Development

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Abstract: The study aimed to identify effective approaches to the organisational and economic modernisation of the agro-industrial complex under conditions of sustainable development. The research was based on a comparative analysis of management practices and investment strategies in the agricultural sectors of Kazakhstan, Uzbekistan, the Kyrgyz Republic, and Tajikistan. Uzbekistan and Kazakhstan significantly outperform other countries in the region across key indicators. Comparison with countries such as Turkey, Chile, and Poland revealed that their models of agricultural modernisation are based on a high level of processing and a focus on value-added products, which remains a challenging benchmark for the Central Asian states.

Keywords: agricultural policy; agro-processing; digitalisation of agriculture; export potential; institutional reforms; investment attractiveness

1. Introduction

The agro-industrial complex (AIC) of the Central Asian countries remains a key factor in ensuring food security, employment, and exports in the region. In the context of climate change, demographic pressure, and limited resources, there is an increasing need to shift from extensive models to innovation-oriented management. Given the high dependence of agriculture on water resources and the volatility of international markets, improving the efficiency of the AIC has become a matter of strategic importance.

The countries of the region demonstrate a diversity of agricultural models, providing a basis for comparative analysis. Despite the ongoing processes of digitalisation and integration into global markets, institutional constraints, investment risks, and weak regional coordination persist. The sustainable development of the AIC requires modern management approaches that take into account environmental, technological, and socio-economic factors. This highlights the necessity of a scientific analysis of accumulated experience and the search for effective transformation models suited to regional specificities.

The growing integration of Central Asian countries into global economic relations has brought the issue of aligning agricultural policy with regional cooperation to the forefront. In this context, V. Kozhogulova et al.[1)] examined the features of sustainable agricultural development in the Kyrgyz Republic, emphasising the need for intersectoral coordination and strategic planning. However, the study lacked a comparative analysis of institutional barriers at the intergovernmental level, which limits the applicability of its conclusions.

The rational use of water, land, and energy resources remains a critically important factor for the sustainability of agrosystems. This aspect was addressed in the study by N. Parpieva et al.[2)], which analysed the resource potential of the Kyrgyz Republic's agricultural sector as a foundation for transition to sustainable models.

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Nevertheless, the study insufficiently explored the role of institutional support for these strategies under conditions of escalating climate threats and the absence of comprehensive resource planning.

Low productivity and weak adaptation to climate change underscore the need to integrate water and agricultural management. In the research conducted by A. D. Dzhailova et al.[3], it was demonstrated that fragmentation between sectors reduces resource-use efficiency. At the same time, the authors focused primarily on the structural aspects of the issue without analysing the potential for implementing integration models at the level of individual administrative units.

Technological backwardness and institutional constraints continue to hinder the modernisation of the AIC. D. Sakkaraeva and M. Kumashev[4] carried out a structural analysis of the Kyrgyz Republic's AIC and called for more active state regulation. However, their study did not address mechanisms for overcoming investment stagnation, nor did it provide an assessment of the prospects for digital transformation as an integral part of the reform process.

The challenges of sectoral specialisation in the Kyrgyz Republic are particularly evident in cotton production. M. Abdiev et al.[5] identified logistical and infrastructural constraints that hinder the development of the industry, highlighting the shortage of processing facilities and distribution channels. However, the study did not analyse the institutional mechanisms that could facilitate overcoming these issues.

In the arid regions of Central Asia, the imbalance between the supply and demand of agro-ecosystem services remains a significant problem. J. Li et al.[6] identified spatial inequality in resource availability and emphasised the need to introduce differentiated management strategies. Nevertheless, the political and institutional conditions required for implementing these strategies were not examined.

The evolution of the agricultural sector in connection with water resources and food security requires an intergovernmental approach. S. Han et al.[7] underlined the importance of developing mechanisms for intergovernmental regulation of water and land relations. However, the study lacked an analysis of successful cases or management models applicable to the regional context.

The relevance of ecosystem planning in the agricultural sector is driven by the risks of degradation. H. Wang et al.[8] modelled the development of ecosystem services using an Earth System Model and highlighted the need for integrated planning. Nonetheless, the study focused primarily on biophysical aspects without considering the socio-economic determinants of agro-system viability.

The need for integrated management of water, energy, and food resources defines the framework for sustainable development. Y. Hu et al.[9] substantiated the importance of systemic interaction among these components of the agro-environment, particularly under climate risk conditions. However, the study was largely conceptual and did not propose specific tools for implementation at the governmental level.

Agro-industrial complexes can perform not only economic but also social functions in regional development. This is confirmed by the study of L. Castillo et al.[10], which demonstrated that such structures contribute to employment growth and the reduction of territorial disparities. Nevertheless, the study did not include a comparative analysis of countries with differing levels of institutional reform, making it difficult to generalise the findings.

An analysis of the reviewed academic sources indicates that, despite a considerable number of publications, there is still no comprehensive, integrated study of the transformational processes within the AICs of Central Asian countries. Existing research is largely fragmented, focusing on individual states or specific aspects of development, and fails to fully encompass the institutional, investment, and digital components of sustainable agricultural growth. Under these circumstances, there is a clear need for a systematic comparative analysis that takes into account current challenges and the potential for regional integration.

The present study aimed to identify effective approaches to the management and modernisation of the agro-industrial complex in Central Asian countries, taking into consideration sustainable development priorities. The research objectives included: analysing current trends in the development of the AICs of Kazakhstan, Uzbekistan, the Kyrgyz Republic, and Tajikistan in terms of investment dynamics, labour productivity, and the structure of agricultural exports; identifying key institutional and technological factors influencing the sustainability and efficiency of the agricultural sector; and comparing national models of agro-industrial management to determine strategic directions for their transformation based on digitalisation, environmental sustainability, and inclusive growth.

2. Materials and methods

The present study was comparative in nature and examined management practices and modernisation instruments within the agro-industrial complexes of the Kyrgyz Republic, Kazakhstan, Uzbekistan, and Tajikistan during 2020-2024. These four countries were selected because sufficiently comparable policy documents and economic indicators were available for the chosen period. Turkmenistan was not included because the available sources did not provide a sufficiently complete and methodologically comparable set of data for the institutional, investment, digitalisation, processing, and

export indicators used in the analysis. The period 2020-2024 was selected because it covers the most recent five-year cycle of agricultural reform, including post-pandemic economic adjustment, accelerated digitalisation, changes in food-security policy, and the introduction of climate-adaptation measures. In this study, sustainable development strategies within the AIC were defined as coordinated institutional, economic, technological, environmental, and social measures intended to increase productivity and value added while improving resource efficiency, climate resilience, food security, and the inclusion of rural producers.

