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ENERGY- EFFICIENT LOW-RISE HOUSING CONSTRUCTION MANAGEMENT ON THE BASIS OF THE PUBLIC-PRIVATE PARTNERSHIP

GESTÃO DA CONSTRUÇÃO DE HABITAÇÕES BAIXAS COM EFICIÊNCIA ENERGÉTICA COM BASE NA PARCERIA PÚBLICO-PRIVADA

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ABSTRACT

Objective: This study aims to develop a socio-economic substantiation for programmatic solutions in the area of low-rise construction in small towns and settlements, leveraging public-private partnerships. The research seeks to propose measures that ensure the intensive development of comfortable and high-quality low-rise housing.

Methods: The research methodology incorporates a theoretical analysis of the main scientific provisions of low-rise construction management. The empirical foundation is based on statistical data from low-rise construction records. The study also integrates the authors' conceptual approach to socio-economic substantiation of programmatic solutions for small towns and settlements using public-private partnerships.

Results: The study demonstrates that the proposed programmatic measures are effective and capable of ensuring the intensification of low-rise housing construction that meets high comfort and quality standards in small towns and settlements.

Conclusions: The research confirms that public-private partnerships can play a critical role in fostering the development of energy-efficient, safe, and affordable housing in less urbanized areas, promoting a higher standard and quality of life for residents. The approach highlights the importance of aligning educational, health, and agricultural development with housing initiatives to create comprehensive improvements in living conditions.

Keywords: Low-rise housing construction, Regional program for low-rise housing construction development, Indicative planning, Energy efficiency, Comfort of living, Standard and quality of life.

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RESUMO

Objetivo: Este estudo visa desenvolver uma fundamentação socioeconômica para soluções programáticas na área da construção de baixo porte em pequenas cidades e assentamentos, utilizando parcerias público-privadas. A pesquisa busca propor medidas que garantam o desenvolvimento intensivo de habitações baixas confortáveis e de alta qualidade.

Métodos: A metodologia de pesquisa incorpora uma análise teórica das principais disposições científicas da gestão de construção de baixa altura. A base empírica é baseada em dados estatísticos de registros de construção de baixa altura. O estudo também integra a abordagem conceitual dos autores para a fundamentação socioeconômica de soluções programáticas para pequenas cidades e assentamentos usando parcerias público-privadas.

Resultados: O estudo demonstra que as medidas programáticas propostas são eficazes e capazes de garantir a intensificação da construção de habitações baixas que atendem a altos padrões de conforto e qualidade em pequenas cidades e assentamentos.

Conclusões: A pesquisa confirma que as parcerias público-privadas podem desempenhar um papel crítico no fomento ao desenvolvimento de habitações seguras, acessíveis e eficientes em termos energéticos em áreas menos urbanizadas, promovendo um padrão e qualidade de vida mais elevados para os residentes. A abordagem destaca a importância de alinhar o desenvolvimento educacional, de saúde e agrícola com iniciativas habitacionais para criar melhorias abrangentes nas condições de vida.

Palavras-chave: Construção de habitações de baixa altura, Programa regional para o desenvolvimento da construção de habitações de baixa altura, Planeamento indicativo, Eficiência energética, Conforto de vida, Padrão e qualidade de vida.

1. INTRODUCTION

The key priority of the construction sector in the regions is supposed to be the improvement of the population's level and quality of life. To achieve this goal, it is necessary to develop and implement recommendations given in comprehensive strategic territorial planning documentation. In fact, this documentation is aimed at solving various problems in main spheres of life, such as housing, healthcare, education and agriculture. Effective development and implementation of strategic territorial planning documentation requires participation of all related parties, including authorities, the public, and businesses; promotes development of detailed mechanisms of public-private partnership (PPP) in implementation of low-rise construction projects and allows for sustainable development of the regions.

Special emphasis is to be placed on the citizens' housing conditions which play an important role in ensuring population's high standards of living. It is highly important to focus on the development of affordable housing especially in small towns and settlements taking

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into account the requirements of energy efficiency and safety, creating a comfortable living environment, as well as developing the PPP system in low-rise housing projects (Buzyrev et al., 2017).

