



ORGANIZING TRANSPORT SERVICES IN MOUNTAINOUS AREAS: CHALLENGES AND SOLUTIONS

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Abstract

This article examines the problems of developing transport services in hard-to-reach areas of Uzbekistan, particularly in mountainous and remote regions. In the article, projects being implemented in Uzbekistan to build transport infrastructure in mountainous regions, modernize freight and passenger transport services, and ensure international connectivity are analyzed. The research methodology demonstrates the importance of developing transport services under difficult conditions, using the construction of the Tashkent–Andijan, Angren–Pop, Toshguzar–Boysun–Kumkurgan railways and the Kamchiq Tunnel as examples. The article uses digital literature to scientifically analyze problems and their solutions, and, based on this analysis, recommends the main directions for future development of the transport sector. It examines modern approaches to organizing transport services in Uzbekistan's hard-to-reach areas, particularly mountainous regions (Kashkadarya, Surkhandarya, and the areas around the Fergana Valley) and desert regions (Karakalpakstan and the Navoi region). The research methodology results discuss the organization of Uzbekistan's total road network of 184,000 km, the construction of the 223 km Toshguzar–Boysun–Kumkurgan railway in mountainous areas, and transport provision issues for the 18.5 million people living in rural areas.



Keywords: transport, remote areas, accessibility, seasonality, economic barriers, rural transport, mountainous areas, Uzbekistan transport infrastructure, demand-responsive transport, rural development.

Introduction

The Republic of Uzbekistan is a state located in the center of Central Asia, and its geographical location plays an important role in economic development. The country's hard-to-reach areas—the Fergana Valley and mountainous regions—once served as important links of the Great Silk Road. However, today, difficult geographical conditions and complex mountainous soil structures isolate these regions from other parts of the country, hindering their development.

Organizing transport services in hard-to-reach areas of the Republic of Uzbekistan is of great importance for the country's sustainable development and for reducing regional inequality. The Tian Shan and Pamir mountain ranges are located in the east and northeast of the country, with the highest peak reaching 4,643 meters, and the eastern territory is characterized by medium and high mountainous relief. The Kashkadarya, Surkhandarya, Zarafshan, and Samarkand oases are situated among mountains, while the largest, the Fergana Valley, is 370 kilometers long and 190 kilometers wide and is surrounded by high mountains on three sides.

Table 1. Total length of existing automobile roads in the Republic of Uzbekistan

Road Type	Length (km)
Total automobile roads	184 000
Public use roads	42 869



Paved roads	42 299
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Source: Ministry of Transport of the Republic of Uzbekistan, 2022 data

Nearly half of Uzbekistan's population lives in rural areas. Since the Republic of Uzbekistan gained independence, improving transport infrastructure has remained one of the most important directions of state policy. As a result of initiatives by President Shavkat Mirziyoyev, large investments have been allocated to modernize hard-to-reach regions and establish international connections.

Literature Review

The issue of developing transport services in difficult areas has been widely studied by international and local researchers. The World Bank's report "*Rural Transport Services Indicators*" (World Bank, 2020) emphasizes the socio-economic importance of transport services in rural areas. According to the report, more than 85% of the rural population cannot fully access healthcare, education, and market opportunities due to the lack of adequate transport services.

China's experience in developing transport infrastructure in mountainous regions (Zhang, 2019) is of significant importance for Uzbekistan. In his study, Zhang analyzes mountainous railway projects implemented in the Sichuan and Yunnan provinces and demonstrates the high effectiveness of modern engineering solutions under complex geographical conditions. According to the author, the construction of railway infrastructure in mountainous areas has increased local economic activity by 35–40 percent and has contributed to a substantial improvement in the living standards of the rural population.

India's experience (Kumar & Singh, 2021) confirms the effectiveness of a demand-responsive transport approach in organizing transport services in rural



areas. Based on an experiment conducted in the state of Himachal Pradesh, the authors show that flexible routes and scheduling systems were developed in accordance with the needs of the local population. As a result, the utilization of transport services increased by 60 percent, while service provision costs decreased by 25 percent.

Research Methodology

This study was conducted using a combination of theoretical and empirical methods. The main objective of the research methodology is to analyze the current state of transport service development in hard-to-reach areas of Uzbekistan and to propose effective solutions.