The comparative-analytical approach enabled the comparison of key directions in agricultural policy, the degree of their alignment with the principles of sustainable development, and the effectiveness of implemented mechanisms of state support and institutional transformation. A systems analysis was employed to identify interrelations among elements of agricultural management – such as investment, digitalisation, resource planning, and regional cooperation – and to assess their potential impact on production and environmental indicators. In addition, elements of critical analysis were applied to interpret constraints, barriers, and institutional gaps in the governance of the agro-industrial complex.

To ensure the validity of the comparative analysis and the depth of interpretation of transformations in the agricultural sector, both national strategies and official reports from Central Asian countries, as well as analytical and statistical materials from leading international organisations, were utilised. The first group included documents issued by government bodies: the Ministry of Economy and Commerce of the Kyrgyz Republic[11], the National Statistics Bureau of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[12], the Ministry of Agriculture of the Republic of Uzbekistan[13], and the Ministry of Agriculture of the Republic of Tajikistan[14], as well as materials from United Nations Economic and Social Commission for Asia and the Pacific (ESCAP)[15] and the Eurasian Development Bank (EDB)[16]. These sources made it possible to cover policy priorities, mechanisms of state support, directions of digitalisation, and institutional modernisation within the agro-industrial complexes of the countries under study. At the same time, to compensate for gaps in the official statistics for 2024 and to ensure data comparability across countries, alternative open-access sources and licensed international reports were used, including those by the Food and Agriculture Organization of the United Nations[17], the World Bank Group[18], Agricultural Policy Monitoring and Evaluation[19], International Fund for Agricultural Development (IFAD)[20], and ESCAP[21]. In cases where official data were incomplete, aggregated values, average estimates, and indicative indicators published by these organisations were employed. This approach ensured analytical consistency, avoided the use of speculative forecasts, and allowed the countries under study to be accurately positioned within the international context of agricultural modernisation.

The analysis encompassed management models, institutional mechanisms, and economic indicators of the functioning of agro-industrial complexes in the examined states. The following parameters were used as evaluation criteria:

- degree of institutional coherence of agricultural policy;
- existence and implementation of sustainable development strategies within the AIC;
- level of digitalisation and technological transformation;
- measures for attracting investment and developing rural infrastructure;
- extent of national participation in international agricultural and logistics initiatives;
- adaptability to climatic and economic risks.

Tabular and contextual comparison methods were employed to clearly identify similarities and differences between countries according to each of the specified criteria. This provided a comprehensive understanding of the current state of the AIC in the region and made it possible to assess which management models proved most effective under the conditions of Central Asia.

For a broader contextual analysis, comparative data were drawn from Turkey, Poland, and Chile because these countries represent distinct but relevant models of agricultural modernisation. Turkey was selected because of its combination of partly arid agricultural zones, irrigation modernisation, farmer support, and integration into regional export markets. Chile was selected as an example of export-oriented agricultural development under water scarcity, supported by integrated processing, logistics, and specialised export institutions. Poland was selected not because of climatic similarity, but because it provides an institutional benchmark based on cooperative development, high processing intensity, digital agriculture, and support under the European Union's Common Agricultural Policy. Materials from the Food and Agriculture Organization of the United Nations[22], the World Development Indicators database of the World Bank Group[18], and a licensed report by the Organisation for Economic Co-operation and Development[23] were used. These sources enabled a quantitative and institutional comparison based on standardised indicators of investment, agricultural support, processing, exports, and technological modernisation.

3. Results

Between 2020 and 2024, the agro-industrial complexes of Central Asian countries were influenced by diverse

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processes, including climate change, global food security risks, pressure on water resources, and the need for institutional reform. In response to these challenges, the governments of four countries – the Kyrgyz Republic, Kazakhstan, Uzbekistan, and Tajikistan – initiated reforms in agricultural policy, introducing digital initiatives, measures for climate adaptation, export potential enhancement, and improvements in governance systems[24].

One of the leading trends was the digitalisation of agriculture. Kazakhstan demonstrated the most advanced level of digital solution implementation, including the development of the e-Agriculture system and satellite monitoring of fields, irrigation, and logistics[25,26]. In Uzbekistan, automation of irrigation systems and yield monitoring using GPS and IoT technologies also began[20]. In the Kyrgyz Republic and Tajikistan, digitalisation remained fragmented and largely confined to isolated pilot projects[15].

Against the backdrop of increasing climate threats, the need for adaptive practices intensified. Kazakhstan adopted a sustainable livestock strategy aimed at reducing the carbon footprint and improving pasture productivity[19]. Uzbekistan saw the expansion of organic farming practices and the modernisation of water management systems. Meanwhile, Tajikistan and the Kyrgyz Republic faced challenges in implementing sustainable agricultural practices due to limited access to finance and technology[24].

The third key direction was the development of export potential. Kazakhstan increased its exports of grains, oilseeds, and meat through logistical modernisation. Uzbekistan expanded its exports of fruit and vegetables to the EU and the Persian Gulf countries. The Kyrgyz Republic and Tajikistan continued to export mainly raw materials without deep processing, which constrained the growth of value-added production[27,28].

Institutional transformation also played an important role. Kazakhstan established mechanisms for interdepartmental coordination and partnerships with the private sector. Uzbekistan restructured its agricultural governance bodies and introduced decentralisation mechanisms. In the Kyrgyz Republic and Tajikistan, institutional changes were implemented with active support from international organisations, yet coordination between different levels of government remained weak[15].

Thus, Central Asian countries exhibit varying degrees of advancement in their transformation processes – from systemic reforms and digital initiatives to limited implementation under conditions of institutional and resource vulnerability. To provide a clear comparison of the key directions discussed above, Table 1 presents institutional coordination, climate adaptation, export potential, and the level of technological and digital development in the four countries.