It is equally important to take into account the potential of each region and its territorial specifics when developing regional development programs. A distinctive feature of the Soviet time reforms was the lack of consideration of territorial aspects of development and inefficient use of resources. This led to a significant depletion of the economic base, a decrease in the population and a considerable increase in urbanization tendencies among rural population. To prevent similar issues now, it is essential to develop and implement development programs for small towns and settlements, attract investment, support businesses, create jobs, as well as improve infrastructure and ensure access to education and health care (Gusakova et al., 2023).

According to the Russian National Classification of Municipal Territories (OKTMO) as of 2023 there are 1,203 cities and 14,580 rural settlements in the Russian Federation. Some significant changes have been observed in the structure of municipalities since 1989. The official statistical data reflects alarming trends in rural areas. A decrease in the number of villages and settlements as well as an increase in the number of rural uninhabited settlements indicate problems related to sustainability and development of rural territories. Development of efficient strategies to support and develop rural communities, restore the population and stimulate economic activity is becoming an important aspect of ensuring sustainable development of the Russian province. The number of municipal territories in Russia is presented in Table 1 (Federal State Statistics Service, 2023).

Table 1: Number of municipal territories as of January 1, 2023

Type of municipal territory	Total
Municipal area	1,421
Municipal district	311
City district	588
City district with an inner-city division	9
Intracity territory (federal cities)	267
Villages	14,580
Town settlements	1,203
Total	18,402

Stereotypical expectations and housing preferences can in fact impact types of residential projects and their location. Multi-storey housing which is often considered more profitable for investors can lead to a concentration of buildings in central districts of cities. Low-rise complex housing development is mainly implemented within city outskirts and in suburban areas. Currently, there are certain problems with the development of low-rise

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housing construction in small towns and settlements: insufficient development of the construction industry; little attention to the quality of construction, comfort, compliance with energy efficiency and safety requirements; insufficient development of engineering and social infrastructure (Krygina, 2015). In fact, the construction of low-rise buildings in small towns and settlements is currently carried out independently at the expense of local or borrowed funds.

Moreover, it is clear that the construction of low-rise housing in the regions is mainly sporadic. Lack of regional programs in the field of low-rise housing development creates difficulties for the sustainable development of this sector. Innovative construction technologies are still rarely utilized, the requirements of energy efficiency and energy saving are not yet fully met (in case of non-contracted farm construction).

Improving housing conditions in small towns and settlements is a hard-achievable goal. One of the main reasons is the lack of housing that meets the standards of comfort and accessibility. An integrated approach consisting in the development of regional programs for low-rise housing construction development might be highly successful in improving this situation (Korostin, 2015).

The most reasonable way for the sustainable development of housing construction in small towns and settlements is implementation of low-rise block-type house construction projects which are able to provide for the integrated development and sustainable growth of engineering, social and traffic infrastructure. In addition, such projects can contribute to the creation of new jobs and an overall improvement in the quality of life of the population.

An integrated approach to the development of territories is able to create additional conditions for an increase in the volume of invite investments in region's economy, an increase in accessibility of housing and quality of housing provision for the population, including state obligations to provide housing for certain categories of citizens eligible for improvement of their housing conditions. It is necessary to develop standard design documentation for low-rise buildings and low-rise housing construction enterprises, standard layout projects that will only require their adjustment to a specific region's conditions taking into account its geography and climate (Larionov & Dmitrieva, 2017).

The development of low-rise housing has its own theoretical and methodological features that influence the understanding and practical implementation of this issue. For example, scientists like S.A. Baronin and P.G. Grabovyj (2011) studied modern priorities of the development of low-rise housing construction which include energy efficiency, cost-effectiveness and environmental development of low-rise housing construction. E.G.

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Kravchenko, A.V. Voronin (2011) showed the region's priority factors of the development of low-rise housing construction, changes in its characteristics causing the formation of these factors. O.V. Grushina, G.V. Khomkalov (2013) in their research proposed an integrated approach to the development of a unified state mechanism for ensuring housing affordability and a possible arrangement structure of this mechanism based on existing and newly created institutions.

Suggestions and methodological recommendations on formation of an economic mechanism for the development of effective territorial markets for low-rise residential buildings are studied in the works of such researchers as S.A. Baronin, V.S. Kazeikin, E.L. Nikolaeva, A.G. Chernykh, A.N. Androsov (Kazeikin & Baronin, 2011). V.I. Sarchenko (2016) studied the issues of urban development effectiveness for the purposes of creation of a comfortable urban environment. Such authors as V.V. Bredikhin and A.V. Volkova (2019) studied modern methods of complex analysis of the regional housing market development. The importance of researching this issue stems from the need to accelerate economic development towards increasing the welfare of citizens and providing housing for the population. L.A. Guzikova, E.V. Plotnikova, A.M. Kolesnikov (2017) substantiated the significance of efficiency evaluation of housing policy bodies at various levels and comprehensive assessment of the housing stock in the country's regions.

