

Factors of formation and development of the transport network in areas inhabited by indigenous small-numbered peoples of the North in Yakutia

Antonina Savvinova^{1,*}, Viktoriya Filippova^{1,3}, Alexey Borisov², Galina Gnatyuk¹ and Alla Fedorova¹

¹M.K. Ammosov North-Eastern Federal University, Institute of Natural Sciences, 58, Belinskogo str., Yakutsk, 677000 Russia

²M.K. Ammosov North-Eastern Federal University, Mining Institute, 58, Belinskogo str., Yakutsk, 677000 Russia

³Institute for Humanities Research and Indigenous Studies of the North, Siberian branch, Russian Academy of Sciences, 1 Petrovskogo str., Yakutsk, 677027, Russia

Abstract. The paper considers the natural, historical, economic and geographical factors of the formation and development of the transport network in the areas inhabited by Indigenous Small-Numbered Peoples of the North in Yakutia. A brief analysis of historical periods of transport network development in Yakutia was carried out. A retrospective statistical analysis of the indicators of the road network development and its access for the areas inhabited by Indigenous Small-Numbered Peoples of the North: the length and density of public roads, the coefficients for assessing the level of the road network and transport was chosen as the study method. The analysis was based on the Engel, Goltz, Uspensky coefficients, as well as the density indicator of the road network as key indicators. Taking into account all coefficients the ranking of areas inhabited by Indigenous Small-Numbered Peoples of the North showed that high level of transport security of the population is typical for the areas with industrial development and a well-developed road network – Neryungrinsky, Mirninsky and Aldansky. The average level is typical for most areas that have year-round regional roads and winter roads. The lowest level of transport security of the population is observed in the Allaikhovsky and Oleneksky districts.

1 Introduction

The development of transport communication, active construction of roads, improvement of transport infrastructure, especially in developed territories, almost erased the borders between the regions. Economic, cultural, social communications are established between them that have a positive economic and social effect: formation of a single economic space, intensification of trade and steady growth of interregional trade, development of the labor market, etc. There is insufficient scientific knowledge of the impact of the state of the transport network on the socio-economic situation of the territories of residence and traditional nature management of the Indigenous Small-Numbered Peoples of the North (ISNPN). In remote regions of the North with a poorly developed transport network and great distances, there are still problems in the development of transport communications. The current structure of the transport network in areas inhabited by Indigenous Small-Numbered Peoples of the North in Yakutia is associated with natural and climatic conditions, with the history of settlement and the type of economic use of the territory.

The places of residence of the ISNPN of Yakutia include the geographical zones of the tundra, forest tundra and the northeastern part of the forest zone. With the exception of small areas in the southwest, almost the

entire territory is in the zone of continuous permafrost. The vast territory of the region represents a combination of both latitudinal-zonal and highland landscapes. The permafrost landscape map of Yakutia shows 143 different combinations of permafrost landscapes. Tundra landscapes occupy 10.3%, northern taiga – 26.4%, middle taiga – 27.5%, mountain deserts – 1.9%, mountain tundra – 9.4%, subalpine shrubs – 2.6%, mountain sparse wood – 20.3%, mountain taiga – 1.5% of the entire territory of Yakutia. In general, flat permafrost landscapes occupy about 64.2%, and mountain landscapes – about 35.4%, water bodies – 0.4% [1].

The studying areas are represented by all relief forms: mountains, plateaus, intermountain basins and lowlands. A significant area of the territories is occupied by plateaus and highlands – the relief is characterized by a combination of flat hills, intermountain depressions and low ridges being the habitats of commercial fur-bearing animal species for hunting, and is suitable for the development of taiga reindeer herding. The coastal territories of Yakutia are bordered by lowlands, which for a significant length retain a uniform flat-hilly relief with low absolute heights, with a weak inclination to the sea – they are the most favorable for the development of tundra reindeer herding.

