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Analysis of Transport Economic and Infrastructure Competence of Surkhandarya Region in the Conditions of International Integration of Uzbekistan

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Abstract: The article focuses on the place and role of the Surkhandarya region as the southern gate in the context of the integration of the Republic of Uzbekistan into international transport systems. In this, the transport infrastructure potential of its interior regions was analyzed and evaluated at the scale of rural districts. Obstacles to increasing the transport transit potential of the region were identified and conclusions were drawn. In this regard, various mathematical statistical methods were used, as well as map schemes developed using the Arc GIS program.
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Key words: transport geography, transport infrastructure, trans-Afghan corridor, density of transport routes, freight transport, passenger transport, transport nodes, international integration, Uzbekistan, Surkhandarya region.

1. Introduction

Surkhandarya region is one of the administrative-territorial units of the Republic of Uzbekistan. It is located in the southernmost part of the republic and borders three foreign countries (Afghanistan, Tajikistan, Turkmenistan) at the same time. This cross-border location of the province, in turn, creates great opportunities for strengthening the international transport-communication and geo-economic potential of Uzbekistan.

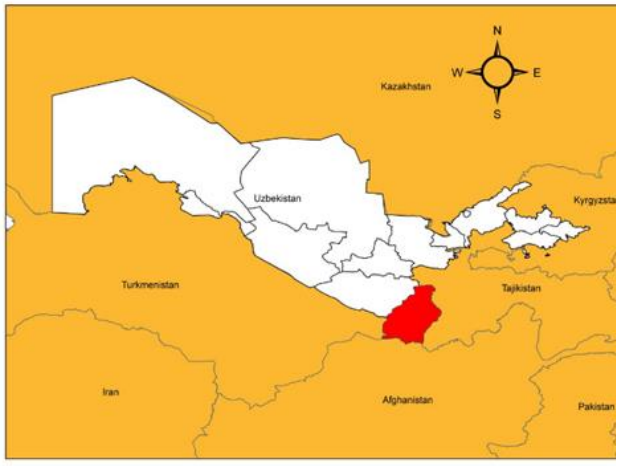

Figure 1. Location of Surkhandarya region.

2. Literature review

The issues of development of transport and its regional systems and scientific research of transport economic and infrastructure potential of regions were carried out by scientists of various fields. Among them, from foreign scientists the works of Jean-Paul Rodrigue (2006, 2020) [1], Joe Grengs (2010) [2], from CIS scientists: И.В. Никольский (1978) [3], В.Н.Бугроменко (1987) [4], А.С.Шпак (2000) [5], М.В. Иванов (2016) [6] are worth mentioning. Among them, the researches of Jean-Paul Rodrigue focus on the mathematical statistical methods of transport research, while the researches on the mathematical determination of the transport convenience of the area can also be seen in the works of В.Н. Бугроменко [4].

Several studies have been conducted on the formation and development of transport in Uzbekistan С.М. Ходжаев (1961) [7] examined this topic, while A. Zoxidov (2018) [8] focused on the effective management of the Central Asian transport system. А. Ўроқов (2009) [9] explored the issues of regionalization in road transport, and А. Қўзиев (2010) [10] investigated the optimal development of surface transport systems. Additionally, А.А. Исаев (2009) [11] studied the geographical aspects of regional transport system development in the Fergana region.

However, it is important to note that local studies have paid limited attention to analyzing and evaluating the transport economic and infrastructural potential of the regions. Consequently, there is a significant gap in exploring the transport, economic, and infrastructural potential of the Surkhandarya region, which is expected to serve as the southern gateway of our country.

3. The main part

In the current era of independent development in Uzbekistan, several existing and planned transport corridors play a crucial role in facilitating foreign trade and economic relations. However, the practical utilization of these corridors varies. Among them, the South-Transafghan transport corridor stands out as one of the most promising directions. In the future, this route is expected to gain strategic significance as it connects our country with the seaports of the Indian Ocean.

During the September 2022 Samarkand Summit of the Shanghai Cooperation Organization, the President of Uzbekistan Shavkat Mirziyoyev hailed the signing of the tripartite agreement on the construction of the China-Kyrgyzstan-Uzbekistan railway as a historic event. Furthermore, he called for support in constructing another strategically important project, the "Termiz-Mozori Sharif-Kabul-Peshowar" railway [13] (Fig. 1).