The purpose of the given research is to develop socio-economic substantiation of program solutions in the field of low-rise housing construction in small towns and settlements which are aimed at improving the citizens' level and quality of life and successful interaction of all involved parties including authorities, the public, and businesses.

2. METHODS

A variety of methods were used to conduct the research including systematic and functional approach, economic and mathematical modeling and indicative planning. These methods made it possible to consider the issues of development of low-rise housing construction and ensuring accessibility of low-rise housing for citizens. The information background of the research is comprised of the data from federal and regional regulatory legal acts related to housing construction issues, electronic statistical databases of the Federal State Statistics Service.

3. RESULTS

At the first stage, systematization of the parties involved in implementation of

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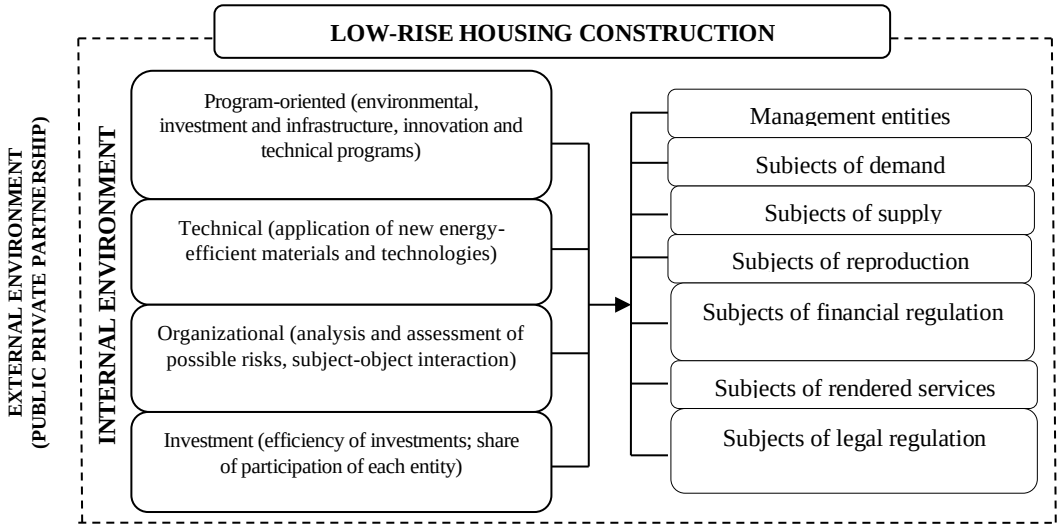
investment and construction projects of low-rise housing construction based on PPP was carried out (Figure 1).

Figure 1: Systematization of subjects in implementation of low-rise housing construction projects based on PPP



Ccompiled by the authors.

According to the given figure, the selected subjects are the main ones and form a system of interactions with each other in implementation of investment and construction projects. Main subjects in implementation of low-rise housing construction are given in (Table 2). Interaction of main entities creates internal and external environments. The internal environment is regulated through technical, organizational, investment and program-oriented management in implementation of investment and construction projects. Efficiency of the external environment entirely depends on the interest of the authorities in investment and construction projects, and for this reason a low-rise construction project is to have social orientation and provide a possibility of public housing programs' utilization (Gusakova, 2021).

Table 2: Main subjects in implementation of low-rise housing construction

Subjects of demand	certain categories of citizens which include specialists employed in socially significant industries
Subjects of supply	customer-developer (general contractor / contractor, subcontractor), private investors, enterprises of the investment and construction sectors
Management entities	authorities (federal, regional, municipal, regional operators)
Subjects of rendered services	organizations of scientific research, architectural design, design and survey, organizations for landscaping and urban gardening, organizations for operation and maintenance of construction machinery, road construction organizations, organizations for production of building structures and materials, utility engineering organizations, energy service companies
Subjects of financial regulation	financial institutions
Subjects of legal regulation	public control

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Previously conducted research on the development of a system of criteria and indicators of an organizational and economic model of low-rise housing development allows us to assess efficiency of functioning of each entity in creation of regional programs for the development of low-rise housing construction, takes into account characteristics and peculiar features of settlements, and also utilizes the case-specific approach in the process of choosing most effective technical solutions for blocked type low-rise buildings (Gusakova et al., 2020).

