# The Role of Transport Infrastructure in Environmental Development of PDAs

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**Abstract.** Research on environmentally sustainable development of territories in Russia have a clear social and economic color, which is distinguished by the lack of understanding and application of the relevant tools in government programs. The heterogeneity of the social and economic situation of the country's territories requires personalization of approaches. According to the Strategy for Spatial Development of Russia, 4 types of territories of priority development are distinguished: exclaves, the North Caucasus, the Far East and the Arctic. The article is devoted to the investigation of the relationship between the level of social and economic development and the level of development of the transport infrastructure of these territories, as well as a comparison of the level of development of the transport infrastructure of priority regions with similar averages for the country. The highest correlation was found between the GRP and the total length of public roads. An analysis of studies in the field of the impact of the growth in the length of roads on the economy helped to single out a decrease in the cost of production, an increase in direct investment and tax revenues. This study did not examine the differentiated study of the impact of road, rail and air traffic development, but noted their substitutive effect.

**Keywords:** Environmental development · Ecological situation · Priority development areas

## 1 Introduction

The issues of environmentally sustainable development of territories became relevant already in the 70s of the 20th century, in fact, from the moment of the beginning of discussions related to concerns "about the rapid deterioration of the environment, human and natural resources, and the consequences of the deterioration of economic and social development." Already in 1983, the World Commission on Environment and Development (WCED) was created within the structure of the UN, and in 1992 the Commission


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on Sustainable Development (CSD) [1]. Even though initially the issues of sustainable development were concentrated around the deterioration of the ecological situation and the depletion of natural resources [2], very quickly the principles of sustainable development spread to all spheres of society.

Sustainable development includes two key interrelated concepts:

1. the concept of needs, including priority needs (necessary for the existence of the poorest segments of the population);
2. the concept of restrictions (due to the state of technology and the organization of society) imposed on the ability of the environment to meet the present and future needs of mankind [3].

Currently, humanity is persistently looking for new economic models that would take into account the sustainability of development and environmental constraints. The impossibility of continuing growth on the basis of traditional economic development is becoming more and more obvious. It is important to note that in Russia "sustainable development" is usually associated with economic growth, while in the world the interpretation of this term also includes the balanced harmonious development of social and environmental processes [4, 5]. In this regard, the sustainable development of territories in Russia implies the formation of such, firstly, an economic system that would ensure a stable growth of economic indicators, and secondly, would not harm the environment and ensure the harmonious development of society.

The heterogeneity of the socio-economic development of the territory of Russia is confirmed by many studies [6, 7]. The RIA Rating study conducted in 2021 demonstrates the social and economic situation of the country's regions [8]. The rating is based on data from the Ministry of Finance, the Federal Treasury and the Federal State Statistics Service. The methodology is based on the aggregation of various indicators characterizing the socio-economic situation of the regions. The selected indicators were divided into four groups:

- Indicators of the scale of the economy - the volume of production of goods and services, the income of the consolidated budget, the number of people employed in the economy, the turnover of retail trade;
- Indicators of economic efficiency - the volume of production of goods and services per capita, investment in fixed capital per capita, the share of profitable enterprises, the level of tax collection;
- Public sector indicators—consolidated budget revenues per capita, the share of tax and non-tax revenues in the total volume of consolidated budget revenues, the ratio of public debt to tax and non-tax revenues of the consolidated budget, the ratio of tax and non-tax revenues of the consolidated budget to expenditures;
- Social indicators—the ratio of the population's income to the cost of a fixed set of consumer goods and services, the unemployment rate, life expectancy at birth, the infant mortality rate, the mortality rate of the population aged 15–59, the proportion of the population with incomes below the subsistence level.

