



ECONOMIC OPTIMIZATION OF SOCIO-EDUCATIONAL SERVICES PROVISION IN NEW RURAL SETTLEMENTS: CASE OF PERM SUBURB IN RUSSIA

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ARTICLE INFO

Received 01/18/2018
Sent to revision 01/23/2018
Accepted 03/13/2018
Available online 10/31/2018

Keywords:

new rural settlement
municipal formation
education services
socio-educational environment

ABSTRACT

Urban metropolitan areas continue to grow not only due to population growth in rural areas, but also by creating new settlements. The establishment of new settlements in the rural suburbs of major cities became widespread in Russia 15 years ago. For instance, 14 settlements formed around Perm in the past six years. Such settlements do not have any production (economic) importance by themselves. At the same time, the establishment of social infrastructure is not planned initially. At the first stage municipalities, in which new settlements form, receive significant economic benefit from the development of the rural suburban resettlement – village administrations budget is replenished by property and land taxes. For example, in the suburban district of Permskii Krai, through the establishment of new settlements, budget increased by 37-43% annually. The need of providing several new settlements with social facilities (e.g. schools, kindergartens, etc.) comes gradually. The establishment of such facilities within the boundaries of the rural municipalities is estimated at hundreds of millions Russian rubles. Thus, all the initial economic benefits from the development of new settlements are lost. Therefore, it appears that there is a need to develop optimization models of educational facilities within the boundaries of municipalities, in order to optimize their number, size and location. The aim of the developed model is minimizing both distance to educational facilities and cost of these facilities. Calculations show that the development of a regional optimization scheme of socio-educational environment of a rural settlement within the boundaries of the suburban zone will reduce expenditure on establishment and operation of these facilities on average by 20-25%.

Introduction

It is well known that with population growth in the city center there is a high concentration of population in a suburban area (UN-DESA, 2014). Metropolitan areas continue to grow not only due to population growth in rural areas, but also by creating new settlements. In many regions, there are ongoing urbanization and rural transformation processes that led to the creation of a *rural-urban continuum* with strong linkages between rural, peri-urban and urban areas (Berdegúe & Proctor, 2014).

The Russian Federation is ongoing a slow but steady urbanization process. According to the Population Division of the United Nations' Department of Economic and Social Affairs (UN-DESA, 2014), urban population in the Russian Federation is expected to increase from 74% in 2014 to 81% in 2050. Nowadays, 35.3% of the Russian population lives in large cities and 36.4% in small cities and towns. Russia has, currently, 16 regions with population above million; their number increases to 20 if we count the number of big cities along with suburb population. Metropolitan areas today are the drivers of the economy of regions and points of attraction of labour resources. Thus, just around the city of Perm 26 settlements were established in the last ten years, among them 14 in the Permskii municipal area. The settlements are built on land for agricultural use, administered by the municipalities. The main function of the settlements created is providing for a certain group of the population a combination of comfortable living conditions in

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rural areas, with the ability to work in the city. Settlements are created initially as commuter towns or 'bedrooms', without taking into account the development of social and educational infrastructure. Initially, the rural territories receive a significant economic benefit from the development of the rural suburban settlement – village administrations budget is replenished by income property and land taxes. So, for example, only in the suburban area of Permskii municipal rayon, through the establishment of new settlements, rural settlements budget increased by 30-35% annually. However, establishments of new settlements bring about not only benefits but also some challenges such as those related to provision of education services. This is due, among others, to some legal gaps regarding metropolitan areas in the Russian Federation. As Kudrin (Russian Gazette, 2017) points out: "*The metropolitan area could get its own legal status. It is necessary to be prescribed in regulations*".

1. Education organization challenges in new settlements

Urbanization and rural transformation come not only with opportunities but also some challenges for urban policy makers and planners (FAO, 2017). In the future, there are problems inherent in the development of all the agglomerations in the world. There is, first and foremost, the problems of circular labour migration and unmanaged commuting not only of active part of the population, but also members of their families. Nevertheless, there are also other problems such as transport.

Every day, hundreds of citizens living in new settlements are forced to bring their children to urban educational institutions. As a rule, the children are from 7 to 17 years. To move to the city and back creates a certain discomfort, transport fatigue and unnecessary time spent on travel in urban schools, and financial expenses of the family. Studies have shown that the weekly time spent on moving children to urban educational institutions is, on average, 7-12 hours. At the same time, availability of local schools could solve that problem. The problem is made more complicated by the fact that in a number of new settlements, it is impossible to organize a full education, because the population number in these settlements ranges from 150 to 1500 people. Thus, the creation of a full-fledged high school in these villages is not possible. However, the activities of the education sector should be seen as an instrument for the development of the intellectual potential and human capital of the territories and to improve the quality of life of the population, as a means of ensuring high rates of economic growth of the country, region, municipality (Zheliaskov & Ponosova, 2015). In fact, there is evidence that rural employment, especially in non-farm sector, remains largely associated with education levels (e.g. Lanjouw and Murgai, 2009).