This 760-kilometer railway will serve as a vital link connecting major markets in South and Southeast Asia with China, CIS countries, and Europe. Additionally, the railway will enable the economic exploration of mineral deposits within Afghanistan [15]

Figure 2. "Termiz-Mozori Sharif-Kabul-Peshawar" Trans-Afghan (Kabul) railway corridor map-scheme. Source: Uzbekistan railways (https://youtu.be/Mg2hEQoBOy4?feature=shared).

The estimated cost for constructing the Trans-Afghan railway corridor is 4.6 billion US dollars, with a planned implementation period of 5 years [15].

The Termiz-Mazari Sharif section of this project was completed in 2010. Upon its full implementation, the transportation volume is expected to increase from an initial 3 million tons of cargo in the first year to 15 million tons by 2030. Consequently, transit times and costs will be reduced by 30-40%. According to UN experts, this transport cooperation will result in a doubling of the regional GDP.

The complete realization of this project will enhance the transport and transit potential of Central Asian countries, with Uzbekistan possessing significant capabilities in this regard. In this context, the Surkhandarya region will serve as a crucial regional transport and logistics hub, directly linking our country to the Trans-Afghan corridor from the south. This necessitates the augmentation of the transport, transit, and logistics potential of the region.

Based on these considerations, the primary objective of this research is to analyze the transport, economic, and infrastructure potential of the Surkhandarya region within the framework of Uzbekistan's international integration efforts.

To achieve this objective, the research will encompass the analysis and investigation of the following tasks:

- analysis of the structure of the regional transport industry and assessment of its economic potential.
- development and evaluation of transport centers and nodes within the region.
- analysis of the existing transport infrastructure.
- identification of challenges and prospects for the development of regional transport infrastructure.

Starting with the analysis of the regional transport network composition and the economic potential of transport, it is important to note that the Surkhandarya region spans an area of 20.1 thousand km2 and is administratively divided into 14 rural districts. As of 2023, the region is expected to have a population of 2.8 million people. The city of Termiz, with a population of 190 thousand people, serves as the administrative, economic, and cultural center of the region.

The Surkhandarya region, despite its abundant natural resources and labor potential, ranks lower in the republic in terms of key macroeconomic development indicators. As a result, the region contributes 4.1% to Uzbekistan's gross domestic product (2021), 1.6% to its industrial output, and 9.1% to agricultural production.

Currently, the region has developed automobile, railway, air, pipeline, and water transport systems. Road transport is the primary mode of transportation within the region, while railway transport plays a crucial role in its external economic relations.

Conversely, pipeline and water transport are underdeveloped, and air transport development is centered around Termiz International Airport. The development of water (river) transport is directly linked to the Amudarya River, although its significance and level of development have declined compared to previous times. The city of Termiz houses a river port.

The region has a total length of 2,843 km of public highways and 413 km of railways. In 2021, the total volume of transported goods in the region reached 73,779.6 thousand tons, representing a 102.1% increase compared to the previous year. During the same period, the number of passengers transported was 246.9 million, reflecting a 109.7% increase.

The rural districts, which are the internal administrative-territorial units of the region, possess varying potentials in terms of cargo and passenger transportation (Table 1).

The analysis of the dynamics of rural districts in the Surkhandarya region based on the volume of transported goods between 2010 and 2021 reveals that the majority of rural districts fell into the low potential group in both periods (transported goods volume less than 1.5 million tons). In 2010, 69.3% or 9 rural districts belonged to this group, while in 2021, this number decreased to 50.0% or 7 districts, indicating a positive trend.

On the other hand, only one district, Denau, located in the remote northern part of the region, belongs to the high transport economic potential group (more than 3.0 million tons). Notably, Denau district has maintained its leading position in 2021. All other rural districts fall into the middle potential group.