All major rivers – Lena, Yana, Indigirka, Kolyma, Olenek, Anabar – are used for river transport during

* Corresponding author: sava_73@mail.ru

navigation, along which most of the cargo for the northern regions is imported. They are characterized by high spring flood, annually repeating small summer and autumn floods and long and low water season [2]. Rivers and lakes are abundant in fish and contribute to the development of one of the traditional economic activities of the ISNPN – fishing. The climate in most of the territory belongs to the Arctic and subarctic continental climatic zone, the main characteristics of which are dryness and significant fluctuations in both daily and seasonal temperatures. Thus, the natural conditions of the places of residence of the ISNPN in the Republic of Sakha (Yakutia) are characterized by extreme climatic conditions, the predominance of tundra, forest tundra and taiga characterized by wide biodiversity.

2 Factors of transport network formation in Yakutia

The development of the vast territory of Yakutia and related territories by indigenous peoples took place in different historical periods. Each people that inhabited the region developed their own system of transport link, which was determined not only by the presence of official roads, paths, but also by the way of life and economic activities of the population. If we analyze the history of the development of the transport network in Yakutia as a whole, then generally accepted periods are distinguished: pre-Soviet, Soviet and post-Soviet.

Before joining Russia Yakutia had no regular routes of communication. In the 17th century, waterways prevailed with the construction of strongholds from the Lena River with access to the Pacific coast. Pathbreakers walked along the river, animal transport also began from the rivers, and sledding was laid along the rivers in winter. The main cargo transportation was carried out by waterways. In 1738, the Irkutsk-Yakutsk tract was established in the system of ways of communication, which was laid along the left bank of the Lena River from Vitim to Yakutsk in completely uninhabited places. For several centuries the route from Irkutsk Region remained the main transport axis for the delivery of goods to the region. During the Second Kamchatka Expedition under the leadership of Captain-Commander V.I. Bering, there was a need for stable communication between Yakutsk and the Port of Okhotsk. From 1650 to 1720, the Yakut-Okhotsk route of water-land communication operated, which ran through the places of residence of the Evenks. Since 1845, the connection of the Ayan port with Yakutsk became regular and since 1852 the Yakutsk-Ayan tract, with a length of 1120 versts, becomes operational year-round [3].

In the Soviet period the rapid growth of the gold mining industry in the south of the republic began from the 1920s. At that time, the main population of the regions of Southern Yakutia were the Evenks engaged in traditional types of husbandry. Gold mining and the construction of the year-round Amur-Yakutsk highway (Bolshoy Never-Yakutsk) turned the southern part of the republic into one of the major centers of the country's mining industry. In 1932, the construction of the

Yakutsk-Magadan highway began to ensure gold mining in the north-east of Yakutia. In parallel, the development of the Northern Sea Route was underway, which subsequently played a positive role in ensuring the northern import to ISNPN residences in the Arctic regions of Yakutia. Continuous air communication was established both between district centers within the republic center and with large cities of the USSR. In the 1950s diamond-bearing deposits were developed in Western Yakutia in the area of the Mirny city, and a transport hub was formed for the development of a new industry, roads to mining sites appeared. A large supply base was created in the city of Lensk, conveniently located on the main river highway of the Lena River. The diamond-producing region (Mirny, Aikhal, Udachny, Chernyshevsky) with a new transport supply base was connected by a highway stretching about 400 km.

The establishment of the South Yakutsk Territorial-Production Complex (TPC) led to the construction of the Baikal-Amur Mainline – Tynda – Berkakit railway line in the 1970s, which connected Yakutia with the Baikal-Amur and Trans-Siberian main lines.

Today, the transport network not only provides the need for the economy and the population in transportation, but also serves as a material basis for the socio-economic development of the region. The main volume of goods is transported by road transportation, which occupies 45% and by inland water transport in the short navigation period, the share of which in cargo turnover is 44%, railway – 10%, others – 1% [4].