Table 1: Comparative overview of key directions in the transformation of the AIC in Central Asian countries, 2020–2024

Country	Institutional coordination	Climate adaptation	Export potential	Technology and digitalisation
Kyrgyz Republic	Weak intersectoral coordination and dependence on international support	Limited implementation of adaptive practices because of restricted access to finance and technology	Predominantly raw agricultural exports with limited processing capacity	Isolated pilot projects with low scalability
Kazakhstan	Systemic coordination involving relevant ministries and private-sector partnerships	Sustainable livestock management, pasture-productivity measures, and resource-monitoring systems	Expansion of grain, oilseed, meat, and processed-product exports supported by logistics modernisation	e-Agriculture, satellite field monitoring, precision agriculture, and digital logistics
Uzbekistan	Structural reform, decentralisation, and restructuring of agricultural institutions	Modernisation of irrigation, expansion of water-saving technologies, and development of organic farming	Expansion of fruit, vegetable, and processed-product exports to the EU, China, and Gulf countries	Irrigation automation, GPS, IoT technologies, and agricultural information platforms
Tajikistan	Centralised management with weak local and interagency coordination	Limited adaptation because of insufficient finance, technology, and infrastructure	Predominantly raw-material exports constrained by weak processing, certification, and logistics	Initial level of digitalisation based mainly on donor-supported pilot projects

Source: compiled by the authors based on Organisation for Economic Co-operation and Development[19], Food and Agriculture Organization of the United Nations[24], and USDA[29].

The comparative analysis in Table 1 indicates that the transformation of the agro-industrial complex in Central Asian countries is fragmented and uneven. Kazakhstan and Uzbekistan demonstrate stronger institutional coordination, more developed climate-adaptation measures, greater export potential, and broader adoption of digital technologies. In contrast, the Kyrgyz Republic and Tajikistan remain constrained by limited access to finance and technology, weak processing and logistics, and donor-dependent pilot initiatives. Overall, Table 1 highlights differences in the four transformation directions discussed above and provides a foundation for a more detailed examination of the national cases, beginning with the Kyrgyz Republic.

The agro-industrial complex of the Kyrgyz Republic continues to hold significant importance for the national economy, contributing approximately 13-15% of GDP in different years and providing employment for over a quarter of the workforce, predominantly in rural areas. However, despite the sector's macroeconomic significance, its contribution to national value added remains limited due to the predominance of low-technology production, weak processing capacity, and institutional instability.

Investment activity in the agricultural sector remains fragmented and largely dependent on international assistance[15]. Data from A.A. Baimuratov et al.[30]) indicate that public investment is primarily directed towards infrastructure projects, often implemented under donor initiatives such as IFAD, EDB, and the Asian Development Bank (ADB). The absence of a long-term national investment strategy focused on economic efficiency restricts the potential for large-scale modernisation. According to G. Osmonkulova[31]) and M. Abdiev et al.[5]), profitability in subsectors such as cotton production remains low due to outdated cultivation methods, lack of processing facilities, and weak logistics.

To illustrate the dynamics of the Kyrgyz Republic's agricultural sector between 2020 and 2024, Table 2 presents key economic indicators of the agro-industrial complex.

As shown in Table 2, despite a gradual increase in both investment and the share of processing, the agricultural model of the Kyrgyz Republic remains dependent on a raw-material export orientation and international support, which limits the sector's economic resilience. Between 2020 and 2023, the share of the agro-industrial complex in the country's gross domestic product gradually increased from 12.9% to 14.2%. This trend reflects the strengthening role of the AIC within the structure of the Kyrgyz Republic's economy, particularly against the backdrop of overall macroeconomic instability and limited growth in other sectors. At the same time, the slight decline to 14.0% in 2024 may be associated with fluctuations in agricultural commodity prices or the impact of external shocks. Employment in the AIC remained consistently high, exceeding 25% throughout the period under review. This confirms the social significance of the agricultural sector for the population, especially in rural areas. However, growth in employment without a corresponding increase in productivity may indicate low efficiency in the use of labour resources and an excessive reliance on manual work.

The total volume of investment rose from 172 million USD in 2020 to 235 million USD in 2024, representing an increase of 36.6% over five years. This is a positive signal, suggesting growing interest from donors, the state, and the private sector in modernising the industry. Nevertheless, in absolute terms, the level of investment remains moderate, particularly given current needs in infrastructure, digitalisation, and technological upgrading. The share of processed products gradually increased from 16.4% to 18.5%, indicating modest progress in developing value-added chains. Growth rates remain low, highlighting a structural issue: the AIC continues to focus on raw-material exports, while the expansion of processing infrastructure proceeds slowly due to institutional barriers, underdeveloped logistics, and insufficient capital investment.

Exports from the Kyrgyz Republic remain largely raw-material in nature. They consist mainly of unprocessed crops and livestock products, primarily supplied to neighbouring countries and markets within the EAEU. The lack of deep processing reduces value added and export revenue, while high volatility in commodity prices makes the sector vulnerable to external economic shocks[3]. This raw-material export orientation contributes little to sustainable growth and underscores the need for a strategic shift towards the development of the agro-processing industry.

Table 2: Key economic indicators of the agro-industrial complex in the Kyrgyz Republic (2020-2024)

Year	Share of AIC in GDP, %	Employment in AIC, % of population	Investment volume, million USD	Share of processing in AIC, %	Agricultural exports, million USD
2020	12.9	24.8	172	16.4	312
2021	13.3	25.1	198	17.0	346
2022	13.7	25.5	210	17.6	361
2023	14.2	26.0	224	18.2	379
2024	14.0	25.8	235	18.5	388

Source: compiled by the authors based on Organisation for Economic Co-operation and Development[19], Food and Agriculture Organization of the United Nations[24], USDA[29], Ministry of Economy and Commerce of the Kyrgyz Republic[11].

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In terms of digitalisation, as noted by S. Umarov et al.[32] and ESCAP[15], there have been isolated initiatives in irrigation automation, yield monitoring, and the introduction of mobile platforms for agricultural advisory services. Nevertheless, the absence of a centralised digital policy and the limited technical capacity of farms hinder the generation of sustainable economic benefits from digitalisation. According to K.D. Dzhumabayev et al.[33], farming cooperatives suffer from inadequate access to knowledge, technology, and concessional credit, which restricts opportunities to improve productivity. Financial pressures on farmers are further compounded by limited access to bank financing: the agricultural sector is characterised by high risk and a low collateral base, particularly among smallholdings. The lack of specialised credit instruments and insurance mechanisms increases sectoral instability. In addition, the tax base in the AIC remains narrow, limiting the state's capacity to expand fiscal support for agricultural production.

Thus, the AIC of the Kyrgyz Republic demonstrates systemic economic vulnerability, stemming from structural limitations, institutional fragmentation, and low investment attractiveness. Transitioning to a sustainable development model requires not only strengthened institutional coordination but also the formulation of a long-term economic strategy focused on increasing value added, diversifying exports, and digitally transforming agricultural production.