Table 1

Grouping of rural districts by transport economic potential (by volume of goods transported by car)

Rural districts groups	2010 y			Rural districts groups	2021 y		
	Rural districts				Rural districts		
	The number	%	Name		The number	%	Name
I- High (more than 3,0 mln tonns)	1	7,7	Denau	**I- High** (more than 8,1 mln tonns)	1	7,1	Denau
II- Medium (more than 1,5 -3,0 mln tonns)	3	23,0	Shorchi, Sariosiya, Jarkurgan	**II- Medium** (4,1 -8,0 mln tonns)	6	42,8	Kumkurgan, Termiz, Sherabod
III-Low (less than 1,5 mln tonns)	9	69,3	Uzun, Kyzyrik, Oltinsoy, Angor, Boysun, Muzrabod, Kumkurgan, Termiz, Sherabod	**III-Low** (less than 4,0 mln tonns)	7	50,0	Shurchi Sariosiya, Jarkurgan Bandikhan Uzun Kyzyrik Boysun Oltinsoy Angor Muzrabad
	13*	100			14	100	

Note: *Bandikhon district did not exist in 2010.

Nevertheless, some positive changes in the structure of transport economic potential within the rural districts can be observed between the two periods. Specifically, the number of districts in the low potential group (less than 1.5 million tons per year) decreased from 9 to 7 between 2010 and 2021 (69.3% to 50.0%). In contrast, the number of rural districts in the medium potential group doubled during the same period.

Development of transport centers and nodes

The topographic characteristics of the Surkhandarya region, as well as the configuration of its hydrographic network and the distribution of settlements in terms of size and density, have significantly influenced the establishment of various transport nodes with different positions and importance.

Numerous studies conducted by foreign, CIS, and local scholars have explored the formation and development of transport nodes and their role within regional transportation systems. Professor Jean-Paul Rodrigue from Hofstra University (New York) in the USA emphasizes that transport primarily connects places that are frequently identified as nodes. These locations serve as entry points in the distribution system or intermediate points within the transport

network. Transport terminals, where flows originate, terminate, or undergo transshipment between different modes of transportation, fulfill such functions. Therefore, transport geography should consider both collection and distribution points [1].

A transport node refers to a point where roads of the same type intersect, connect, or branch out [3].

According to researcher П.А. Козлов et al., a transport node represents an infrastructural and technological interconnection of various transportation systems that coordinate traffic flows within a specific area [12].

Based on the aforementioned concepts, the following transport nodes can be identified within the region. The city of Termiz serves as not only the administrative, economic, and cultural center of the region but also the southernmost transportation hub in Uzbekistan. With the launch of the Trans-Afghan transport corridor, it is expected to become a major regional transport center. Significant roads and railways pass through Termiz, and the city is also home to an international airport.

In terms of demographic and production potential, the city of Denau holds the second position after Termiz, the regional center. Denau is situated in the northern part of the region and serves as both the district center and a significant transport hub.

Another important railway junction in the region is the city of Kumkurgan, which connects the "Tashguzor-Boysun-Kumkurgan" railway (established in 2007) with the "Termiz-Dushanbe" route.

These transport nodes play a pivotal role not only within the region but also in the internal and external relations of Uzbekistan. Consequently, considerable attention is focused on Termiz, as transforming it into a major transport hub in the southern part of Uzbekistan is of great importance for the country's future development.

Analysis of transport infrastructure.

The transport infrastructure of the Surkhandarya region comprises railways (413 km), highways (2,843 km), railway stations (6), train stations (26), bus stations (10), stops (808), parking lots (176), an airport (1), an airfield (1), a river port (1), terminals (1), and pipeline transport. Additionally, bridges and tunnels are integral components of the infrastructure.

Regarding the length of public highways in the Surkhandarya region, it amounts to 2,843 km, accounting for 6.7% of the total length. Out of this, 351 km are of international significance, 990 km are of national importance, and 1,502 km are classified as local importance.

The international highways in the region form two main corridors. The first corridor is the Tashkent-Termiz route, passing through the Boysun, Sherabod, Angor, and Termiz districts. The second corridor is the Termiz-Dushanbe route, which includes the Termiz, Jarkurgan, Kumkurgan, Shurchi, and Denau districts. In the future, the upgrading of the national highway on the Boysun-Oltinsoy-Denau route to the international level in the region may be of great economic and social importance.

In the analysis and assessment of the transport infrastructure potential of the regions, mathematical statistical research on the ratio (density) of the available area and the number of inhabitants gives important results.