At the second stage, as soon as the indicator system is developed, approbation calculations on “Socio-economic substantiation of program solutions” are conducted. As the development of regional programs focuses on the development of low-rise housing in small towns and settlements, a small settlement with a low level of socio-economic development ‘Yagodnoye’ (Tomsk region, Russia) was chosen. The indicators’ calculation is carried out before and after implementation of the program activities. The results are given in Table 3 (Federal State Statistics Service. Official website, n.d.).

Table 3: Socio-economic substantiation of program solutions

Indicator	Measurement unit	Before implementation of program activities	After implementation of program activities
Provision of citizens with (affordable, energy efficient, comfortable, safe) housing in remote areas of special climatic conditions	m^2 per 1 person	0	18
Price of 1 m^2 of commissioned housing	thous. rub.	69,717	36,669
Cost of housing maintenance during operation of building	rub./m^2 per month	46,45	13,29
Level of provision of specialists in the field of healthcare, education, sports, culture, etc.	%	8	100
Provision of housing for certain categories of citizens	%	4	100
Family rate	–	2,2	4
Share of dilapidated and old housing in the general housing stock		80	0
Production of building materials from local natural resources and supplies	%	40	100
Energy efficiency class of constructed buildings	class	C	B+
Level of settlement upgrading	%	30	100

At the moment, according to the analyzed material and technical support programs, specialists are not provided with affordable, energy-efficient, comfortable, and safe housing. Specialists who have received a subsidy buy housing on their own, which does not meet the aforementioned requirements. After implementation of the program measures, the amount of affordable, energy-efficient, comfortable, safe housing is supposed to be at least 18 m^2

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per 1 specialist.

According to the local statistics, the cost of 1 m^2 of housing in Tomsk region on the secondary market in 2023 reached 69,717 rubles. In the given approbatory calculation the cost of 1 m^2 of profiled log is 36,669 rubles. The cost of housing maintenance during operation is calculated twice: before and after implementation of the program activities.

The data of municipalities for the reporting period in Yagodnoye settlement stated that the settlement required 24 specialists, 2 of which were recruited in 2022 which comprised 8%. One specialist was provided with housing which corresponded to 4%. It is assumed that during implementation of the program, the provision of specialists will reach 100%.

The family rate is currently 2.2. After implementation of the program measures according to the developed system of indices/indicators, the rate will increase to 4. According to statistics the share of dilapidated housing in small settlements in remote areas with special climatic conditions is more than 80%. Construction of new affordable, energy-efficient, comfortable, and safe housing will be able to gradually decrease this amount.

Construction of low-rise block-type housing in small towns and settlements is to be performed using the local construction materials and supplies. After implementation of the program measures this ratio is supposed to increase from 40% to 100%. The existing housing stock in small settlements does not comply with the level of energy efficiency but with the new construction the energy efficiency class will be at least B+. According to the data available in the state information systems, the level of upgrading of settlements in remote areas is currently 30%, but as a result of the program activities this figure will be able to reach 100 %.

4. CONCLUSIONS

The presented concept is a set of tools, methods, mechanisms, criteria, stages and forms of regulation of investment and construction projects of low-rise housing construction. Low-rise housing is to be purchase-affordable for certain categories of citizens employed in socially significant sectors of the economy, as well as comfortable and convenient for living, energy efficient and safe during the operation period. Economic instruments of regulation of low-rise construction within the framework of PPP include: tools for regulating the volume of construction and development of low-rise housing construction, tools for regulating financial investments in regional low-rise construction development programs in terms of energy saving requirements, tools for evaluating effectiveness of low-rise housing construction and

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evaluating its quality in implementation of an investment and construction project based on PPP.

In general, assessment of the results of socio-economic substantiation of the program solutions allows concluding that at the moment the given indicators do not reach the necessary values. For example, the settlement of Yagodnoye, which is remote from large municipal centers, requires prefabricated construction with the simultaneous use of local building materials to be prevalent in the structure of low-rise buildings within this territory. Only these are able to provide inexpensive economical in operation housing equipped with modern engineering equipment characterized by a high level of energy saving.

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