

## ECONOMIC EFFICIENCY OF CLUSTER MODELS IN INDUSTRY

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**Abstract.** *This study investigates the economic efficiency of industrial cluster models in Uzbekistan, with a focus on their contribution to productivity, cost reduction, and sustainable development. In the face of growing environmental and economic challenges, cluster-based approaches offer integrated solutions by encouraging inter-firm collaboration, innovation, and shared infrastructure. Using a mixed-method analysis combining national statistics and expert insights, the research reveals that cluster enterprises outperform non-cluster firms across multiple performance indicators. The findings also highlight existing challenges in governance, financing, and environmental management. The study concludes by recommending targeted reforms to enhance the effectiveness and sustainability of cluster initiatives in Uzbekistan's industrial sector.*

**Keywords:** *industrial clusters, economic efficiency, Uzbekistan, productivity, sustainability, innovation, governance, green financing, industrial policy.*

### **Introduction**

Since the beginning of the 21st century, rapid globalization, urbanization, and industrialization have significantly influenced economic development models around the world. However, these advancements have also intensified environmental issues, including increased carbon emissions and ecological degradation, especially in industrial zones. In this context, industrial clusters have emerged as a strategic tool for enhancing economic efficiency while addressing sustainability challenges.

An industrial cluster is defined as a geographically concentrated network of interconnected businesses, suppliers, research institutions, and associated services operating within a specific sector. Cluster models promote innovation, reduce transaction costs, and improve the use of shared infrastructure. They also offer potential for reducing the environmental footprint of industries through integrated planning and resource efficiency.

Uzbekistan, in its pursuit of sustainable industrial transformation, has prioritized the development of cluster models in sectors such as textiles, metallurgy, agriculture, and pharmaceuticals. This paper aims to analyze the economic efficiency of industrial cluster models, focusing on their productivity, cost-effectiveness, and contribution to sustainable industrial development in Uzbekistan.

**Methods**

The study employs a mixed-method approach combining qualitative and quantitative research methods. Primary data was collected through expert interviews with policymakers, industrial managers, and economists involved in cluster development programs. Secondary data was obtained from official statistics, governmental development strategies (such as “Uzbekistan–2030”), and international reports on cluster performance.

Economic efficiency was assessed using key performance indicators (KPIs) such as labor productivity, unit cost of production, export growth, and energy consumption per output unit. Comparative analysis was conducted between cluster-based enterprises and non-cluster enterprises across textile and agro-industrial sectors. International benchmarks from countries like China, Turkey, and South Korea were used to contextualize the findings.

**Results and Discussion**

The analysis reveals that industrial clusters in Uzbekistan exhibit higher economic efficiency compared to standalone enterprises. For instance, textile clusters in Fergana Valley show 18–22% higher labor productivity due to centralized logistics, shared services, and integrated supply chains. Agro-industrial clusters in Samarkand and Tashkent have reported up to 25% reduction in operational costs through joint use of cold storage, marketing, and irrigation infrastructure.

Moreover, clusters have enhanced firms’ access to export markets by offering branding support and facilitating compliance with international standards (e.g., ISO, Global GAP). However, the study also identified certain challenges, including inadequate coordination among stakeholders, insufficient digital integration, and limited innovation financing. Environmental performance remains modest due to the lack of integrated sustainability measures in some clusters.

International experience suggests that successful cluster models often benefit from strong public-private partnerships, active innovation ecosystems, and continuous workforce development. Uzbekistan’s progress aligns with these patterns but requires further institutional and regulatory strengthening to maximize benefits.

**Table 1. Comparative Analysis of Cluster-based and Non-cluster Enterprises in Uzbekistan (2024)**

Indicator	Cluster-based Enterprises	Non-cluster Enterprises	Difference (%)
Average labor productivity (UZS/worker/year)	165,000,000	135,000,000	+22.2%
Unit cost of production (UZS/kg)	4,300	5,100	−15.7%
Export share in total output (%)	38.5	25.1	+13.4 p.p.
Energy consumption per unit (kWh/kg)	0.95	1.20	−20.8%
Annual revenue growth (%)	13.7	8.4	+5.3 p.p.

*Source: Author's calculations based on data from the Ministry of Investment, Industry and Trade of Uzbekistan, 2024.*

The data demonstrates that enterprises operating within industrial clusters outperform non-cluster enterprises across key efficiency metrics. Labor productivity is over 22% higher in clusters due to process integration and skill specialization. Similarly, unit production costs and energy consumption are significantly lower, indicating resource optimization. Furthermore, cluster enterprises have stronger export orientation and higher revenue growth, reflecting improved market access and competitiveness.

### **Conclusion**

Industrial cluster models present a strategic and effective approach to enhancing both the economic efficiency and sustainability of Uzbekistan's industrial development. The findings of this study demonstrate that cluster-based enterprises exhibit higher productivity, lower production costs, and stronger export performance compared to non-cluster firms. These advantages stem from shared infrastructure, streamlined value chains, and improved coordination among stakeholders.

However, realizing the full potential of industrial clusters requires comprehensive policy support and systemic improvements. Key areas that demand further attention include institutional coordination, access to innovation financing, and the integration of environmental sustainability practices into cluster strategies.

Based on the analysis, the study puts forward the following recommendations:

- Strengthen inter-firm cooperation and enhance the governance of cluster initiatives to ensure efficiency and accountability.

- Expand access to green financing and promote the use of digital platforms for cluster development, particularly in logistics and resource management.
- Integrate vocational education and R&D institutions into cluster ecosystems to support innovation, skills development, and technological diffusion.
- Improve environmental performance monitoring to align cluster activities with the United Nations Sustainable Development Goals (SDGs) and national climate strategies.

As Uzbekistan continues to implement structural industrial reforms, cluster-based development can act as a dual lever—driving economic modernization while fostering socially inclusive and ecologically responsible growth.

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