In this regard, the analysis of the transport infrastructure potential of the rural districts of the region based on their supply of transport roads (road density: road length per 1000 km^2, km) gives certain conclusions[14]. This can be calculated based on the following formula:

$$П_S = \frac{L_э}{S} \cdot 1000 \quad (1)$$

in this case:

$П_S$ – road density (road length per 1000 km^2, km)

$L_э$ – length of roads (road, railway)

S – area (km2)

As a result, the transport infrastructure (highway, railway, etc.) potential of rural districts is evaluated based on their territorial density.

In the same way, the road infrastructure potential of rural districts with different demographic capacity can be calculated in relation to their population. In this case, the length of the road per 10,000 inhabitants of the district is considered. It can be found based on the following formula[14].

$$П_H = \frac{L_э}{H} \cdot 10\,000, \text{ in this case:} \quad (2)$$

$П_H$ – road density (road length per 100,000 inhabitants, km)

$L_э$ – length of roads (road, railway)

H – population of the area.

The following results were obtained based on the calculation of road density in rural districts of the region (Table 2). According to it, the **high density** of highways belongs to the districts of Oltinsoy (346), Angor (310), Kyzirik (393), Denau (388), and to the **middle group** - Muzrabod (295), Termiz (247), Shurchi (180) , roads belong to the **low density group** - Sariosia (41), Uzun (75), Boysun (90), Jarkurgan (147), Kumkurgan (94), Bandikhon (113), Sherabod (141 km) districts. This indicator is the average for the region - 141 km.

Table 2. **Road infrastructure potential of rural districts**

Rural districts	Road length (km)		Road length (km)			Goltz coefficient (providing of the area's settlements with a motor transport network)
	Car	Railway	Car (1000 km^2 -km)	Railway (10000 km^2 -km)	For every 10,000 people - km	
Angor	121	7	310	7	9	0,9
Boysun	338	92	90	24,7	28	0,7
Denau	291	28	388	37	7,2	0,9
Jarkurgan	168	35	147	30	8	0,6
Kumkurgan	198	40	94	20	7.4	0,5
Kyzyrik	130	-*	393	-	11	1,0
Muzrabot	219	40	295	50	14	1,0
Oltinsoy	194	-*	346	-	10	1,0
Sariosiya	159	28	41	3	7.3	0,2
Uzun	175	8	75	3,7	9	0,4
Termiz	203	120	247	14.6	25	1,2
Sherabod	385	8	141	3	19	0,7
Shurchi	153	31	180	36	7	0,7
Bandikhon	77	-	113	-	9,7	0,4
By province	**2843**	**413**	**141**	**20**	**10**	**0,6**

Note: The table was calculated by the author based on the data of the regional transport department.* There is no railway.

The results of the grouping of rural districts by the density of communication (car) roads (Table 3) show that 50.0% of the rural districts of the region belong to the group of low road infrastructure density. Together with the middle group, they make up 72.0% of the total rural district.

Similarly, according to the density of railways, the highest group of districts - Termiz, Muzrabot, the middle group - Boysun, Denov, Kumkurgan, Jarkurgan, Shurchi districts, and the low group - Angor, Uzun, Sariosia, Sherabod district. There are no railways in Oltinsoy, Kyziriq and Bandikhon districts (Fig.3).

Table 3

Grouping of rural districts according to the density of communication (motor) roads

Transportation		Rural districts		
convenience	density km^2	number	%	Name
High	300 <	4	28,0	Kyzyrik, Denau, Oltinsoy, Angor
Middle	150-300	3	22,0	Muzrabot, Termiz, Shurchi
Low	150 >	7	50,0	Jarkurgan, Sherabod, Bandikhon, Boysun, Kumkurgan, Uzun, Sariosiya
		14	100,0	

Table calculated by the author.