The rating score for each region is ranged from 1 to 100. Regions with the best value of the indicator received a rating score of 100, while the worst is 1. The rating score for a group of factors is defined as the arithmetic mean of the rating scores of all indicators included in the group. Integral rating is calculated as the geometric mean of the rating scores of all analyzed groups of factors. The maximum possible value of the integral rating is 100, the minimum possible is 1. An analysis of the rating and the dynamics of its changes compared to 2019 showed that the top ten leaders and the last ten outsiders have not changed, and the gap in the value of the integral indicator is almost 8 times: 83.929 points Moscow (rank leader) and 10.682 Jewish Autonomous Region (rank outsider).

The heterogeneity of the social and economic development of the country's territory requires the development of equalization mechanisms, which should be based on the initial position of each specific region: its geographical location, the availability of natural resources, the demographic situation, the level of infrastructure development, and so on.

Analysis of foreign experience [9, 10] showed that one of the important factors that can give impetus to the integrated development of the territory is the issue of transport infrastructure. Transport infrastructure facilities include: communication routes, technical facilities, cargo and passenger airports, railway stations and stations, logistics centers, warehouses, engineering networks, transport communications, etc. It is rather difficult to give a complete objective description of the transport infrastructure due to its extreme vastness. For the purpose of the socio-economic development of the territory, the basic objects of the transport infrastructure are considered to be communication routes, passenger and cargo airports, railway stations and stations.

The Spatial Development Strategy of Russia identifies the following priority territories for development: exclave territories, territories of the North Caucasus, territories of the Far East and territories of the Arctic zone. The purpose of the study is to identify the presence of a direct relationship between the level of socio-economic development and the level of development of the transport infrastructure of these territories, as well as to compare the level of development of the transport infrastructure of priority regions with similar averages for the country. This will help to form an objective picture of the initial positions of the territories and their differences.

## 2 Methods and Materials

Since the priority development areas are conditional zones, and have no formally fixed borders, in order to analyze development indicators, it is necessary to clearly identify the constituent entities of the Russian Federation that are included in them.

1. Regions of the Russian Federation characterized by an exclave position - the Republic of Crimea, the city of federal significance Sevastopol, the Kaliningrad region;
2. Regions of the Russian Federation located in the North Caucasus - the Karachay-Cherkess Republic, the Kabardino-Balkarian Republic, the Republic of Dagestan, the Republic of Ingushetia, the Republic of North Ossetia-Alania, the Chechen Republic, the Stavropol Territory;

3. Regions of the Russian Federation located in the Far East - The Republic of Buryatia, the Republic (Sakha) of Yakutia, the Trans-Baikal Territory, the Kamchatka Territory, the Primorsky Territory, the Khabarovsk Territory, the Amur Region, the Jewish Autonomous Region, the Magadan Region, the Sakhalin Region, the Chukotka Autonomous Region;
4. Regions and parts of subjects of the Russian Federation included in the Arctic zone of the Russian Federation in accordance with Decree of the President of the Russian Federation of May 2, 2014 No. 296 - the territory of the Murmansk region, the Nenets, Chukotka, Yamalo-Nenets Autonomous Okrugs, municipalities - Belomorsky, Loukhsky and Kemsky municipal districts (Republic of Karelia), urban district "Vorkuta" (Republic of Komi), territories of Abyisky ulus (district), Allaikhovskiy ulus (district), Anabar national (Dolgan-Evenk) ulus (district), Bulunskiy ulus (district), Verkhnekolymskiy ulus (district), Verkhoyansky district, Zhigansky national Evenki district, Momsky district, Nizhnekolymsky district, Oleneksky Evenki national district, Srednekolymsky ulus (district), Ust-Yansky ulus (district) and Eveno-Bytantaisky national ulus (district) (Republic of Sakha (Yakutia), territories of the urban district of the city of Norilsk, the Taimyrsky Dolgano-Nenetsky municipal district, the Turukhansky district (Krasnoyarsk Territory), terri municipalities City of Arkhangelsk, Mezensky Municipal District, Novaya Zemlya, City of Novodvinsk, Onega Municipal District, Primorsky Municipal District, Severodvinsk (Arkhangelsk Region), lands and islands located in Arctic Ocean.

