

SYSTEMIC BARRIERS TO SUSTAINABLE RURAL ROAD INFRASTRUCTURE

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Abstract: This thesis is devoted to the scientific, theoretical and practical analysis of systemic factors that hinder the sustainable development of rural road infrastructure. Rural roads are an essential communicative foundation for territorial economic activity, the delivery of agricultural products to markets, access to education and health services, employment, and the development of local entrepreneurship. At the same time, their efficiency is determined not only by the volume of new construction or reconstruction, but also by such factors as financial sustainability, a culture of maintenance, institutional coordination, digital monitoring, climate resilience, and public oversight. In recent years, Uzbekistan has implemented important measures to modernize the road sector, promote the integrated development of regions, improve road safety, and rehabilitate rural roads in cooperation with international financial institutions. In particular, the Development Strategy, presidential decisions on improving the road sector, and international projects aimed at strengthening rural road resilience increase the relevance of this topic.

Keywords: rural roads, sustainable infrastructure, systemic barriers, transport policy, road assets, financing, maintenance, climate resilience, institutional governance, public oversight

INTRODUCTION

Rural road infrastructure is one of the fundamental networks required for the territorial development of a country, the daily mobility of the population, and the stable functioning of local economies. When rural roads are in good condition, farmers can deliver their products to markets more quickly, schoolchildren and patients can reach social services more easily, and logistics costs for business entities decrease. Conversely, poor road conditions increase production costs, reduce investment attractiveness, and deepen socio-economic disparities between regions.

The relevance of the topic lies in the fact that sustainable rural roads cannot be reduced to construction works alone. The service life of a road depends on design quality, material selection, drainage systems, load control, preventive repair, continuity of financing, and management discipline. In many territories, road repair begins only after the problem becomes severe, although early prevention reduces the cost of capital repair and improves road safety. Therefore, problems in rural roads should be analyzed not as isolated technical failures, but as a systemic governance issue.

In the Republic of Uzbekistan, the development of roads and transport infrastructure has become an important direction of state policy in recent years. The Development Strategy of New Uzbekistan for 2022-2026 defines tasks related to the comprehensive socio-economic development of regions and the preparation of programs based on the study of the problems and opportunities of each district and city. Presidential decisions on the further improvement of the road sector, government documents regulating the construction, reconstruction, repair and operation of roads, and projects implemented jointly with international financial institutions confirm the strategic importance of this sphere.

At present, transport projects supported by the World Bank, the Asian Development Bank, and the Asian Infrastructure Investment Bank are aimed at improving road safety, climate resilience, and regional connectivity in Uzbekistan. This process requires rural roads to be examined not

merely as a local problem, but as an integral component of national economic competitiveness and the international logistics system. In this regard, the study of systemic barriers to sustainable rural road infrastructure has both theoretical and practical significance.

MAIN PART

The first systemic barrier affecting the sustainable development of rural road infrastructure is the excessive dependence of financing on the construction phase. In practice, the construction of a new road or capital repair produces a visible result, but if regular preventive maintenance is neglected, the road may become unusable again within a short period. Therefore, funding should be linked not only to the completion of an object, but also to the road's service life, condition index, and road safety indicators.

The second barrier is the fragmentation of institutional responsibility. Rural roads are often located at the intersection of powers belonging to the national, regional, district, and mahalla levels. If the duties of the customer, contractor, operating organization, and local authority are not clearly defined, quality control weakens, warranty obligations do not work effectively, and repair activities are delayed. In such conditions, contractual responsibility, technical audit, and independent monitoring acquire particular importance.

The third barrier is the insufficiency of digital databases. Modern road management must rely on accurate information about traffic flows, pavement condition, accident risk, drainage systems, and economic efficiency. If there is no unified GIS map, open rating, and regular diagnostics of rural road conditions, it becomes difficult to establish repair priorities fairly. As a result, some roads may be repaired repeatedly, while socially important routes remain outside attention.

The fourth barrier is weak adaptation to climate and natural risks. Sharp temperature fluctuations, floods, rainwater, soil salinity, and intersections with irrigation networks directly affect pavement quality. If drainage, culverts, strong base layers, and the properties of local materials are not sufficiently assessed, roads deteriorate rapidly. For this reason, each road project should be developed together with a climate risk assessment and a set of engineering measures that correspond to local environmental conditions.

The fifth barrier is the limited participation of the public. Users of rural roads - farmers, entrepreneurs, passengers, schoolchildren, and mahalla residents - understand local needs more clearly than external observers. If they do not participate in defining priority routes, the project may not correspond to real social demand. Open tenders, online reporting, discussions at the mahalla level, and the systematic collection of user feedback increase transparency and improve road quality.

As a scientific approach, it is appropriate to apply the concept of life-cycle management to rural roads. This concept views design, construction, operation, preventive maintenance, and rehabilitation as a single system. Consequently, the goal is not to select the cheapest initial project, but to choose the most effective and safe solution during the entire service life of the road. Life-cycle thinking also allows policymakers to compare alternative investments, forecast future maintenance needs, and prevent the accumulation of hidden infrastructure deficits.

The analysis shows that sustainable rural road infrastructure requires the combination of financial planning, institutional accountability, modern technologies, environmental adaptation, and public control. In this context, road asset management systems should be introduced step by step. Such systems make it possible to inventory roads, determine their technical condition, rank investment priorities, and monitor the effectiveness of expenditures. They also create a basis for transparent decision-making and reduce the risk of subjective allocation of resources.

CONCLUSION

In conclusion, the sustainability of rural road infrastructure should be assessed not by the amount of allocated funds or the number of kilometers built, but by the population's year-round ability to move safely, conveniently, and reliably. Systemic barriers are manifested in the form of financial discontinuity, institutional fragmentation, the lack of digital monitoring, climate risks, and weak public oversight. Eliminating these barriers requires strengthening road asset management, results-based financing, and control systems based on open data.

As a scientific and practical recommendation, it is advisable to develop a unified digital cadastre for rural roads, create a stable financial mechanism for preventive maintenance, make climate risk assessment mandatory for each project, evaluate contractors by quality and service-life indicators, and identify priority routes with the participation of local residents. Such an approach will help develop rural roads as strategic infrastructure that ensures economic growth, social justice, and environmental sustainability. In the long term, sustainable rural roads can become not only a transport facility, but also an instrument for reducing poverty, expanding access to services, and increasing the competitiveness of remote territories.

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