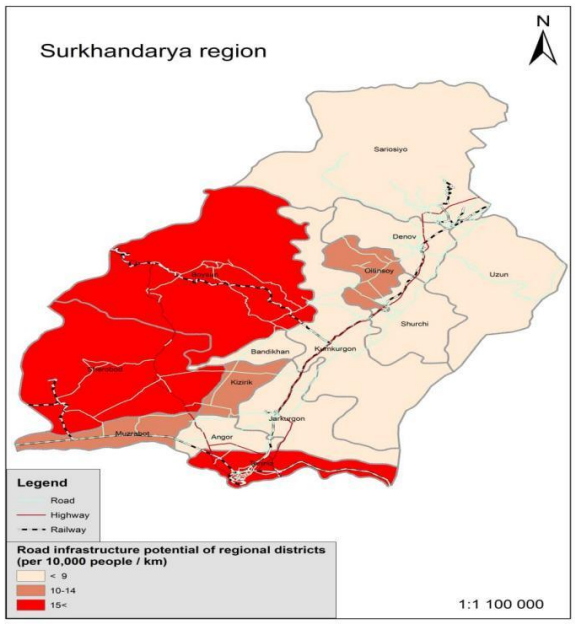

Figure 3. Every 1000 km^{2a} is a straight rider highway density, in km.

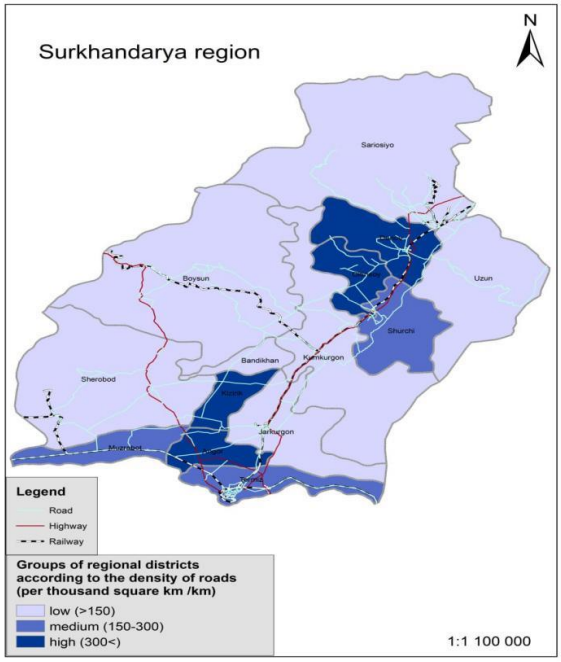

Figure 4. Per 10,000 people highway density in km

In addition to the above, calculating the Gol'ts coefficient [16] gives important results when assessing the transport infrastructure potential of regions, determining the level of supply of settlements with a transport network (see Table 2).

$$\Gamma = \frac{\mathbf{L}}{\sqrt{\mathbf{S} * \Pi}}$$

In this case, Γ is the Goltz coefficient (providing the area's settlements with a transport network;

L - length of roads (road or railway);

S – territory;

П – the number of settlements located in the territory.

The analysis of the provision of regional settlements with a road transport network at the level of rural districts reveals that the Goltz coefficient, which measures the level of transport accessibility, has an average value of 0.6 for the Surkhandarya region. However, certain districts such as Sariosia, Uzun, Bandikhon, and Kumkurgan have lower indicators. On the other hand, districts such as Termiz, Kyzyriq, Muzrabod, and Oltinsoy have indicators higher than 1.0, indicating a high level of transport accessibility. The remaining rural districts fall into the average range.

Despite the positive changes in the volume of transport services in the region in recent years, the following hinders the growth of the transport economic potential of the region and the acceleration of economic development:

- poor development of transport infrastructure for cargo and passenger transport, weak transport potential of rural districts;
- large regional differences in the provision of transport services to the population (including the almost non-existence of passenger transport infrastructure in remote areas of the city);
- low transport efficiency in the main transports (transportation quality, speed, time consumption, etc.);
- slow filling of the existing transport fleet with modern vehicles;
- Inability to use the transport and transit potential of the region under the influence of the "Afghan factor".

Conclusion

Based on the conducted analysis, the following points can be made regarding the modern state of the transport infrastructure of the region and its development. In recent years, the volume of freight and passenger transportation has been increasing in the region, but it is necessary to pay more attention to the improvement, modernization and expansion of its road infrastructure. In this regard, it is necessary to connect

remote rural districts with the center of the region, rural settlements with district centers, and modernize their transport road infrastructure.

At the same time, due to the cross-border nature of the region, adaptation of international road infrastructures passing through its territory to international requirements, construction of new corridors is of significant geo-economic and geo-political significance.

It is also desirable to expand the transportation and logistics capabilities of the regional center - Termiz, to turn it into a major transportation "Hub" and the southern transportation gate of Uzbekistan.

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