The Republic is characterized by the weak development of the road network, the territorial isolation of individual roads, as well as the significant development of the departmental road network, which actually performs the functions of the public road network. The road network in the region has a length of over 30 thousand km, of which more than half are temporary (seasonal) roads – winter roads. To date, more than 300 settlements of the republic have not been provided with year-round access to the public network with paved roads. Only 16 out of 34 districts are provided with such a transport link. Air transport remains the main year-round passenger mode of transport and plays a huge role in the socio-economic and cultural development of the republic. Aviation accounts for 84% of passenger turnover. On July 27, 2019, the first passenger train in the history arrived at Nizhny Bestyakh station; it opened traffic on the Amur-Yakut Railway throughout its length. Infrastructure facilities and a railway station at the Nizhny Bestyakh station were built. This country's largest railway construction in the last 25 years is a key project for the creation of a support transport network in the region and the main strategic object of transport construction. Thus, the socio-economic development of the vast territory of Yakutia is largely determined by the state and effectiveness of the transport system, which plays an exceptional role in ensuring its life, creates an uninterrupted supply of strategically important sectors of the economy.

The settlement of the population of Yakutia is characterized by high dispersion and a large number of scattered rural settlements with low population. Transport accessibility of settlements plays an important role in the settlement pattern of the population in the areas of residence of the SIPN. The historically established settlement system, primarily the scarcity of people and the dispersion of settlements, low density, branching and poor quality of local roads, have largely determined the territorial organization of the population, the level of socio-economic development and the mobility of the population of the studied territories.

In the conditions of the industrialization policy pursued in the Soviet period, a new settlement framework was formed laying the basis for various settlements with different size and functions, which were dispersed throughout Yakutia, and the number of which was supported by state-stimulated migrations (northern allowances, Komsomol construction projects, etc.). The spatial location of these settlements was characterized by high fragmentation, which in many ways was determined by their monofunctionality (mining centers), as well as the actual underdevelopment of the transport infrastructure in the territory.

3 Current state of the transport network in the places of residence of ISNPN

According to the Order of the Government of May 8, 2009 No. 631-p, 21 districts with rural settlements (naslegs) in Yakutia are included in the list of places of traditional residence and traditional economic activity of Indigenous Small-Numbered Peoples of the North of the Russian Federation [5]. In total, according to the Law "On the List of Inaccessible and Remote Areas in the Republic of Sakha (Yakutia)" (as amended by the Law of the Republic of Sakha (Yakutia) No. 1249-V of 25.04.2017), 185 settlements and 163 production sites in Yakutia belong to hard-to-reach areas [6]. Areas inhabited by Indigenous Small-Numbered Peoples of the North are the most inaccessible territories of the Republic of Sakha (Yakutia). Among 18 districts of Indigenous Small-Numbered Peoples of the North (except for Mirninsky, Neryungrinsky and Ust-Maysky districts), 55 settlements are considered as hard-to-reach areas.

The length of public and non-public roads in 21 areas inhabited by Indigenous Small-Numbered Peoples of the North is 19668 km. The length of paved roads in 11 districts is less than 100 km, in 9 districts – from 100 to 1000 km, and only in the Mirninsky district the length of such roads exceeds 1000 km (1,037 km). In 4 districts, the share of paved roads is more than 50% – Aldansky, Mirninsky, Oymyakonsky and Tomponsky. But this does not mean that paved roads are available to all settlements where the Indigenous Small-Numbered Peoples of the North live. Paved roads mainly pass to district centers. Thus, most of the places of residence of the Indigenous Small-Numbered Peoples of the North do not have a year-round connection and are transport-isolated.

Ground and freight transportation are available only through winter roads running along rivers and passages that operate from the end of December to mid-April.

If the density of the network of paved public roads in the Republic of Sakha (Yakutia) by the end of 2020 was 4.2 km per 1000 km² territory, then in 21 areas inhabited by Indigenous Small-Numbered Peoples of the North the average value is 0.8 km per 1000 km². The density of the road network is associated with the level of economic development of the districts. In 9 out of 21 districts the road density is from 2 to 10 km per 1000 km², and in 12 districts – from 10 to 15 km per 1000 km².

The average density of public and non-public roads per 100 km² of the ISNPN area is 1 km per 100 km². In 7 districts the density is less than 1 km per 100 km², in 12 districts – 1.0-1.5 km per 100 km² and in only 2 districts – 1.5-1.6 km per 100 km².

