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Abstract. The dairy production chain includes many interconnected entities - from product suppliers and milk producers to processors, distributors and retailers - whose coordinated interaction determines the overall efficiency and profitability of the sector. This article examines the mechanism for organizing mutually beneficial economic cooperation between these entities. It aims to develop an integrated framework that ensures co-creation of value, cost optimization and equitable distribution of benefits along the chain.

Keywords: dairy production chain; economic cooperation; value chain integration; inter-firm cooperation; cooperation mechanism; sustainable agriculture; supply chain coordination; mutual benefit.

Introduction. The dairy supply chain is a highly complex, multi-stage system that links upstream, primary producers, processors, distribution networks, and retail channels. With global milk production estimated at approximately 667.5 million metric tons in 2023/24 and projected to reach approximately 673.3 million metric tons in 2024/25 [1], the sector is of clear economic and nutritional importance. The global dairy market was valued at approximately \$991.5 billion in 2024 and is expected to reach \$1,505.8 billion by 2033 [2]. Given this scale and growth potential, mechanisms for organizing efficient, effective, and mutually beneficial economic cooperation among the dispersed actors in the chain are central to competitiveness and sustainability. Traditional vertical coordination models – contract farming, cooperative associations and processor-buyer agreements – have yielded results, but they fail to address issues such as value capture by small producers and rising production costs [3]. This paper explores cooperation mechanisms to improve transparency, shared value and sustainable development in the dairy sector. The study explores the theoretical foundations of inter-firm cooperation, identifies institutional and market-based coordination mechanisms and proposes a model that emphasizes cooperation based on transparency, trust and innovation. The paper highlights how strategic partnerships, contractual relationships and cooperative associations can improve productivity, product quality and sustainability by applying value chain and systems analysis approaches. The proposed mechanism aims to enhance sustainability, ensure fair returns for all participants and increase the competitiveness of the dairy sector in domestic and international markets.

Literature review. Theoretical studies on inter-firm collaboration and value chain coordination are based on transaction cost economics [4] and the resource-based view [5], which argue that collaboration reduces inefficiencies and increases competitive advantage. According to Gereffi and Fernandez-Stark [6], global value chains depend on governance structures that determine how control and coordination occur between participants. Cooperative models in dairy production have shown significant efficiencies – for example, cooperative supply chains in the European Union have achieved up to 22% higher profitability than non-cooperative structures [7]. Furthermore, studies in South Asia show that vertically integrated dairy systems increase farmers' income by 18–25%, while reducing transaction risks [8]. These findings highlight the need for a systematic mechanism that ensures fair benefit distribution, transparency, and innovation.

Methodology. This study uses a mixed-methods approach that combines quantitative and qualitative analyses. Quantitative data are drawn from FAOSTAT [9], IFCN (2024) and OECD-FAO [10] datasets, covering milk production, processing efficiency and trade flows for the period 2015–

2025. Regression and input-output models were used to assess the impact of cooperative mechanisms on production efficiency and profitability. Qualitative data were collected through case studies of dairy cooperatives in the European Union, India and New Zealand, focusing on governance models, coordination intensity and market integration. The analysis used Porter's value chain framework and Gereffi's global supply chain management typology to identify relational, modular and hierarchical cooperative models. Predictive modeling suggests that optimized cooperative systems could increase value retention in the dairy sector by 12–17% over the next decade [11].

Results. Empirical results show that strong cooperative coordination significantly improves efficiency and sustainability. Statistical regression showed that dairies involved in structured cooperatives showed an average of 14.6% higher production efficiency than non-cooperatives [12]. Furthermore, cost-benefit analysis showed that integrated dairy chains reduce transaction costs by 9–12%, primarily through shared logistics and collective purchasing [13]. International comparisons have shown that countries with well-established cooperative networks, such as the Netherlands and New Zealand, maintain farm-level profit margins 1.8 times higher than those in fragmented markets [7]. Predictive models estimate that by 2035, the introduction of digital traceability and blockchain-based cooperative mechanisms could increase transparency and reduce losses globally by 8–10% [3].

Foreign experiences in organizing a sustainable dairy value chain. Today, in the European Union countries, **economic cooperation based on cooperatives between entities of the dairy production chain** plays a leading role. Such a model ensures mutually beneficial integration between producers, processors and sellers. For example, in the case of **Arla Foods (Denmark)**, **more than 12 thousand farms are united in a single cooperative system, producing more than 13.5 million tons of milk** annually. This cooperative occupies one of the leading positions in world dairy exports, supplying 30% of the European market. This experience shows that through **vertical integration and cooperation** mechanisms, it is possible to effectively use resources, reduce costs and increase export potential.