Briefly summarized, the priority territories are: Crimea, Kaliningrad, the Caucasus, the Far East and the Arctic zone of the Russian Federation, and these territories are key points connecting the center and the periphery. Kaliningrad is the western axis, Crimea and the Caucasus are the southern axis, the Far East is the eastern axis, and finally the Arctic zone is the northern axis.

Correlation analysis is used to identify the presence or absence of dependencies between different quantities. The mathematical measure of correlation dependence is usually the correlation coefficient, which can vary from $+1$ to $-1$. The following indicators were analyzed as the initial analyzed variables:

1. Gross regional product (GRP),
2. Average salary, rubles,
3. Length of public roads,
4. Density of public railway tracks per 10 thousand sq. m. of territory.

The initial data used for the analysis are shown in Table 1. The Arctic zone was not studied, since there are no public data on individual municipal districts that make up its composition, which makes the comparison based on the data of the entire subject of the federation biased.

The initial data presented in Table 1 are taken from the official public sources of the Federal State Statistics Service for 2020.

**Table 1.** Initial data for analysis

| # | Area | GRP, million rubles | Average salary, rubles | Length of public roads, km | Density of public railway tracks per 10 thousand sq. m. of territory |
|---|---|---|---|---|---|
| **1** | **Crimea + Sevastopol city** | **606,208** | **35,240** | **16,761.7** | **255** |
| **2** | **Kaliningrad** | **519,725** | **36,647** | **9155.8** | **442** |
| **3** | **North Caucasus** | **2,296,657** | **31,799** | **90,178.3** | **123** |
| | Karachay-Cherkess Republic | 92,019 | 29,865 | 9740.8 | 35 |
| | Kabardino-Balkarian Republic | 171,044 | 29,899 | 6996.1 | 107 |
| | Republic of Dagestan | 718,498 | 31,342 | 28,961.2 | 101 |
| | Republic of Ingushetia | 73,186 | 29,648 | 4812.2 | 108 |
| | Republic of North Ossetia-Alania | 173,235 | 30,479 | 6584.2 | 180 |
| | Chechen Republic | 241,631 | 29,771 | 12,677.6 | 195 |
| | Stavropol Territory | 827 044 | 33 877 | 20 406,1 | 139 |
| **4** | **Far East** | **5,971,488** | **60,358** | **127,278.3** | **17** |
| | Republic of Buryatia | 285,832 | 41,800 | 14,874.4 | 35 |
| | Republic (Sakha) of Yakutia | 1,220,320 | 77,178 | 30,910.7 | 3 |
| | Transbaikal region | 364,556 | 47,172 | 22,444.6 | 56 |
| | Kamchatka Territory | 279,673 | 85,623 | 2260.9 | 0 |
| | Primorsky Territory | 1,066,724 | 50,105 | 17,085.7 | 95 |
| | Khabarovsk Territory | 802,972 | 53,113 | 10,886.0 | 27 |
| | Amur Region | 412,481 | 52,430 | 16,248.3 | 81 |
| | Jewish Autonomous Region | 56,571 | 46,237 | 2846.5 | 141 |
| | Magadan Region | 213,580 | 102,843 | 2713.3 | 0 |
| | Sakhalin Region | 1,173,895 | 92,518 | 4803.5 | 96 |
| | Chukotka Autonomous Region | 94,884 | 120,641 | 2204.4 | 0 |

*Source: compiled by the authors from* [11]

## 3 Results

Pearson's correlation coefficient was used to measure variables with a quantitative scale. Variable names were encoded as follows:

X 1 – GRP,
X 2 – Average salary,
X 3 – Length of public roads,
X 4 - Density of public railway tracks per 10 thousand sq. m. of territory.

The results were processed using the Minitab 19 program and are displayed in Table 2.

