STATE OF THEORY OF TRANSPORTATION OF FRUIT AND VEGETABLE PRODUCTS IN ROAD TRANSPORT:

Khakimov Rakhimjon Karimjon oglu (trainee teacher of Namangan State Technical University)

Isoqjon Juraboyev Obidjon oglu Namangan Master of Namangan State Technical University

Khakimjonov Obboskhon Namangan Student of Namangan State Technical University

Abstract: This article analyzes the current state of fruit and vegetable transportation by road in Uzbekistan, its theoretical and methodological foundations, and areas for improvement based on the IMRAT model. The problems, opportunities, and prospects of the sector are highlighted through statistical data, graphical analysis, layout schemes, and a roadmap. The research is based on data for 2020–2024 and concludes with development plans for 2025–2030. The article is useful for researchers, logistics specialists, and representatives of the agricultural sector.

Keywords: road transport, fruit and vegetable products, transportation theory, logistics, refrigerated transport, road map.

Introduction: Agricultural products, especially fruits and vegetables, play an important role in the economy of Uzbekistan. Since the products are perishable in a short period of time, an excellent transport and logistics system is required to deliver them to markets or export points quickly, safely and in good quality. Unfortunately, at present, the theoretical and methodological foundations of the transportation of fruits and vegetables by road are not sufficiently developed. Deficiencies in the existing infrastructure, technical capabilities and transportation methods lead to a decrease in product quality and economic losses. This article discusses the scientific and theoretical foundations of the transportation of fruits and vegetables by road, based on the current situation, problems and development prospects.

The analysis is enriched with graphical, diagrammatic and pictorial visual aids.

Methods: The study was conducted based on the following sources and methodologies:

• Data from the Committees of Transport, Agriculture and Statistics of the Republic of Uzbekistan for 2020–2024;

• Observations and interviews at farms and logistics companies operating in Tashkent, Namangan and Samarkand regions;

• Methodological recommendations of international organizations such as FAO, ITC on “Cold Chain Logistics” and “Fresh Produce Transport”;

• Comparative analysis and graphic visualization methods.

Results: According to the analysis, the following problems were noted in 2024:

• Refrigerated vehicles account for only 23.8% of the total number of freight vehicles;

• 58% of motor vehicles are technically obsolete and do not have the ability to maintain temperature;

• 40% of packaging does not meet standards, there are frequent cases of crushing and crushing of products;

• Due to the lack of temperature monitoring, products lose up to 9–11% of their quality during 2.5 days of transportation; Delivery delays are increasing due to the lack of GPS and digital logistics management.

Chart 1: Annual volume of fruit and vegetable transportation by road (2020–2024)