The agro-industrial complex of Kazakhstan, between 2020 and 2024, exhibited a steady trend towards institutional and economic modernisation. The sector contributes approximately 5%-6% of the country's GDP and serves as a key driver of employment in rural regions, while its contribution to export revenue significantly exceeds its nominal share in the economy due to its orientation towards external markets[25]. Kazakhstan actively leverages its agricultural sector as a tool for economic diversification and regional development, particularly against the backdrop of volatile energy prices. Between 2020 and 2024, the country implemented extensive state-supported agricultural programmes, including export subsidies, technological modernisation, and the development of the processing industry. The State Programme for the Development of the Agro-Industrial Complex for 2021-2030, adopted in 2021[29], focuses on productivity growth, sustainable land use, and digitalisation. According to the Organisation for Economic Co-operation and Development[19], Kazakhstan has demonstrated a systematic approach to managing agricultural transformation, including the establishment of specialised institutions such as KazAgroFinance and KazAgroInnovation, which have helped reduce investment barriers and facilitate technological upgrading.

In terms of investment activity, Kazakhstan's agricultural sector is characterised by a high proportion of domestic public funding, including through concessional credit mechanisms, alongside support from international organisations (ADB, World Bank). The development of public-private partnerships (PPPs) has enabled the implementation of numerous infrastructure projects in logistics, storage, processing, and irrigation. According to United Nations Economic and Social Commission for Asia and the Pacific[15], Kazakhstan is the only country in the region to have successfully developed export-oriented agro-clusters with a high level of vertical integration and product standardisation. Its export policy focuses on strengthening positions in the EU, Chinese, and the Persian Gulf markets. Key export products include cereals, oilseeds, meat, and dairy. The establishment of new logistics corridors and the modernisation of transport infrastructure have contributed to increased export revenues and reduced delivery costs. The implementation of digital trading platforms and certification systems also facilitates integration into international value chains[19]. Positive trends in Kazakhstan's agricultural sector in terms of foreign economic activity and investment attractiveness are illustrated in Table 3.

Analysis of Table 3 highlights key trends in the development of Kazakhstan's agro-industrial complex between 2020 and 2024. Over this period, private investment in the AIC increased from USD 610 million to USD 1,120 million, representing a growth of 83.6%. This indicates strong investment activity, supported by measures to deregulate the agricultural sector, promote agricultural cooperation, and advance digital technologies.

Table 3: Trends in agricultural exports and investment in Kazakhstan (2020-2024)

Indicator	2020	2021	2022	2023	2024
Private investment in AIC, million USD	610	735	845	980	1,120
Volume of state subsidies, million USD	240	265	310	370	415
Export of vegetables and fruit, million USD	1,320	1,460	1,585	1,740	1,830
Share of agro-clusters in AIC structure, %	21.5	26.0	30.8	34.2	37.0
Share of processed products in agro-exports, %	18.4	22.6	26.9	30.1	33.5

Source: compiled by the authors based on Organisation for Economic Co-operation and Development[19], Food and Agriculture Organization of the United Nations[24], USDA[29], National Statistics Bureau of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan[12].

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A significant portion of investment was directed towards developing logistics infrastructure, implementing precision farming systems, and expanding processing capacities for agricultural products.

State subsidies also exhibited positive growth, rising from USD 240 million in 2020 to USD 415 million in 2024, an increase of 72.9%. This reflects a consistent government policy supporting agricultural modernisation, including subsidies for machinery purchases, the development of irrigation infrastructure, and support for export-oriented projects. State financial assistance has played a key role in reducing production costs and stimulating technological upgrading. Exports of vegetables and fruit increased by USD 510 million (38.6%), reaching USD 1,830 million in 2024. This growth was driven by diversification of export markets – including countries of the Commonwealth of Independent States (CIS), China, and the Middle East – improvements in phytosanitary control, and enhanced product quality. Kazakhstan is actively expanding exports of processed products, contributing to more stable foreign currency earnings and reducing dependence on raw commodity prices.

The share of agro-clusters within the AIC structure rose from 21.5% to 37.0%, signalling an institutional shift towards a cluster-based model. This approach integrates production, processing, and distribution segments into a unified value chain, enhancing efficiency, lowering transaction costs, and improving agribusiness profitability. Of particular note is the increase in the share of processed products in agro-exports, from 18.4% to 33.5%, indicating a strategic shift from raw-material exports to high value-added products. This strategy strengthens Kazakhstan's competitive position in global markets and reduces vulnerability to fluctuations in world prices. Overall, the analysis demonstrates a balanced and progressive agricultural transformation, underpinned by institutional reforms, investment activity, and export reorientation[34)].

Uzbekistan exhibits the most dynamic pace of agricultural reform among the Central Asian countries, combining state support, increased private investment, and an export-oriented policy. A key trend is the gradual transition to a cluster-based model with an emphasis on processing, which enhances the economic return per unit of output. At the same time, risks persist regarding unequal access to new tools for small producers, and the rapid pace of growth requires institutional stability. According to the available data, Uzbekistan has the potential to become a regional hub for processed agricultural products, provided investment momentum is maintained and access to technology is expanded.

Digitalisation of the agricultural sector has become a crucial element of this transformation. As noted by the World Bank[25,26)], the country is actively implementing e-Agriculture systems, satellite monitoring, precision farming, and yield forecasting. The government supports technological start-ups and educational programmes in agri-tech, creating the foundations for long-term productivity growth and sectoral resilience. These measures have already contributed to an increase in gross value added in both crop and livestock production. The economic effects of agricultural transformation in Uzbekistan are evident in the rising share of processed products in exports, improved efficiency in the use of natural resources, reduced dependence on food imports, and the creation of new jobs in regional areas. Nevertheless, challenges remain, including climate vulnerability, uneven regional development, and the need to deepen institutional reform at the local government level[35)].

Thus, the case of Uzbekistan demonstrates that a consistent economic and institutional policy can transform the AIC from a vulnerable sector into a source of sustainable growth, foreign exchange earnings, and technological upgrading, positioning the country as a potential leader in agricultural modernisation in Central Asia.

Between 2020 and 2024, Uzbekistan demonstrated the most active institutional restructuring of the agricultural sector among Central Asian countries. The Agriculture Development Strategy of Uzbekistan for 2020-2030[37)] established guidelines for liberalisation, decentralisation, and the sustainable enhancement of economic returns from the AIC. The agricultural sector accounts for approximately 28% of national employment and around 25% of rural exports, playing a pivotal role in regional economies.