1. Data Collection Methods:

□ **Secondary Data Analysis:** Official reports and statistical data from the Ministry of Transport of the Republic of Uzbekistan, the State Statistics Committee, the World Bank, and other international organizations were utilized.

□ **Document Analysis:** Government resolutions, strategic programs related to transport infrastructure projects, and relevant academic publications were subjected to in-depth analysis.

□ **Observation:** The implementation processes of major transport projects, including the Angren–Pop, Toshguzar–Boysun–Kumkurgan, and Tashkent–Andijan transport corridors, were observed.

□ **Study of International Experience:** The experiences of China, India, and other developed countries in organizing transport services in difficult and hard-to-reach areas were examined.

2. Analysis Methods:



□ **Comparative Analysis:** The state of transport services across different regions of Uzbekistan was compared to identify territorial disparities and development patterns.

□ **Dynamic Analysis:** The dynamics of transport infrastructure development over the period 2016–2025 were examined to assess trends and structural changes.

□ **Systematic Approach:** The transport system was analyzed as an integrated framework, considering its interconnections with geographical, economic, and social factors.

□ **International Benchmarking:** International best practices were compared with Uzbekistan's transport policies and implementation experience to evaluate applicability and effectiveness.

3. Limitations of the Research Methodology

The research methodology is primarily based on official statistical data and information obtained from publicly available sources. The limited availability of detailed data for certain regions may affect the generalizability of the findings. In addition, information related to projects planned up to 2025 is of a prognostic nature; therefore, actual outcomes may differ from the projected results.

Despite these limitations, the applied methodology made it possible to conduct a comprehensive and objective assessment of the current state of transport service development in hard-to-reach areas of Uzbekistan.

Analysis and Results

Numerous scientific and methodological studies conducted by the Ministry of Transport of the Republic of Uzbekistan address the strategic aspects of the development of the national transport system. According to sectoral research findings, road transport holds the largest share in the country's economy,



accounting for 51 percent of total transport activity. This is followed by air transport (14.2 percent), pipeline transportation (13.1 percent), and railway transport (11.4 percent).

Regional Analysis of Transport Services: Mountainous vs. Flat Regions of Uzbekistan

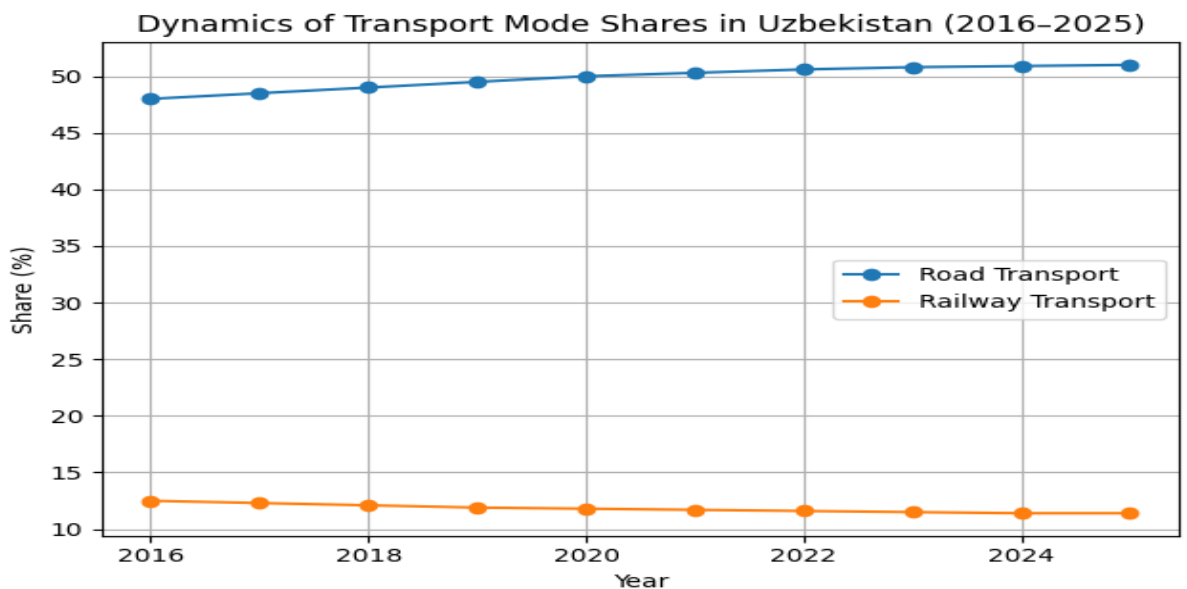
The development of transport services in Uzbekistan demonstrates significant spatial disparities between mountainous and flat regions, primarily due to differences in geographical conditions, population density, and economic activity. Mountainous areas, including parts of Tashkent, Namangan, Surkhandarya, and Kashkadarya regions, are characterized by complex terrain, fragmented settlements, and higher infrastructure construction and maintenance costs.