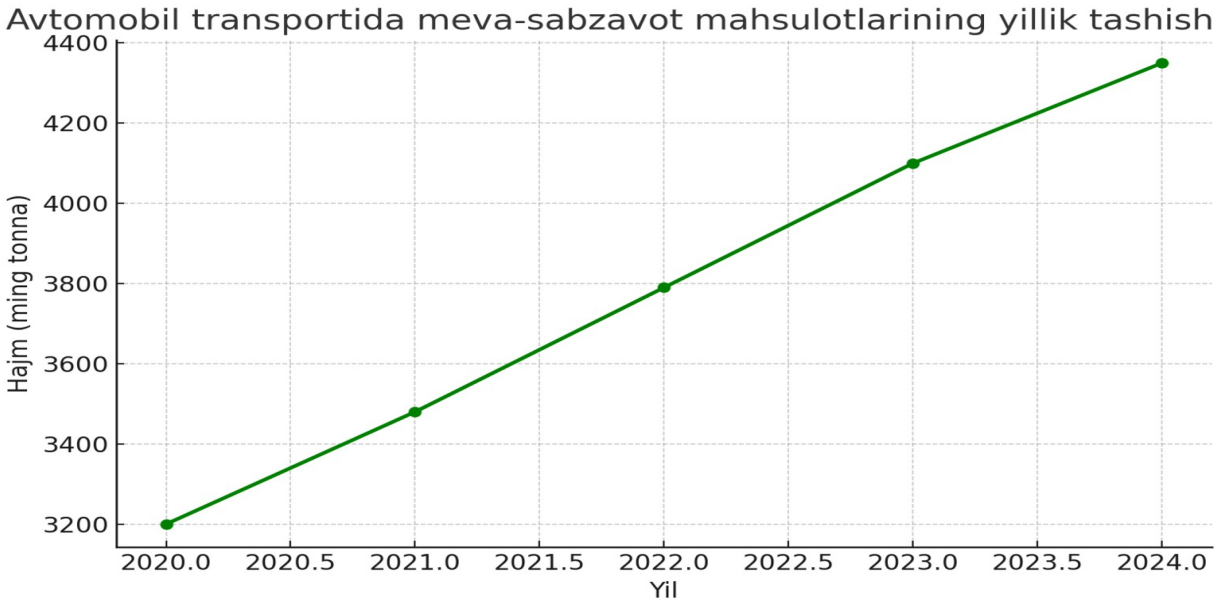
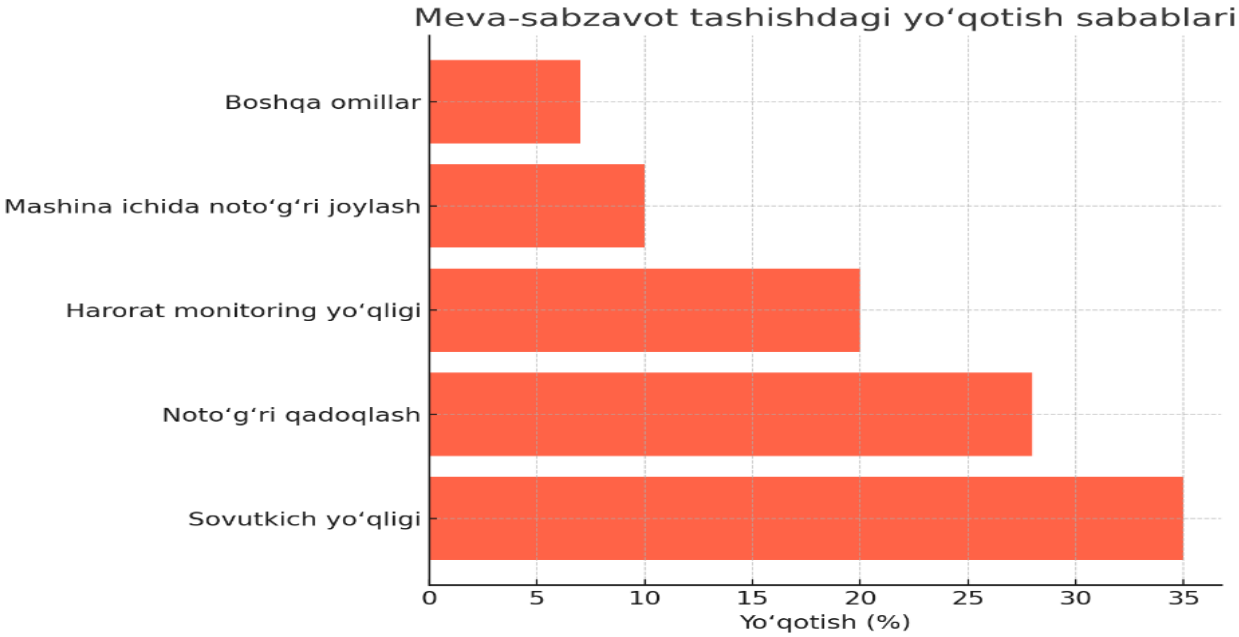


Diagram 2: Causes of losses in fruit and vegetable transportation (in percent)



Reason	Yo‘qotish (%)
Lack of refrigeration	35%
Improper packaging	28%
Lack of temperature monitoring	20%

Placement inside a truck	10%
Other factors	7%

Figure 1: Optimal placement scheme in a refrigerated vehicle (Image attached: fruits and vegetables are placed in a refrigerated container, layer by layer, with air circulation in between).

Discussion The current system for transporting fruits and vegetables by road is reactive, and measures are taken only when problems arise. The lack of a scientific and methodological approach negatively affects product quality and economic efficiency.