**Table 2.** Correlation check

| | X 1 | X 2 | X 3 | X 4 |
|---|---|---|---|---|
| X 1 | 1.000 | | | |
| X 2 | 0.887 | 1.000 | | |
| X 3 | 0.935 | 0.665 | 1.000 | |
| X 4 | −0.854 | −0.586 | −0.930 | 1.000 |

*Source: compiled by the authors*

The greatest correlation is observed between the GRP indicator and the Length of public roads, which led us to conclude that there is a direct relationship between these indicators: the greater the Length of public roads, the higher the GRP level. Otherwise, no statistically significant correlation was found between the indicators, which indicates the absence of direct relationships. Indeed, for example, in the Far East, with the highest length of public roads, there is the smallest Density of public railway tracks per 10 thousand sq. m. of territory. There is probably a substitution effect when one type of transport infrastructure is replaced by another.

It is obvious that an important role in the formation of the cost of production is played by transportation costs, which, according to analytics [12], exceed similar indicators in developed foreign countries by 1.5 times. This difference is most often associated with poor road conditions, which lead to increased fuel consumption and vehicle wear.

## 4 Discussion

The positive impact of the development of the economy and the quality of the road network on the development of the economy of the territory is well studied. British surveys of population employment in relation to the quality of the road surface through employment in the respective places [13]. However, despite the fact that the effect is purely local in nature, which often causes suspicion, unexpectedly, relocation is carried out in a new region, which generally does not change the picture at the macro level. Coverage of scientific publications related to the development of the transport network

of the population of cities and the presence of the population of the suburbs [14]. In some studies, there is an increase in the growth of roads on the growth of exports [15], tourism [16] and, in general, private investment in the market [17]. An analysis of road conditions influence on various sides of the social and economic development of areas was accumulated in the scheme presented in Fig. 1.

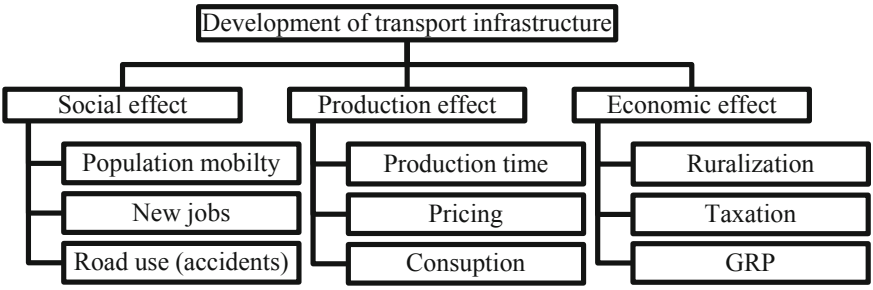


**Fig. 1.** Analysis of the impact of roads on socio-economic development

The fiscal function of the use of the road network has big importance too. Transport tax in Russia is paid regardless of the annual mileage of the car. In addition, the amount of damage caused to the road by a particular vehicle is not considered. The greatest efficiency of tolls is achieved when the payment for the use of transport infrastructure is as close as possible to the point of its use, and the amount of the toll is set at a level close to the marginal cost. The transport strategy currently adopted in the European Union until 2050 provides for the improvement of the system of taxation of road users. The main focus is on the greater use of road user charges in lieu of road taxes. Such a mechanism, on the one hand, more clearly determines the targeting of payments, and on the other hand, creates additional and sometimes insurmountable obstacles to the misuse of these funds.

## 5 Conclusion

Thus, one of the key factors influencing the sustainable social and economic development of priority areas is transport infrastructure. The highest correlation was found between the GRP and the total length of public roads. Even though this study did not consider the issues of detailing the type of transport links - roads, railways or air traffic - it is obvious that they partly have a substitutive effect, but largely depend on the geographical features of the location. Since the simplest and cheapest type are motor roads, their development is seen by the authors as the most promising in the light of the need to form a strategy for sustainable social and economic development of priority areas in Russia.

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