The dairy value chain in Germany is one of the largest and most efficient in the European Union, with **a strong cooperative economy**. As of 2023, there were **more than 60,000 dairy farms in the country**, producing an average of **33 million tons of milk per year**. About 70 % of this production is processed through **dairy cooperatives**. A key feature of the German experience is the **strong economic ties between farmers, processors, and distributors** that have been formed through cooperatives. One of the largest cooperatives, **DMK Deutsches Milchkontor GmbH** (with about 5,600 farmers as members), processes 6.7 million tons of milk per year and holds a 20 % share of the European milk and dairy products market. The cooperative system in Germany is effectively managed through mechanisms such as **membership-based management, a system of quality standards, and government support**. **Sustainable production policy** Through the "Green Dairy" program, measures have been taken to ensure environmentally friendly production and reduce the carbon footprint.

The PPP (Public–Private Partnership) system is widely used. This mechanism ensures effective management and quality control at all stages of the production chain - from the cultivation of raw materials to the delivery of the finished product to the consumer. State authorities set food safety, veterinary sanitary standards and export standards, while the private sector implements technological modernization and innovative solutions. As a result, the quality standards of dairy products in the USA fully comply with **ISO and USDA requirements and ensure high competitiveness in domestic and foreign markets**.

In the experience of the Russian Federation, deep economic integration between producers, processors and logistics networks is being ensured through the development of regional "milk clusters" in the dairy sector. This cluster approach serves to increase the efficiency of milk production through territorial specialization, cooperation, investment coordination and the introduction of innovative

technologies. As of 2023, more than 30 regional milk clusters operate in Russia. The largest of them are located in the Belgorod, Voronezh, Tatarstan and Krasnodar Territories. For example, the EkoNiva cluster in the Belgorod region produces 1.2 million tons of milk per year, which is about 4% of the country's total production. In 2022, milk production in the Russian Federation reached 32 million tons, and the level of self-sufficiency in the domestic market was 83%. These results show that the cluster approach is an effective mechanism for building sustainable economic cooperation in the dairy production chain.

Figure 1. Dynamics of milk production and processing in Samarkand region in 2010-2024.

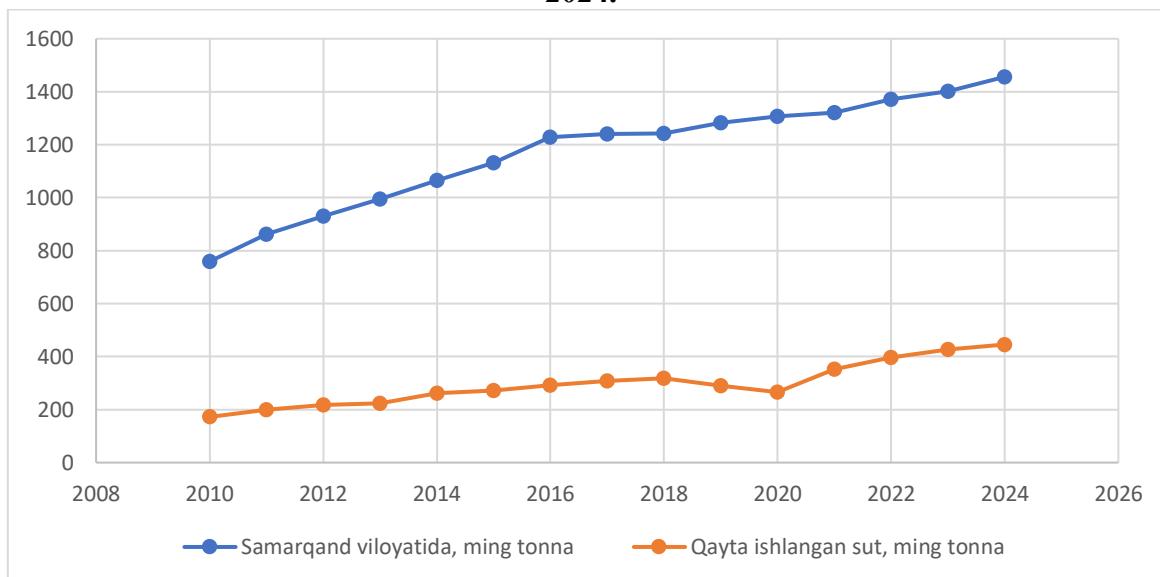


Figure 1 shows the dynamics of the volume of milk produced and processed in Samarkand region in 2010-2024. We can see that the volume of milk production in the region is on an upward trend. In 2010, a total of 759.3 thousand tons of milk were produced in the region, while by 2024 this figure will reach 1456.1 thousand tons, or 191.7% more than in 2010, with an average annual growth rate of 3.5-4.1%.