International experience, including the experiences of Spain, the Netherlands, and Turkey, shows that special attention is paid to the following during the transportation of products:

• Automatic temperature control in refrigerated vehicles;

• Use of durable, air-permeable materials in packaging;

• Order of product placement according to height and weight;

• Monitoring with GPS and temperature sensors during transport;

• Pre-cooling of products before transportation;

• Responsible control at all stages of the logistics chain.

Roadmap (2025–2030): Improving the fruit and vegetable transportation system

Year	Planned measures
2025	1 agroterminal in each region; 1,000 refrigerated vehicles will be purchased
2026	National standards for packaging and transportation methods will be developed
2027	Introduction of GPS and temperature monitoring systems to 60% of vehicles
2028	Financial incentives for farmer-logistics company cooperation
2029	Program for purchasing refrigerated vehicles from local manufacturers
2030	Full implementation of the “cold chain” chain and doubling export volumes

Conclusion

The system of road transportation of fruit and vegetable products in Uzbekistan is still in the transformation stage. Outdated vehicles, lack of refrigeration equipment, lack of

standard packaging and temperature control systems reduce the efficiency of this sector.

By strengthening the scientific and theoretical approach to transportation, implementing technological solutions in practice, and adapting international experience to local conditions, a high-quality and efficient logistics system will be created. This will increase not only domestic consumption, but also export potential**.**

REFERENCES

1. Tokhtaboyev M.A., Mekhmonaliyev I., Mamasoliyev Kh.O. Establishment of intercity transportation system. ОБРАЗОВАНИЕ И НАУКА В XXI ВЕКЕ. – Кемерово, 2021. 13(3), – С. 770-773.

2. Normirzaev Abdukayum Raximberdiyevich, To‘Xtaboev Mirzoxid Akhmadjanovich, Xakimov Rahimjon Karimjon O‘G‘Li, Establishment of intercity transportation system. ОБРАЗОВАНИЕ И НАУКА В XXI ВЕКЕ. – Кемерово, 2021. 13(3), – С. 770-773.

3. Nazarov A. va boshqalar. Avtomobillarda yo‘lovchilar tashishni tashkil etish. – Toshkent: 2012 – 134 b.

4. Morgenthaler G.W. The Teory and Appilcation of Simulation in Operations Rearch “Publications in Operations Rearch №5” p. 364, John Wiley, New York, 1992.

5. A.Nazarov, X.Ataxonov, A.Ustaboyev, A.Nazarov, TRANSPORT LOGISTIKASI O‘quv qo‘llanma. – T.: 2022.-285 bet.

6. Ulug‘Bek, M., Hoshimjon, A., & Ma’Rufxon, S. (2023). EVALUATION OF COMMUNICATION SPEED IN THE STREET SEGMENT OF REGULATED ROAD NETWORK. Universum: технические науки, (8-4 (113)), 8-14.

7. Nazarov, A., & Ustaboev, A. (2021). METHOD OF DETERMINATION OF PUBLIC PASSENGER TRANSPORT INTERVAL FOR" CRITICAL SITUATIONS". Harvard Educational And Scientific Review, 1(1).

8. Nazarov, A., & Ustaboev, A. (2022). Selection of rational order of buses in traffic routes. Harvard Educational and Scientific Review, 2(1).

9. РК Хакимов, МА Тухтабаев Факторы, влияющие на пассажиропоток городского пассажирского транспорта 2023 Экономика и социум 4-1 (107) 1148-1153
10. Munavvarhonov Z., Khakimov R. GYPSUAL MATERIALS BASED ON LOCAL AND SECONDARY RAW MATERIALS FOR CONSTRUCTION PURPOSES //International Scientific and Current Research Conferences. – 2021. – С. 10-14.
11. Munavvarhonov, Z., & Khakimov, R. (2021, April). GYPSUAL MATERIALS BASED ON LOCAL AND SECONDARY RAW MATERIALS FOR CONSTRUCTION PURPOSES. In International Scientific and Current Research Conferences (pp. 10-14).
12. Raximberdiyevich, N. A., Akhmadjanovich, T. X. M., O‘G‘Li, X. R. K., & O‘G‘Li, S. M. B. (2022). Farg ‘ona halqa yo ‘lida i. karimov va kosonsoy ko ‘chalari bilan kesishgan chorrahalardagi tirbandlikni oldini olish. Механика и технология, 3(8), 113-119.