The economic transformation of the sector began with the dismantling of the previous command-and-quota system, the transition to market-based pricing, and the stimulation of private initiatives in crop and horticultural production. According to International Fund for Agricultural Development[20)], substantial growth in private investment has been driven by reforms in land lease arrangements, the legalisation of cooperatives, and simplified access to credit. The effects are particularly noticeable in fruit and vegetable production, with Uzbekistan emerging as one of the largest suppliers of fresh produce to the Middle East, the EU, and China. A key strategic focus has been the modernisation of the irrigation system. Investments in the reconstruction of irrigation channels, alongside the introduction of drip and precision irrigation, have significantly reduced water losses and increased crop yields in the most arid regions[15)]. These measures, supported by ADB and the Food and Agriculture Organization of the United Nations, have laid the foundation for sustainable production growth under conditions of climatic instability.

The agricultural strategy has emphasised the development of agricultural logistics and processing infrastructure as key areas for sectoral modernisation. The establishment of agro-industrial clusters – including export-oriented ones – has enhanced the localisation of added value. According to

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the Organisation for Economic Co-operation and Development[19], the share of processed products in exports has increased through the launch of modern sorting centres, cold storage facilities, and packaging lines, particularly in the Fergana and Samarkand regions.

Digitalisation has also become an integral part of agricultural reform. The country is developing and implementing agricultural information platforms for crop monitoring, land registration, and water resource management. As noted by International Fund for Agricultural Development[20], pilot projects utilising IoT technologies and GPS navigation have begun generating economic benefits through improved forecasting accuracy and resource optimisation. At the same time, access to digital solutions for small farmers remains limited due to a lack of knowledge and financial resources. Financial policy in the sector is focused on stimulating investment, with subsidised credit lines, insurance mechanisms, and import incentives for agricultural machinery being introduced. According to Eurasian Development Bank[16] reports, total private investment in Uzbekistan's AIC increased by more than 40% over the period, with up to 60% of projects implemented in partnership with international financial institutions.

Thus, Uzbekistan exemplifies a model of agricultural transformation in which economic efficiency is achieved through institutional liberalisation, the growth of private investment, infrastructure modernisation, and the expansion of export potential. Key challenges remain the scaling of innovations, the elimination of regional disparities, and the maintenance of achieved results amid external economic fluctuations.

Table 4: Trends in key economic indicators of Uzbekistan's agricultural sector (2020-2024)

Indicator	2020	2021	2022	2023	2024
Private investment in AIC, million USD	495	620	710	840	950
Volume of state subsidies, million USD	180	205	250	290	330
Export of vegetables and fruit, million USD	1,150	1,290	1,390	1,540	1,660
Share of agro-clusters in AIC structure, %	17.8	21.3	25.0	29.2	32.5
Share of processed products in agro-exports, %	14.5	18.1	22.4	26.0	29.8

Source: compiled by the authors based on Organisation for Economic Co-operation and Development[19], Food and Agriculture Organization of the United Nations[24], USDA[29], Ministry of Agriculture of the Republic of Uzbekistan[13].

To illustrate the scale of economic transformation in Uzbekistan's agro-industrial complex, key indicators for 2020-2024 are presented in Table 4.

Analysis of Table 4 shows that between 2020 and 2024, private investment in Uzbekistan's agricultural sector increased from USD 495 million to USD 950 million, reflecting a gradual recovery of interest in the sector following the initial waves of land and tax liberalisation. Investment dynamics remain moderate but stable, partly due to protracted institutional reforms and the need to strengthen confidence among foreign investors. The steady rise in state subsidies, from USD 180 million to USD 330 million, demonstrates the government's strategic focus on supporting agricultural modernisation, particularly in irrigation, technological upgrading, and the localisation of processing capacities. Subsidies also offset high transaction costs associated with fragmented logistics and an underregulated land market.

Exports of vegetables and fruit increased from USD 1,150 million to USD 1,660 million, indicating a gradual export orientation of Uzbekistan's AIC. Key factors driving this growth included improvements in product certification, targeting high-value markets (notably the EU, China, and Gulf countries), and the consolidation of production units through clusterisation. The share of agro-clusters within the AIC structure rose from 17.8% to 32.5%, confirming the effectiveness of policies promoting consolidation, vertical integration, and resource concentration within logistically coordinated systems. This has contributed not only to reduced costs and increased productivity but also to the broader adoption of modern agri-technologies in agriculture.

The significant rise in the share of processed products in exports – from 14.5% to 29.8% – reflects a strategic shift in foreign trade policy, moving from raw-material exports to the export of value-added products. This indicator also highlights the active expansion of the domestic processing sector, the development of packaging and logistics hubs, and the introduction of financial incentives for processing enterprises. Collectively, these changes point to a gradual institutional transformation of the agricultural development model, advancing towards an export-oriented, innovative, and capitalised agricultural sector. This reduces vulnerability to commodity price fluctuations, broadens export opportunities, and supports the generation of stable foreign exchange earnings. Such a transformation is a sign of a mature agricultural policy focused on achieving comprehensive economic returns.

Thus, based on the presented data, it can be concluded that Uzbekistan is consistently implementing a model of agricultural modernisation that combines institutional reforms, investment activity, and export-oriented processing. Progress in clusterisation, the rise in the share of processed products, and the steady increase in export volumes indicate a move towards a sustainable, capitalised,

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and technologically upgraded agricultural system. At the same time, challenges remain regarding inclusivity and the scalability of successful solutions for small and medium-sized producers, requiring continued support at both local and regional levels[36,37].

The agro-industrial complex of Tajikistan remains one of the most vulnerable sectors of the national economy. Although agriculture accounts for over 60% of employment and roughly 20% of GDP, its structure and productivity are poorly adapted to contemporary challenges. Production is dominated by small dehkan farms, which are family-operated agricultural holdings that use household or leased land and rely mainly on family labour, with limited access to investment, technology, and markets[15]). Institutional management of Tajikistan's AIC remains highly centralised, while low coordination between levels of government and a lack of interagency cooperation hinders the implementation of development programmes. National plans for food security and sustainable land use exist in principle but are weakly implemented at the regional level[38]). The 2023 Agro-Food System Development Programme up to 2030 lacks clear mechanisms for funding and coordination[39]). From an investment perspective, the sector suffers from limited state involvement and near-total dependence on donor support. A significant portion of investment projects is implemented through technical assistance programmes (Food and Agriculture Organization of the United Nations, UNDP, World Bank), often without ensuring long-term sustainability or institutional support. Due to a weak credit system and the absence of specialised financial instruments, farmers lack the means to develop production based on sustainable financial models.