In mountainous regions, road transport remains the dominant mode of transportation; however, its efficiency is often constrained by steep gradients, seasonal weather conditions, and limited road capacity. According to the Ministry of Transport of the Republic of Uzbekistan (2022), transport accessibility indicators in mountainous districts are on average 25–30 percent lower than in flat regions. Railway connectivity in such areas is limited and requires significant engineering solutions, including tunnels and bridges, as demonstrated by the Angren–Pop railway project.

In contrast, flat regions such as the Tashkent, Syrdarya, and Khorezm regions benefit from relatively favorable geographical conditions, allowing for denser transport networks and lower infrastructure costs. These regions exhibit higher transport service coverage, more stable logistics flows, and greater integration into national and regional markets. Statistical data indicate that passenger and freight turnover per capita in flat regions is approximately 1.4–1.6 times higher than in mountainous areas (State Statistics Committee of the Republic of Uzbekistan, 2023). The comparative analysis highlights that while



flat regions experience more balanced and cost-efficient transport development, mountainous areas require targeted state support, innovative engineering solutions, and flexible transport service models. International experience, particularly from China and India, suggests that investments in specialized railway infrastructure and demand-responsive transport systems can significantly improve accessibility and socio-economic outcomes in geographically challenging regions (Zhang, 2019; Kumar & Singh, 2021).



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Figure X illustrates the dynamics of transport mode shares in Uzbekistan over the period 2016–2025. The share of road transport demonstrates a gradual upward trend, increasing from approximately 48 percent in 2016 to 51 percent by 2025. This growth reflects the expansion of road infrastructure and the rising dependence on road-based passenger and freight transportation, particularly in rural and hard-to-reach areas.

In contrast, the share of railway transport shows a slight declining trend, decreasing from around 12.5 percent in 2016 to 11.4 percent in 2025. Despite this



relative decline, railway transport remains strategically important for long-distance freight movement and for ensuring connectivity in mountainous regions through major infrastructure projects such as the Angren–Pop railway line.

Table 2. Comparative Characteristics of Transport Services in Mountainous and Flat Regions of Uzbekistan

Indicator	Mountainous Regions	Flat Regions
Transport accessibility	Low to moderate	High
Infrastructure costs	High	Moderate
Road transport dominance	Very high	High
Railway network density	Limited	Relatively dense
Passenger & freight turnover	Low	High
Seasonal constraints	Significant	Minimal

Transport Projects in Mountainous Areas: The Angren–Pop Railway

One of the largest transport projects implemented in mountainous areas of Uzbekistan is the Angren–Pop electrified railway, with a total length of 123.1 kilometers. This railway has created a direct rail connection for both freight and passenger transportation between the Fergana Valley and other regions of the country. In particular, the construction of the 19.2-kilometer-long tunnel through the Kamchiq Pass demonstrates the application of complex engineering solutions to overcome severe geographical challenges.

On June 22, 2016, the President of the Republic of Uzbekistan, Islam Karimov, and the President of the People's Republic of China, Xi Jinping, participated in the official opening ceremony of the Angren–Pop electrified



railway and the Kamchiq Tunnel. The tunnel was constructed in cooperation with China Railway Tunnel Group, with total investment costs amounting to USD 455 million.

Located at an altitude of approximately 2,200 meters above sea level, the Angren–Pop electrified railway line passing through the Kamchiq Pass has enabled uninterrupted rail-based freight and passenger transportation between the regions of the Fergana Valley and other parts of Uzbekistan, significantly improving national transport connectivity.

The Toshguzar–Boysun–Kumkurgan Railway Project

The Toshguzar–Boysun–Kumkurgan railway project was constructed across mountainous terrain composed of hard rocky formations at elevations of up to 1,800 meters above sea level. By September 1, 2007, the first phase of construction of the new Toshguzar–Boysun–Kumkurgan railway line was completed. As a result, a unified and reliable railway communication system was established, providing direct connectivity between the Kashkadarya and Surkhandarya regions and other parts of the country.