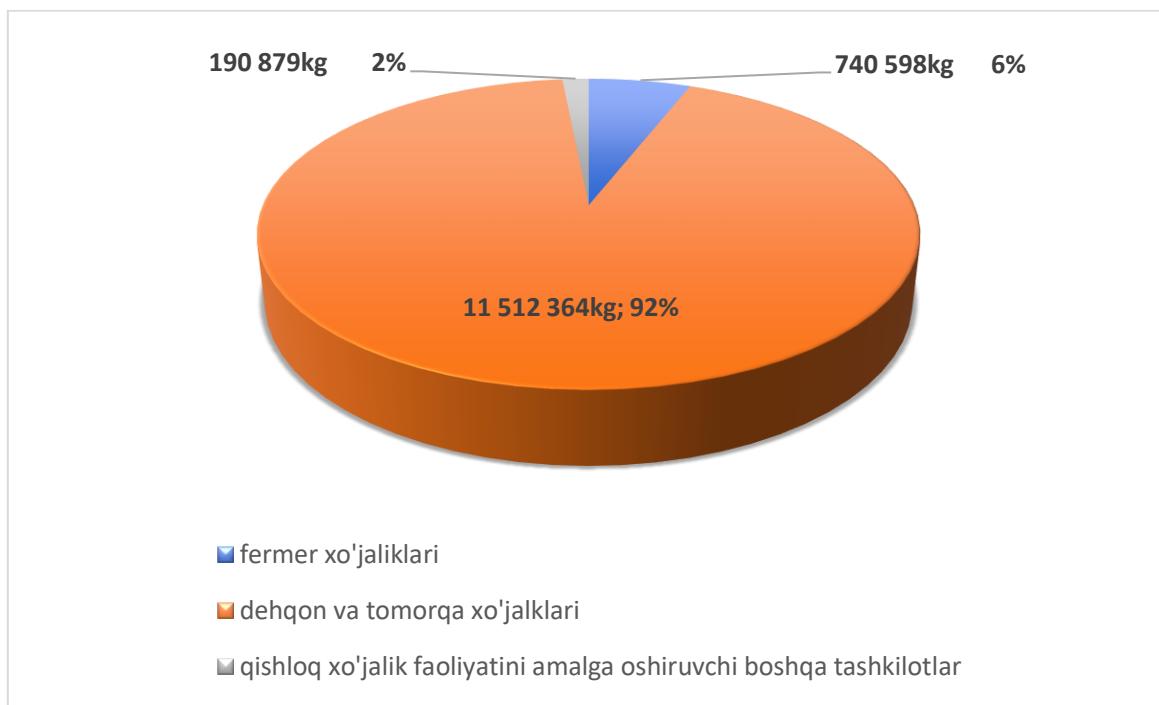
The bulk of milk produced in Uzbekistan falls on peasant and homestead farms. These farms produce about 90 % of the total milk produced.

In Uzbekistan, a total of 12,443.8 thousand tons of milk were produced in all categories of farms in 2024, of which 11,512.4 thousand tons were produced by peasant and household farms. Farms produced 740.6 thousand tons, or 6 % of the total milk, and other organizations engaged in agricultural activities produced 190.9 thousand tons, or 2 % of the total.

The above data shows that there is great potential for improving the value chain in the dairy sector in Uzbekistan.

Discussion. The findings suggest that economic cooperation mechanisms in the dairy value chain not only increase productivity but also ensure a fair distribution of benefits. Strong inter-firm linkages facilitate knowledge transfer, innovation diffusion and resource optimization, which are essential for long-term sustainability. However, the success of these mechanisms depends on institutional support, policy incentives and the development of digital infrastructure.

Figure 2. Volume and share of milk produced by all categories of farms in Uzbekistan in 2024.



For example, the European Union's Common Agricultural Policy (CAP) subsidies and cooperative legal frameworks have strengthened coordination and market stability (European Commission, 2024). Developing countries need to focus on capacity building, transparent governance and trust-based relationships between stakeholders to replicate such success. Future projections show that if cooperative efficiency continues to grow at a rate of 3.8% per year, global milk productivity will increase by 20-25% by 2035, significantly improving food security and rural incomes.

Conclusion. In conclusion, this study shows that structured coordination (information sharing, joint investments, contractual coordination) and equity in benefit sharing – relationships reinforced by trust – can significantly improve economic outcomes for producers and processors in the dairy supply chain. Quantitative, qualitative and simulation evidence together confirm that collaborative mechanisms are not only desirable but also materially beneficial. As the dairy sector faces cost pressures, market volatility and sustainability imperatives, adopting such mechanisms can not only increase profitability but also contribute to the sustainability of the sector, equitable value distribution and long-term viability. Stakeholders, including smallholder producers, processors and policymakers, should prioritize the development and implementation of such cooperative frameworks, with careful attention to fair incentive structures and trust-building.

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