Tajikistan's export potential is limited. Products are primarily shipped to Russia, Afghanistan, and Kazakhstan as raw materials. The absence of facilities for deep processing, a weak certification system, and logistical challenges prevent access to more lucrative markets. As United Nations Economic and Social Commission for Asia and the Pacific[15]) notes, transport and energy costs in the country's AIC remain among the highest in the region, reducing the competitiveness of its products.

Key indicators of Tajikistan's agricultural sector for 2020-2024 are presented in Table 5, highlighting its structural limitations and dependence on external support.

The Figures presented in Table 5 demonstrate stagnation in key indicators, particularly in processing, productivity, and export diversification. Foreign aid increased from USD 158 million in 2020 to USD 200 million in 2024, representing a growth of only 26.6% over the period. This indicates a modest scale of external financing and a lack of significant expansion in international support. The share of the AIC in GDP has gradually declined – from 20.2% in 2020 to 19.3% in 2024 – reflecting a relative reduction in the sector's significance within the overall economy. This trend may result from the slow growth of the AIC and the comparatively faster development of other sectors, including remittances and construction. Foreign aid volumes fluctuate within the range of USD 158-200 million, highlighting a stable but moderate dependence on external financing. Most of these funds are channelled through technical assistance programmes and are not utilised for deep structural modernisation, underscoring the sector's limited internal resources and the insufficient effectiveness of institutional management. Labour productivity remains exceptionally low, ranging from USD 1.46 thousand to USD 1.65 thousand per worker – substantially below the Central Asian benchmarks, where Kazakhstan and Uzbekistan exhibit levels 2.5-4 times higher. This reflects technological backwardness, a predominantly manual production model, and low capitalisation of the sector. The modest increase in the share of processed products – only 1.2 percentage points over five years– confirms the absence of significant changes in the production structure. Agricultural output remains predominantly raw, with low added value, sharply limiting profitability and export potential. The share of raw materials in exports remains extremely high, with unprocessed goods accounting for over 80% of agro-exports. The slow decline in this share highlights the limited efforts to integrate into global value chains and the sector's inability to access higher-margin markets.

Tajikistan's agricultural sector continues to exhibit structural dependence on foreign donors and raw-material specialisation. Productivity, processing, and export efficiency remain critically low, failing to support sustainable growth. Without strategic modernisation, institutional coordination, and systemic investment, the country's AIC cannot overcome stagnation or enhance its

Table 5: Key indicators of Tajikistan's agricultural sector (2020-2024)

Indicator	2020	2021	2022	2023	2024
Share of AIC in GDP, %	20.2	20.0	19.8	19.5	19.3
Volume of foreign aid in AIC, million USD	158	170	189	192	200
Labour productivity, thousand USD per AIC worker	1.46	1.52	1.58	1.63	1.65
Share of processed output in agricultural production, %	11.8	12.3	12.5	12.9	13.0
Share of raw materials in agricultural exports, %	84.5	83.6	82.3	81.1	80.0

Source: compiled by the authors based on Organisation for Economic Co-operation and Development[19]), Food and Agriculture Organization of the United Nations[24]), USDA[29]), Ministry of Agriculture of the Republic of Tajikistan[14]).

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competitiveness[40]. These data underscore the urgent need to shift from piecemeal assistance to an integrated economic policy, including infrastructure reform, incentives for processing, and improved access to technology.

Digitalisation and technological transformation remain at an embryonic stage. The country lacks centralised platforms for recording and monitoring agricultural production, and there are no systematic measures to train farmers in digital skills. Pilot projects involving international organisations reach only a very limited number of farmers and are often primarily demonstrative in nature[25,26]. The degradation of rural infrastructure remains a pressing issue – irrigation systems, roads, and storage facilities are in poor condition. This reduces crop yields, increases post-harvest losses, and hinders the development of modern value chains. According to Eurasian Development Bank[16], over 70% of agricultural produce fails to reach processing facilities or markets in suitable condition.

Consequently, Tajikistan's AIC remains in a prolonged state of institutional and economic stagnation. Without a comprehensive management strategy, infrastructure modernisation, and increased investment, the country risks losing its competitiveness even at the regional level. Achieving economic resilience in the agricultural sector requires not only technical assistance but also an internal institutional commitment to systemic reform[41,42].

A comparative review of the four Central Asian countries highlights a clear differentiation in the pace, priorities, and outcomes of agro-industrial reforms. Kazakhstan and Uzbekistan exhibit stronger signs of economic transformation, institutional coordination, and increased investment activity. In contrast, the Kyrgyz Republic and Tajikistan remain in a catch-up position, characterised by fragmented digitalisation, limited export specialisation, and a high degree of dependence on external support.

From an institutional management perspective, Kazakhstan represents the most mature model: the integration of relevant ministries, the development of public-private partnerships, and the deployment of digital management platforms enable comprehensive oversight of agricultural transformation[43]. Uzbekistan, despite its more recent reform efforts, has shown progress in restructuring its management system, promoting competition, and developing agro-industrial clusters. In the Kyrgyz Republic and Tajikistan, problems persist in coordination between governance levels, and there is no systematic approach to institutional modernisation.

Investment policy reflects the degree of political will and managerial capacity[44,45]. Kazakhstan and Uzbekistan actively employ tools such as investor incentives, subsidies, and credit support, enabling higher value-added production and improved logistics. In contrast, in the Kyrgyz Republic and Tajikistan, investments are largely ad hoc, with a significant proportion of projects financed solely through donor funding.

Digitalisation serves as a marker of an economy's adaptability to global trends[46,47]. Kazakhstan has already implemented elements of precision agriculture, digital mapping, and yield monitoring, while Uzbekistan is actively investing in irrigation automation and agricultural information platforms. In the Kyrgyz Republic and Tajikistan, digital initiatives remain confined to pilot programmes and lack state-level support.

Export potential also varies. Kazakhstan has expanded both the volume and geographical reach of its exports, modernised logistics, and developed export-oriented clusters. Uzbekistan focuses on niche markets and the promotion of processed products. By contrast, the Kyrgyz Republic and Tajikistan predominantly export raw materials, generating limited economic multiplier effects.

Thus, the key factors for effective management of the AIC in the region are institutional coherence, proactive investment and export policies, support for digital transformation, and integration into international value chains. Countries that have achieved balanced development across these areas – namely Kazakhstan and Uzbekistan – demonstrate more resilient economic performance and greater potential for long-term growth. For the Kyrgyz Republic and Tajikistan, a pressing challenge remains the need to overcome institutional and financial vulnerability through comprehensive reforms and integration into regional economic initiatives.

To allow a quantitative comparison of the development of agro-industrial complexes in Central Asian countries, key indicators for 2024 are presented in Table 6.

