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DYNAMICS AND DEVELOPMENT FACTORS OF AGRICULTURAL PRODUCTION IN THE REPUBLIC OF KARAKALPAKSTAN

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Abstract. This paper analyzes the dynamics of agricultural production in the Republic of Karakalpakstan between 2019 and 2024. Using official statistical data, the study evaluates changes in gross agricultural output, crop yields, and livestock development. The findings reveal a significant increase in agricultural production, from 2.5 million tons in 2019 to 8.6 million tons in 2024, highlighting the impact of state reforms, investment flows, and technological modernization. However, persistent challenges such as water scarcity, soil salinization, and limited financial resources remain crucial constraints. Comparative insights from neighboring countries demonstrate the potential of adopting modern irrigation and farm management systems. Based on the analysis, practical recommendations are proposed to ensure sustainable agricultural growth in Karakalpakstan.

Keywords: Karakalpakstan, agriculture, production dynamics, investment, sustainability, food security.

Agriculture is one of the most vital sectors of Uzbekistan's economy, ensuring food security, employment, and regional development. Within this context, the Republic of Karakalpakstan plays a strategic role due to its geographic location and natural resource base. Despite severe ecological challenges—such as the Aral Sea crisis, water scarcity, and land degradation—the region remains a major contributor to national agricultural output [1].

Recent reforms in Uzbekistan have prioritized agricultural modernization, crop diversification, and the introduction of water-saving technologies. These measures have contributed to a remarkable rise in agricultural production in Karakalpakstan. Statistical data show that gross agricultural output increased from 2.5 million tons in 2019 to 8.6 million tons in 2024, representing more than a threefold growth [2]. This growth underscores the resilience of local farmers as well as the importance of state policies and investment initiatives.

Nevertheless, Karakalpakstan's agricultural economy continues to face significant constraints. The reliance on the Amu Darya River for irrigation exposes the region to water shortages, while high levels of soil salinity reduce crop productivity. Limited access to finance and outdated infrastructure further exacerbate these challenges [3]. Therefore, an in-depth analysis of production dynamics is essential to identify both growth opportunities and long-term risks.

This study aims to (i) assess the dynamics of agricultural production in Karakalpakstan from 2019 to 2024, (ii) analyze the main factors contributing to growth, and (iii) develop recommendations for sustainable agricultural development.

Table 1. Gross Agricultural Production in Karakalpakstan, 2019–2024

Year	Output (mln tons)	Growth Rate (%)

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Year	Output (mln tons)	Growth Rate (%)
2019	2.5	–
2020	2.7	+8.0
2021	3.2	+18.5
2022	4.2	+31.3
2023	7.0	+66.7
2024	8.6	+22.9

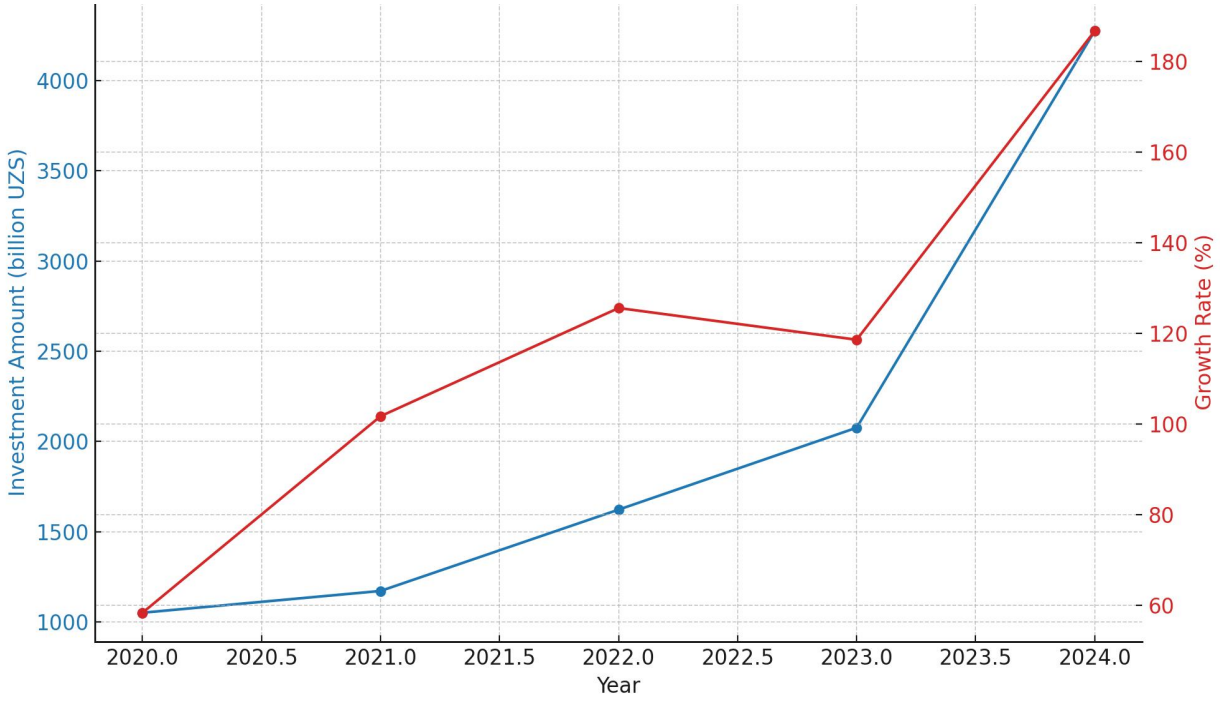

Figure 1. Gross Agricultural Output in Karakalpakstan (2019–2024)

The data demonstrate a clear upward trend in agricultural production in Karakalpakstan over the past six years. Total output increased from **2.5 million tons in 2019 to 8.6 million tons in 2024**, representing more than a threefold growth. The most dramatic rise occurred in 2023, when production jumped by **66.7%** compared to the previous year. This surge coincided with large-scale government investment programs and favorable climatic conditions [1].