The Engel, Goltz, Uspensky and Vasilevsky coefficients, as well as the density indicator of the road network, were used as key indicators to assess the level of provision of the studied territories with a road network and transportation. The Engel coefficient allows obtaining a generalized estimate of the region's security of the transport network – this is the ratio of the length of transport routes to the developed area and the population. However, the Engel coefficient may slightly distort the level of transport development of these territories, given that the population of different districts, regions and countries may vary significantly. Therefore, the Goltz coefficient was also calculated, which shows a more verified picture of the level of security of the transport network between settlements [7].

In order to fully assess the development of the road network of a particular district and its constituent municipalities it is not enough to use only the Engel and Goltz coefficients, despite the fact that they allow taking into account two important factors that especially affect the state of the studied object – the area and the number of settlements. Both indicators have one significant drawback: inability to assess the level of transportation of the territory under study. Other indicators are already coping with this task – Uspensky and Vasilevsky coefficients [8].

The Engel, Goltz, and Uspensky coefficients do not have normative values, and the higher the value of these coefficients, the more the region is provided with transport infrastructure. These indicators are designed to build rankings for the provision of territories with transport infrastructure [9, 10].

4 Conclusion

Considering that some of these coefficients show a slightly distorted perspective of the transport development in the territories, we believe that in the conditions of Yakutia it is most optimal to use the aggregate coefficient, which gives a more approximate scenario of the level of security of the studied territories by the transport network (Table 1).

Table 1. level of provision of the studied territories by the transport network

Region	Engel coefficient-1 (Ke-1)	Goltz coefficient-1 (Kg-1).	Uspensky coefficient-1 (Ku-1)	Sum of coefficients	Ranking
Mirninsky	0.013	47.370	0.042	47.425	1
Neryungrinsky	0.014	78.422	0.066	78.502	1
Aldansky	0.019	22.880	0.090	22.989	1
Tomponsky	0.038	9.265	0.197	9.500	2
Anabarsky	0.025	8.734	0.167	8.926	2
Olekminsky	0.038	8.448	0.230	8.716	2
Kobyaysky	0.041	7.893	0.265	8.199	2
Oymyakonsky	0.042	7.007	0.205	7.254	2
Ust-Yansky	0.059	6.451	0.416	6.926	2
Verkhnekolymsky	0.029	6.464	0.111	6.604	2
Ust-Maisky	0.048	6.244	0.288	6.580	2
Abyisky	0.047	6.227	0.305	6.579	2
Eveno-Bytantaysky	0.047	6.150	0.372	6.569	2
Bulunsky	0.047	5.577	0.484	6.108	2
Verkhoyansky	0.054	5.757	0.249	6.060	2
Srednekolymsky	0.039	5.472	0.290	5.801	2
Zhigansky	0.017	5.638	0.087	5.742	2
Momsky	0.060	4.760	0.736	5.556	2
Nizhnekolymsky	0.034	4.032	0.273	4.339	2
Oleneksky	0.032	3.610	0.402	4.044	3
Allaikhovskiy	0.063	3.134	0.631	3.828	3

Our calculations of the total coefficient and ranking by ISNP areas of residence in Yakutia showed the following results:

– high level of transport security of the population is typical for the areas of their residence with industrial development – Neryungrinsky, Mirninsky and Aldansky. The railway and the Lena federal highway pass through the territories of the first two districts, and the Vilyuy federal highway passes through the territory of the Mirninsky district;

– average level is typical for most areas that have year-round federal roads, such as the Kolyma road, republican roads: Kobyai, Amga, winter roads: Arctic, Yana, Verkhoyanye, Bulun, Indigir, Sebyan and intra-district winter roads pass through the territories of the districts;

– lowest level of transport security of the population is observed in Allaikhovskiy and Oleneksky districts.

Thus, despite the changes towards improving transport accessibility in the republic, most territories, especially Arctic ones, are in the conditions of transport isolation. The development of transport infrastructure is necessary to provide the population with food and industrial goods year-round, stimulate trade, increase the availability of medical and other social services, which will improve the level and quality of life in the places of residence of the Indigenous Small-Numbered Peoples of the North.

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