Table 6: Comparative economic indicators of the AIC in Central Asian countries

Indicator	Kazakhstan	Uzbekistan	Kyrgyz Republic	Tajikistan
Share of AIC in GDP, %	5.6	11.8	14.0	19.3
Private investment in AIC, million USD	1,120	950	235	65
Agricultural export volume, million USD	4,210	1,660	388	212
Share of processed products in exports, %	33.5	29.8	18.5	13.0
Dependence on foreign aid in the sector	Low	Medium	High	Very high

Source: compiled by the authors based on Organisation for Economic Co-operation and Development[19], Food and Agriculture Organization of the United Nations[24], USDA[29].

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The comparison reveals that a high contribution of agriculture to GDP does not necessarily indicate an advanced agro-industrial model. In the Kyrgyz Republic and Tajikistan, the greater economic weight of agriculture is associated with limited diversification, low labour productivity, weak processing capacity, and dependence on external assistance. Kazakhstan and Uzbekistan have smaller or moderate agricultural shares in GDP but demonstrate stronger investment capacity, export infrastructure, and integration of processing into agricultural value chains.

The main distinction therefore concerns the quality rather than the scale of agricultural activity. Kazakhstan and Uzbekistan are progressing towards capital-intensive and processing-oriented systems supported by institutional reform and export development. The Kyrgyz Republic and Tajikistan remain more dependent on primary production and donor-supported projects, indicating the need to strengthen domestic financing, processing infrastructure, logistics, and technological access.

The comparative findings identify six strategic directions for transforming agro-industrial management in Central Asia: strengthening interagency and regional policy coordination; expanding long-term investment instruments, concessional credit, guarantee mechanisms, and crop-insurance systems; creating interoperable digital platforms for land, water, production, and market data; developing processing, storage, certification, and logistics infrastructure; integrating climate-adaptation measures into irrigation, land, and livestock management; and expanding regional cooperation in transport corridors, food standards, technology transfer, and cross-border value chains. Their implementation should be differentiated according to national institutional capacity: Kazakhstan and Uzbekistan require further scaling and inclusion of small producers, whereas the Kyrgyz Republic and Tajikistan require the establishment of basic financial, institutional, and technological infrastructure.

To broaden the analytical perspective and verify the identified trends in the agricultural transformation of Central Asian countries, key indicators were compared with data from Turkey, Poland, and Chile – countries that demonstrate sustainable development of their AICs through institutional modernisation and deep integration into global food chains. This comparison enabled an assessment of the relative levels of processing, investment volumes, and dependence on external support in the context of successful reforms. In Turkey, the agricultural sector accounts for 6.5% of GDP, which is comparable to the Figures for Uzbekistan and Kazakhstan. Private investment in the AIC is estimated at USD 5.2-5.5 billion per year, including direct government support for farmers, subsidies for the purchase of seeds and equipment, expansion of irrigation systems, and development of cooperatives[22]. Agro-exports exceed USD 22 billion, of which approximately 47% is processed products, including canned vegetables, tomato pastes, olive oil, and dried and frozen fruits. Digitalisation of the AIC has intensified, with the introduction of satellite monitoring, drone technologies, and digital land cadastres. The country exhibits a low dependence on international assistance, maintaining robust domestic institutional mechanisms to support the sector[23]. Poland demonstrates one of the most balanced models of agricultural development in the EU. Despite the relatively low share of the AIC in GDP (2.4%), the country ranks among the leading food exporters in Central and Eastern Europe, with exports exceeding USD 40 billion in 2023. Private investment in the sector amounts to USD 3.8 billion, a significant portion of which is provided through EU programmes under the Common Agricultural Policy (CAP). Notably, the share of processed products in exports reaches 68-70%, reflecting deep specialisation in the processing of meat, dairy, cereals, and related products. Polish agriculture is highly digitalised, employing precision technologies, automated yield management systems, and support programmes for small agribusinesses. Dependence on external assistance is negligible, with support delivered through domestic and European programmes[18,23]. Chile represents the South American model of agricultural transformation, characterised by export orientation and active private sector integration. The AIC accounts for 4.0% of GDP, with agricultural exports valued at around USD 24 billion, including fruits, wine, nuts, fish, and high value-added products. The share of processed goods in exports exceeds 60-65%, indicating deep integration of logistics and processing chains[22]. Private investment reaches USD 3.3 billion per year, directed towards infrastructure, storage, processing, and innovative technologies. Government institutions, such as the Chilean Ministry of Agriculture and agencies including CORFO and ProChile, provide systematic support to export-oriented producers. Dependence on international aid is negligible, with state policy focused on strengthening competitiveness and diversifying agricultural production[18,26].

A comparative analysis indicates that agricultural transformation in Central Asian countries remains less balanced and more fragmented than in Turkey, Poland, and Chile. Key differences include a lower share of processed products, limited export diversification, and insufficiently mature support institutions for agribusinesses. These contrasts underscore the need for deeper institutional reforms, a shift towards export-oriented value-added models, and stronger integration into international agro-industrial chains.

In summary, the study examines managerial approaches, institutional conditions, and economic parameters of the agro-industrial complexes in Central Asia, identifying factors of efficiency and vulnerability, and setting priorities for regional modernisation. The findings

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demonstrate that sustainable development of the agricultural sector is achievable only through comprehensive reform – anchored in technological renewal, transparent investment, product processing, and integration into global value chains. This requires not only economic mechanisms but also coordinated policies aimed at long-term food security, ecological adaptation, and social inclusivity.

4. Discussion

The findings indicate significant heterogeneity in agricultural transformation across Central Asian countries. Despite a general commitment to cluster-based models and modernisation of the AIC, the success of these initiatives depends heavily on the quality of the institutional environment, access to investment, and the level of technological integration. While there is a clear trend towards increasing the share of value-added products, institutional and infrastructural constraints continue to limit the full potential of these reforms.

In Uzbekistan, the share of processed products in exports has risen to 29.8%, while private investment has grown to USD 950 million, accompanied by the expansion of agro-clusters to 32.5% of the AIC. These developments point to a systemic institutional transformation oriented towards vertical integration and export expansion. Similar conclusions were drawn by L. Nguyen et al.[48], who emphasise that support for agro-processing through subsidies and tax incentives plays a crucial role in establishing sustainable export models in developing countries. Furthermore, a meta-analysis covering over 80 countries demonstrated that processing efficiency increases substantially when institutional support exists for logistics, certification, and product traceability mechanisms. Accordingly, interventions in processing have a multiplicative effect: they not only enhance profitability but also drive a structural reorganisation of the agricultural sector towards an export-oriented, capital-intensive model[49].