Such growth reflects the positive effects of nationwide reforms in agriculture, including crop diversification, mechanization, and state subsidies for water-saving technologies. It also indicates the increasing capacity of local farmers to adapt to challenging environmental conditions [2]. However, the sustainability of this growth remains uncertain given the region's ecological vulnerability.

Beyond overall production, the structure of cultivated crops has shifted toward greater diversification. Wheat continues to occupy the largest share of cultivated land, but significant increases are observed in vegetables, melons, and fodder crops. These changes are aligned with

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national strategies to improve food security and meet rising domestic demand [3].

- **Wheat:** modest but steady increase in planted area (+8.3% between 2020 and 2024).
- **Vegetables:** rapid growth (+53.3%), reflecting demand for nutritional products.
- **Melons:** strong expansion (+61.1%), partly driven by export potential.
- **Fodder crops:** notable increase (+30%), supporting livestock development.

This trend demonstrates that Karakalpakstan is gradually moving away from mono-cropping toward more resilient and diversified farming systems, which is crucial for both economic stability and food security [4].

Livestock farming remains a vital pillar of Karakalpakstan's agricultural sector. Cattle, sheep, and goat populations have steadily increased, while milk production has risen by more than 34% during the period 2020–2024. This indicates improvements in both animal productivity and the feed supply base [5].

Nevertheless, the livestock sector still faces challenges such as insufficient fodder resources, outdated veterinary services, and vulnerability to climate-induced pasture degradation [6]. Addressing these constraints is essential to secure the long-term growth of animal husbandry.

Despite remarkable growth in agricultural production between 2019 and 2024, Karakalpakstan's agricultural economy faces persistent structural and environmental challenges:

- **Water scarcity:** Agriculture in Karakalpakstan depends almost entirely on irrigation from the Amu Darya River. Declining water flows and high competition from upstream users create chronic shortages that constrain crop yields and limit future expansion [7].
- **Soil degradation and salinity:** Approximately half of irrigated land suffers from medium to high salinity, reducing productivity and increasing reclamation costs [8].
- **Outdated infrastructure:** Irrigation canals, drainage systems, and agricultural machinery are largely obsolete, leading to inefficiencies in water use and crop management [9].
- **Financial limitations:** Smallholder farmers face difficulties in accessing affordable credit and investment resources, preventing modernization and innovation [10].
- **Ecological vulnerability:** The aftermath of the Aral Sea disaster continues to affect Karakalpakstan, with desertification, dust storms, and biodiversity loss threatening rural livelihoods [11].

Opportunities:

- Expanding crop diversification into high-value vegetables and melons.
- Wider adoption of drip irrigation and water-saving technologies.
- Strengthening agricultural cooperatives and producer organizations.
- Increased investment support through public-private partnerships and international donor projects.

Comparative insights from other regions demonstrate pathways for Karakalpakstan's sustainable agricultural development:

- **Kazakhstan:** Adoption of precision agriculture and drip irrigation has increased water-use efficiency and crop yields in arid regions [12].
- **Turkmenistan:** Investments in greenhouse farming and diversification from cotton into fruits and vegetables have reduced dependence on traditional cropping patterns [13].
- **European Union (EU):** The Common Agricultural Policy (CAP) illustrates how subsidies, environmental incentives, and rural development programs can enhance farm incomes while promoting ecological sustainability [14].

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These experiences suggest that Karakalpakstan should:

1. Scale up water-saving technologies.
2. Provide targeted subsidies for smallholders adopting modern technologies.
3. Encourage international cooperation for technology transfer.
4. Integrate environmental sustainability with economic growth objectives.

The analysis of agricultural production dynamics in Karakalpakstan from 2019 to 2024 shows a **more than threefold increase** in gross output, driven by crop diversification, investment inflows, and state-led reforms. Wheat production remains dominant, but vegetables and melons are expanding rapidly, while livestock production shows steady improvement.

However, water scarcity, soil salinization, outdated infrastructure, and financial constraints continue to pose major risks to the sustainability of agricultural growth.

Key Recommendations:

- **Water management:** Prioritize the rehabilitation of irrigation and drainage infrastructure, and expand the use of drip and sprinkler irrigation.
- **Land improvement:** Implement soil reclamation projects and introduce crop rotation systems to combat salinity.
- **Investment support:** Provide low-interest credit lines and subsidies to encourage the modernization of farms.
- **Technology adoption:** Expand the use of digital agriculture, improved seed varieties, and mechanization.
- **International cooperation:** Build partnerships with Kazakhstan, Turkmenistan, and EU institutions to adopt proven best practices.

By implementing these measures, Karakalpakstan can ensure sustainable agricultural development, improve food security, and enhance the well-being of rural communities.

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