It seems that the problem of the organization of education in rural areas should be addressed on several fronts. The first is giving a certain legal status to agglomerations, the second metropolitan area should be developed in the framework of certain government programs. In this case, their development will be controlled, predictable and financially secure. However, these are issues of the future. In the meantime, problems should be tackled by using optimization methods of investment allocations. Let us consider the example of the Permskii municipal district.

2. Education facilities and services in Permskii municipal district

Number of resident population in the Permskii municipal district is 107 thousand people, or 4% of the population of Permskii Krai. The area belongs to the typical suburban districts that make up the metropolitan area. The next stage of modernization of Russian education radically changes approaches to the management of the education system at the municipal level.

In order to address the issue of availability of compulsory general education, improve the quality of the service provided, the complete exclusion of the proportion of students enrolled in the second shift and the removal of social tensions in the territory of Permskii district, a decision to optimize the number, sizes and properties of secondary schools was taken. Permskii municipal district took on obligations to organize and finance education expenditures. In the years 2010-2017 was observed a steady increase of students of educational institutions in the district. In the year 2010, 9.9 thousand children were enrolled in schools of the district, in 2016 – more than 12 thousand.

On January 1, 2017 on the territory of Perm municipal area there were 28 educational institutions, which were located in 30 buildings. Including 12 or 40% of the buildings were constructed before 1980, 15 buildings (50%) from 1981 to 2002 and 3 (10%) of the building after 2003. At the same time, there is an annual increase in the proportion of children attending school in the second shift (Table 1).

Table 1. Dynamics of development of educational institutions network of Permskii municipal district in Permskii Krai

	2010	2011	2012	2013	2014	2015	2016
Number of students, total	9721	9927	10209	10464	10810	11408	12006
Number of schools, total	30	28	27	27	27	27	27
including secondary	24	22	20	20	20	20	20
Of them, working in 2 shifts	13	13	13	13	13	13	13
The number of students in the 2 nd shift	1394	1635	1644	1857	1965	2353	2991
% of the total number of students	14.3	16.5	16.1	17.7	18.2	20.6	24.9

In a number of rural settlements proportion of students enrolled in the second shift is over 50%, contrary to the adopted strategy for socio-economic development of the Perm municipal area for 2016-2030. The area is a developing area with active construction of high-rise residential buildings, which also causes a constant flow of population, a growing number of students. The existing infrastructure will not ensure high quality and accessible education for residents of a number of rural settlements.

3. Development of a model for optimizing socio-educational services in Permskii district

For realization of the investment project in accordance with the Federal law “On general principles of organization of local self-government in the Russian Federation” the district carries out budgetary investments in facilities of municipal property of the Perm municipal area.

The main objectives of optimization of socio-educational environment are:

- development of a network of educational organizations that implement quality educational services and ensure cost-effectiveness;
- elimination of district schools in the second shift;
- creating conditions for the realization of the Federal State Standard of general education – alignment of starting opportunities for ensuring the achievement of school aged children the development level necessary and sufficient for the successful study;
- optimization of the number and size of educational establishments, taking into account the population growth in the area.

Economic feasibility for the implementation of the strategy is to optimize the number of school institutions while minimizing the cost of their construction and operation (Zheliaskov & Shestakova, 2012). It seems that the solution would be achieved when implementing the construction plans of new buildings and optimization model of logistics of schoolchildren to educational institutions of those settlements where schools do not exist. Schoolchildren transportation systems from small villages to large towns in Permskii Krai are practiced for a long time. However, the need to optimize the process of growth and the number of settlements, and the population is obvious. Authors considered possible sources of new schools construction in Perm municipal district, as well as the possibility of reconstruction of some buildings converting them into schools. Calculations made based on data in Table 2 shows that in the area in the near future it is necessary to provide a full education for 3.5 thousand students. This will enable single-shift training. In the near 5 years the need for school places will continue to grow and reach 5 thousand pupils. It is about building of 3-4 schools with a standard capacity of 1100 students.

The alleged need for financing within the framework of realization of such an investment project is estimated at 615.6 million rubles, including federal and regional budgets – 50% each. The cost of the buildings renovation is calculated bearing in mind that they are used by population groups with impaired mobility.