Kazakhstan demonstrates a stable trajectory of agricultural transformation, underpinned by an active export policy and a high proportion of processed products in agro-exports. In 2024, the country's agricultural exports reached USD 4,210 million, with the share of processed goods rising to 33.5%, indicating a clear shift towards a value-added model. However, J. Degila et al.[50] emphasise that successful transformation requires digital inclusivity and institutional support – elements lacking in several countries, including those in Central Asia. The absence of widespread digitalisation can restrict smallholders' access to supply chains and exacerbate socio-economic inequality. Evidence from other regions demonstrates that agricultural modernisation can be implemented through modular technologies adapted to different production scales. Green manufacturing and agro-edutourism practices in Indonesia show how environmental technologies can generate additional rural income while improving resource efficiency[51]). Sustainable hydroponic systems illustrate opportunities for food production in water- and land-constrained urban areas[52-54], while artificial-intelligence-based yield forecasting and automated product sorting can improve resource allocation, quality control, and market readiness[55,56]. For Central Asian countries, these examples are most applicable when introduced together with farmer training, affordable finance, digital infrastructure, and mechanisms that allow small producers to participate rather than limiting technological benefits to large agricultural enterprises.

Risk-management instruments should accompany technological and institutional modernisation. Weather-indexed and yield-indexed crop insurance can reduce producers' exposure to drought, temperature extremes, and harvest losses, while public co-financing of premiums can improve access for small farms[57,58]. Credit-guarantee schemes, emergency funds, diversified production, and digital early-warning systems can complement insurance by reducing financial instability and allowing farmers to continue investing after adverse climatic events.

Research findings indicate that Kazakhstan has developed an effective model of inter-agency coordination in agriculture, enabling the mobilisation of USD 610 million in private investment and an increase in productivity to USD 6.1 thousand per worker. A key feature of this model is the implementation of public-private partnership (PPP) mechanisms, alongside support for agro-industrial clusters and agricultural logistics. A. Akhmet[35] highlights that the development of transport and logistics infrastructure is a fundamental element for sustainable agro-exports in countries transitioning to an industrial-style agricultural model. Kazakhstan is cited as a successful example of integrating agricultural strategy within broader national economic policy. The study also notes that, without reliance on local initiatives, investments in logistics do not guarantee long-term impact – a factor requiring further investigation in subsequent research. The findings indicate that institutional modernisation and the development of logistical networks create not only a foundation for investment activity but also the necessary groundwork for the subsequent implementation of digital solutions in the agricultural sector. In this context, digitalisation is not viewed as a separate initiative but rather as an extension of structural transformation processes aimed at improving management efficiency and increasing the engagement of rural producers[59].

The combined findings indicate a clear gap in Central Asia, not only in terms of processing, productivity, or exports, but also in the underlying institutional foundations of agricultural governance. Uzbekistan and Kazakhstan demonstrate a shift towards ecosystem-based management

of the agricultural sector, whereas the Kyrgyz Republic and Tajikistan remain at the stage of fragmented interventions. This observation aligns with the analysis of L. Castillo et al.[10], who describe agri-industrial complexes as multifunctional entities encompassing economic, social, and territorial dimensions. The authors emphasise that the integration of all three dimensions is essential for long-term development sustainability, including employment and local welfare. This conclusion has direct practical relevance for the present study, underpinning the need for holistic models of agricultural transformation.

A review of the literature clearly indicates that sustainable growth of the agro-industrial complex is unattainable without institutional renewal, technological diversification, and strategic export specialisation – these components form the foundation for long-term sectoral efficiency and adaptability in the face of contemporary challenges[60]. At the same time, the analysis confirms the validity of critiques concerning limited inclusivity, the vulnerability of digitalisation, and the weak environmental dimension of agricultural policies. These discrepancies emphasise the need for further research into comprehensive models of agricultural development that combine innovation with social sustainability and environmental stewardship.

5. Conclusions

This study has enabled a comprehensive assessment of transformation processes within the agro-industrial complex of four Central Asian countries – Kazakhstan, Uzbekistan, the Kyrgyz Republic, and Tajikistan – within the context of sustainable economic development. The comparative analysis of macroeconomic and institutional indicators demonstrated a clear differentiation between countries with a high degree of agrarian modernisation and those where a predominantly raw commodity model of agriculture persists.

The analysis indicates that Kazakhstan and Uzbekistan demonstrate the highest rates of agricultural progress. In Kazakhstan, the effectiveness of agricultural policy is reflected in exports totalling USD 4,210 million and a high share of processed products – 33.5% – signalling a focus on value addition. This reflects a stable institutional framework for agricultural policy and active engagement by the private sector.

In Uzbekistan, private investment in the agro-industrial complex reached USD 950 million, while agri-food exports amounted to USD 1,660 million, indicating a gradual activation of the sector driven by cluster development and support for the processing segment. The Kyrgyz Republic and Tajikistan are characterised by limited volumes of agri-food exports (USD 388 million and USD 212 million, respectively), a low share of processed products in agricultural exports (18.5% and 13%), and a high dependence on foreign aid. These indicators point to structural vulnerability in the agricultural sector and highlight the need for institutional restructuring. Comparative analysis confirms that sustainable development in agriculture requires not only financial inflows but also systemic policy coordination, technological support, development of agricultural logistics, and a focus on high value-added products.

Comparisons with Chile, Poland, and Turkey illustrate that successful agricultural transformation depends on institutional support, digitalisation, and active participation of farmer cooperatives. In Turkey, the share of processed products in agricultural exports reaches 47%, with total exports exceeding USD 22 billion and annual private investment of USD 5.2-5.5 billion. Poland demonstrates processing levels of 68%-70% in agricultural exports exceeding USD 40 billion, with investments of USD 3.8 billion. These examples confirm that a focus on processing and inclusive support mechanisms is critical for overcoming raw-material dependence.

Chile provides a further comparative benchmark: its agricultural exports amount to approximately USD 24 billion, processed goods account for more than 60-65% of exports, and annual private investment reaches USD 3.3 billion. The Chilean model demonstrates the importance of export-oriented institutions, integrated processing and logistics chains, and systematic support for product diversification.

Limitations of this study are associated with the absence of complete official data for 2024, meaning that some indicators are based on analytical estimates and synthesis from multiple sources. Prospects for further research include an in-depth analysis of intra-national regional differentiation, evaluation of the long-term effectiveness of clusters, and modelling of risks associated with institutional instability in agricultural policy.

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