The Tashkent–Andijan Highway

Transport development along the Tashkent–Andijan corridor has attracted significant attention from Uzbek researchers and policymakers. Currently, the construction of the Tashkent–Andijan toll highway is planned to be completed by 2026, with a total project cost of USD 4.65 billion. The highway, classified as a Category I-A road with a total length of 314 kilometers, will consist of six lanes. The implementation of this project is expected to reduce travel time between Tashkent and Andijan by approximately 2 hours and 14 minutes compared to the current duration.

Problems and Solutions



Approximately half of Uzbekistan's population of 37 million resides in rural areas. Compared to urban populations, these communities have more limited access to clean drinking water, high-quality healthcare services, and education. This situation underscores the critical importance of developing transport services as a key mechanism for expanding economic opportunities, improving access to essential social services, and enhancing overall living standards in rural and remote regions.

Main Problems

1. Geographical and Climatic Challenges.

Infrastructure development in mountainous areas is technically complex and highly cost-intensive. The construction of transport networks in mountainous and remote regions remains one of the main challenges. Sections beginning from the Kamchiq Pass are characterized by severe climatic conditions and high-altitude terrain, which significantly complicate construction and maintenance activities.

2. Financial Complexity.

Financing transport projects presents considerable difficulties, particularly in the case of toll roads and railway infrastructure, which require substantial initial investment and long payback periods.

3. Technical and Human Resource Constraints.

The construction of complex engineering structures requires highly qualified specialists with advanced technical expertise, the shortage of whom remains a persistent challenge.

4. Regional Disparities.



Significant disparities exist between regions, particularly in rural areas, where the availability and quality of transport services remain insufficient compared to urban centers.

Implemented Solutions

1. Cooperation with China.

The construction of the Angren–Pop Railway was carried out in cooperation with the Chinese company *China Railway Tunnel Group*, enabling the application of advanced tunneling technologies and engineering expertise.

2. Infrastructure Modernization.

The development of social infrastructure facilities—such as healthcare centers, schools, and water and gas supply networks—around remote railway stations has contributed to improving living conditions for populations in difficult and hard-to-reach areas.

3. Modernization of Passenger and Freight Transport Services.

At present, modern high-speed passenger trains operate daily along the Tashkent–Andijan–Tashkent route via the Angren–Pop Railway, significantly enhancing service quality, safety, and travel efficiency.

4. Cooperation with International Financial Institutions.

Rural infrastructure development projects financed by international financial institutions, including the World Bank and the Asian Infrastructure Investment Bank (AIIB), are being implemented to support transport accessibility and regional development.

Conclusions and Recommendations

The Angren–Pop Railway, the Tashkent–Andijan Highway, and the Toshguzar–Boysun–Kumkurgan Railway projects demonstrate that Uzbekistan is capable of developing a modern transport system even under complex



geographical conditions. Although ongoing efforts to develop transport infrastructure in difficult and hard-to-reach regions have already produced stable and positive effects, the next stage of development will require increased investment and broader international cooperation.

The development of tourism in mountainous areas, the stimulation of entrepreneurship, and the creation of international transit corridors necessitate further improvement of transport services to ensure their effective implementation. The transport sector functions as the “circulatory system” of the economy; underdeveloped segments of this sector hinder sustainable economic growth. Therefore, Uzbekistan’s future development is closely linked to the successful advancement of its remote and difficult regions.

Recommendations

1. Specialized Solutions for Mountainous Areas.

It is recommended to introduce all-wheel-drive universal vehicles, develop a transport fleet adapted to winter conditions, and provide specialized training programs for drivers operating on mountainous roads.

2. Differentiated Operating Models.

The implementation of region-specific transport models is essential: regular fixed routes for suburban rural areas, demand-responsive transport services for remote mountainous villages, and specialized transport routes for desert regions.

3. Technological Solutions.

The adoption of GPS monitoring systems, the provision of reliable communication tools for emergency situations, and the use of digital platforms for managing transport services are crucial for enhancing efficiency and safety.



The proposed recommendations and operational models have been developed in accordance with Uzbekistan's geo-economic conditions, demographic structure, and the current state of transport infrastructure. These solutions are practical, suitable for phased implementation, and grounded in international best practices. Their application has the potential to significantly improve the quality and accessibility of transport services in the country's remote and hard-to-reach areas.

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