Table 2. The alleged information on sources and amounts of funding

Measures	Financing, thousand rubles	
	Financing sources	Funds for the implementation of measures, thousand rubles
Construction of secondary schools	Federal and regional budgets	464800.0
Acquisition of buildings to accommodate secondary schools	Federal and regional budgets consolidated with the local budget	514.6

Certainly, in the future, the construction of schools will be included in the development plan of the territories and the necessary funding will be allocated from the regional and federal budgets. This may take from 3 to 5 years. However, the problem of education needs to be addressed today, without waiting for a long time. In addition, there are opportunities to significantly reduce capital construction costs by creating the optimum logistics scheme of moving schoolchildren (Zheliaskov et al., 2016).

Logistic approach to the organization of schoolchildren transportation makes new methodological content, namely that the primary constituent of transportation should be the design of optimal (rational) transportation process. This refers to the search for the best possible organizational solutions to ensure maximum efficiency in transporting students from settlements to the places of education. A model of logistics system and establishment of optimal transport and logistic scheme of students' transportation are proposed for the municipal district.

Some of the widely used linear programming methods are adapted to solve a certain class of tasks; their use gives great advantages in comparison with simplex-method (applicable for any type of linear programming problems). The most common of these is the distribution method, which in some cases simplifies calculations, improves the accuracy of calculations and reduces the amount of time required to input the original information. Its essence consists in the following:

Resource sources m and points of its consumption n are given. Resource stocks in the sources make up $A_i, i = 1, \dots, m$, needs – $B_j, j = 1, \dots, n$. Transportation cost of resource units from i -source to j -consumer – C_{ij} , X_{ij} – quantity of resource, carried from i -source to j -consumer. We need to determine the values X_{ij} , where total transportation costs will be minimal. The problem assumes as balanced; common stock resource at providers and general demand among consumers are equal:

$$\sum_{i=1}^m A_i = \sum_{j=1}^n B_j$$

Such a problem is called *closed*; if this balance is not maintained, the transportation challenge is *open*. Taking into account the equilibrium constraint, model of transport task can be formulated as follows:

- Efficiency function:

$$Z = \sum_{(i,j)} C_{ij} x_{ij} \rightarrow \min \quad (1)$$

- Limitations on the capacity of the district's secondary school:

$$\sum_{j=1}^n x_{ij} = A_i, i = 1, \dots, m \quad (2)$$

- Restrictions on the presence of students in the district:

$$\sum_{i=1}^m x_{ij} = B_j, j = 1, \dots, n \quad (3)$$

- Balance constraint:

$$\sum_{i=1}^m A_i = \sum_{j=1}^n B_j \quad (4)$$

- Non-negativity constraint:

$$x_{ij} \geq 0, i = 1, \dots, m, j = 1, \dots, n \quad (5)$$

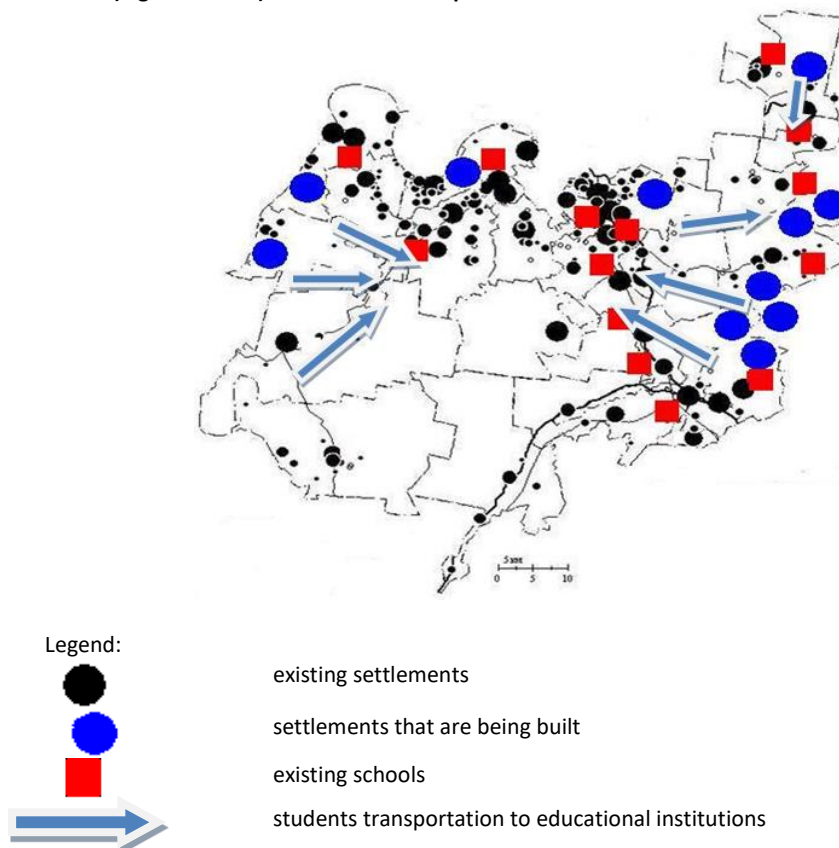
The objective function Z expresses the total transportation costs to move students.

For each rural settlement, the task consists in finding an optimal transportation of students from places of residence to the place of education and vice-versa. Based on that a scheme of pupils optimal movement within the Permskii district can be formulated.

4. Expected socio-economic benefits of socio-educational services optimization

The construction of new schools and the acquisition of buildings for their subsequent adaptations under the school will allow providing high-quality education for all the inhabitants of the developing Perm urban agglomeration. Through the realization of the investment project, will be built 3 secondary schools for 3200 pupils with the total area of 6996.2 m², 49 classes. However, first, the problem of student transportation to educational facilities must be solved. Developed transport model is designed to provide educational opportunities to all students of the municipal area. This will require new costs to the organization of transportation. At the same time, optimizing transportation of students to educational institutions in the region will reduce costs for these transportations on 15-17% annually. Realization of the logistic scheme will save 1.7 million rubles annually.

Figure 1. Optimization of students' transportation from new settlements to the place of secondary education (logistic model) in Permskii municipal district of Permskii Krai.



Conclusions

When planning the development of suburban territories, we must be aware of a new type of rural resettlement; establishment of new settlements that differ from traditional rural ones and specific resettlement system around large cities. Possible emergence of rural settlements around large cities - originally created as commuter towns and which are not meant for economic production, i.e. settlements without any economic significance - should be taken into account at the initial stage of the establishment or adjustment of territorial planning schemes. The emergence of such settlements should be anticipated when developing spatial planning schemes, social development of the territories, plans of the settlements for middle- and long-term perspectives (10-15 years). Along with the establishment of a new type of settlements, municipalities should ensure their social infrastructure. And first of all, education. Elaboration of investment projects for the development of social infrastructure and services in municipalities is a task of public authorities, not only at local level but also at regional and federal ones. Reliable information about the sources, amounts and focus of funding is required at the planning stage. There is no doubt that consolidated investment in development of educational environment in municipal areas is required. There is a need to develop separate sections constituting the planning schemes dedicated to optimizing the socio-educational environment of rural territories. For this purpose, in the first place, it is proposed to compose the optimization models of number and size of social infrastructure facilities while minimizing the cost of their establishment and operation. Elaboration of logistic schemes and mathematic models of organization of students' transportation will significantly reduce both operational (current) costs and capital investments (one-time expenditure) on the establishment of educational system in municipal areas.

References

1. Berdegué J. & Proctor F. (2014) Inclusive rural–urban linkages. Cities in the Rural Transformation. Working Paper Series No. 123. Working Group: Development with Territorial Cohesion. Territorial Cohesion for Development Program, Santiago.
2. FAO (2017) The State of Food and Agriculture - Leveraging food systems for inclusive rural transformation. FAO, Rome. Downloaded on October 20, 2017 from www.fao.org/3/a-i7658e.pdf
3. Kudrin A. (2017) «Suburb comes». Russian Gazette, 18 September. No. 209 (7375). Retrieved on October 12, 2017 from www.rg.ru
4. Lanjouw P. & Murgai R. (2009) Poverty decline, agricultural wages, and nonfarm employment in rural India: 1983–2004. *Agricultural Economics*, 40(2): 243–263.
5. UN-DESA (2014) World urbanization prospects: the 2014 revision. United Nations, Department of Economic and Social Affairs, Population Division (UN-DESA). Report ST/ESA/SER.A/366. Downloaded on October 15, 2017 from <https://esa.un.org/unpd/wup/Publications/Files/WUP2014-Report.pdf>
6. Zheliaskov A.L, Ponosova N.N. (2015) Implementation of land use measures when improving territorial structure of rural settlements of a municipal district. *Perm Agrarian Journal*, No. 1(9), pp. 75-81.
7. Zheliaskov A.L., Shestakova O.A. (2012) Topical tasks of improving the system of rural resettlement. *Prokrost*, Perm, 206 p. ISBN 987-5-94279-122-3
8. Zheliaskov A. L., Berjan S., Fotina O., El Bilali H. (2016) Urban agglomeration formation processes and delimitation approaches: case of Perm city in Ural region of Russia. Partnership of government, business and higher education institutions in fostering economic development: proceedings of the 3rd international conference of the Faculty of Economics Brcko – Brcko, Bosnia and Herzegovina; November 10-12, 2016. p. 89.