Social, economic and ecological characteristics of suburbanization development

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Abstract. This study is devoted to the suburbanization as an important stage of agglomeration development. Foreign research into suburbanization has almost a century-old tradition. In Russia the degree of previous study on these themes is low and very few investigations on this problem have been carried out to date. Therefore, the current relevance of the topic presented remains beyond any doubt. The novelty of this research implies that suburbanization is regarded as one of the main trends in the development of the settlement structure of the Irkutsk agglomeration and a new way of life of a large peripheral city. This study permitted us to identify specific features of suburbanization in the Irkutsk agglomeration. The main trends in suburban development are determined, which are due to the economic, social and ecological factors. Of particular importance in this investigation are mapping and geoinformation methods which have great potential for integral real-time presentation and analysis of the suburbanization process. For this purpose, a series of maps displaying different aspects of the study territory (change in population size, dynamics of construction, etc.) has been compiled. We identified five groups of municipalities of the Irkutsk agglomeration according to the development factors of the territory. The findings indicate a sufficiently dynamic process of change in the suburban territory of the Irkutsk agglomeration. The main conclusions are of great practical significance for administrative bodies considering that the development of the network of suburban settlements and its delimitation are most relevant to date.

1. Introduction
One of the characteristic features in the processes of modern urbanization is the polarization of the territories of cities and suburbs. This dictates an increased need for socio-economic assessments of the relationship between agglomeration processes and suburban development. The suburbanization processes are complex, contradictory and multidirectional.

The term “suburbanization” is closely allied to the concepts of urbanization, agglomeration, etc. In the development of the agglomeration as a sufficiently dynamic structure, researchers single out for consecutive stages: urbanization, suburbanization, deurbanization and reurbanization \cite{1, 2}. Suburbanization implies the development of suburbs, the reverse process of urbanization.

The suburbanization processes which were characteristic for the USA, Canada and many countries of Western Europe as early as the middle of the past century also fully apply for Russian cities to date. Gradually, subsequent to Moscow, St. Petersburg and other million-strong cities, these processes...
involved large provincial cities of Siberia. In this case, suburbanization of cities in the eastern regions of Russia has its specific features.

The Irkutsk City Agglomeration (ICA) exemplifies a historically established agglomeration. Its formation goes back to the latter half of the 20th century when there emerged the industrial satellite cities of Angarsk and Shelekhov. The main factors for their location were cheap electricity produced by the Irkutsk Hydroelectric Power Station, an advantageous transport location, the availability of manpower resources in the south of Irkutsk oblast, the absence of large areas for industrial construction in the city of Irkutsk itself and, at the same time, their existence at a relatively short distance from Irkutsk [3, 4]. The population size of the Irkutsk agglomeration is 1128.7 thousand (as of 1.1.2018) [5]. The last two decades saw a change in the character of circular migration: residents of the rural area and suburbs look for jobs in the central city whereas urban residents acquire real estate outside the city, with their jobs retained. Suburbanization is shaping a new quality of the territory and a new quality of life.

2. Objects, data and methods

The information-empirical basis for the research was provided by official statistical, methodological and normative material of Rosstat and the Administration of the city of Irkutsk, as well as cartographic sources and satellite imagery. This research is based on a comprehensive approach that includes the comparative-geographical, statistical and geoinformation mapping methods.

On the basis of the previously developed geoinformation system for the territory of the Irkutsk agglomeration, we compiled a series of maps displaying the various aspects of the study territory. For reasons of space in the article, we were unable to provide the other, equally important maps, such as the ecological maps, the maps of availability of the socio-economic infrastructure, transport accessibility, urban development dynamics, change in the area of urban development for the first-level municipal entities, etc. The paper presents only one “Map of change in the population size” as the most important map and providing insight into the ongoing processes in ICA. We used the technique based on spatial analysis of the maps generated in the geoinformation environment which makes it possible to determine the modern boundaries of ICA suburbanization and compile the map of these boundaries. Furthermore, an expanded spatial analysis of the additional maps provides information for determining the main factors influencing the development of suburban settlements. Results from analyzing the additional maps can be detailed in future publications.

3. Results and discussion

Within the boundaries of ICA there are the cities of Irkutsk, Shelekhov and Usolye-Sibirskoe as well as the Angarsk city district, and the municipal entities (ME) of the first level of the territories of the Irkutskii, Shelekhovskii and Usol'skii districts. The total migration increase in its population made up 6.55% from 2011 to 2017, whereas Irkutsk oblast showed an outflow of population: – 0.78% for the same seven years [5].

Among the important “markers” of ICA development are the changes in the population size and the urban development dynamics. The existing practice of statistical observation and of the development of data on the population size leads us to analyze the data, initially at the level of a municipal district adjacent to the oblast center and then at the level of rural settlements forming part of the district. We emphasize in this regard that in analyzing statistical data, by a “suburban” district is meant here the Irkutsk rural municipal district adjacent the oblast center whose territory, however, cannot be fully defined as the suburban zone. This remark is sufficiently important in view of the fact that the distance between the city of Irkutsk and the most remote settlements of this district exceeds 120 km.

An analysis of change in the population size and density revealed agglomeration processes of a controversial nature. On the one hand, a gradual concentration of the population of Irkutsk oblast is taking place in ICA. As the most economically developed zone, it attracts the population from the less developed districts of the oblast. On the other, an active deconcentration of the population is typical for the territory of the agglomeration itself, i.e. residents of Irkutsk leave the overpopulated core for
suburban areas with the more attractive living conditions. Thus, the population of the urban districts within Irkutsk increased to 20% between 2010 and 2018, whereas the population of the rural and urban settlements located directly around it increased from 20 to 165% [5, 6].

The main driving forces of the suburbanization process in the Irkutsk agglomeration may well include a high value of quality real estate in the city, obsolescence of housing, the desire of urban residents to escape to countryside, etc.

Thus, the main inflow of the suburban population is due not only to people arriving from the other settlements of Irkutsk oblast and neighboring regions but also to urban residents who preferred to leave for the suburb but retaining their city registration. This is explained by a poorly developed social infrastructure in the suburb. Such a suburbanization is specific to the Irkutsk agglomeration but also to Russia as a whole, unlike other countries.

As regards urban development, ICA is also undergoing substantial changes. By the year 2000, for example, the city of Irkutsk had almost totally exhausted vacant territories for a further urban development, starting its expansion to the Irkutskii district.

There is currently a significant increase in the built-up area of settlements that are closest to Irkutsk and, at the same time, a near-zero growth of settlements located at the periphery of ICA. Two different directions of development are observed around the main core of ICA. The core shows an extremely intense concentration of residential buildings with an increased number of stories, accompanied by the process of extensive expansion of the suburban zone by private low-rise houses with plots of land. Furthermore, the construction of facilities of the social and transport infrastructure in the suburb lags behind significantly from housing construction. The implications of such processes are the overburdening of the existing networks and infrastructure and a shortage of greenery and recreation zones; furthermore, valuable agricultural and recreational territories are being destroyed. Thus, the unsustainable use of land resources of ICA leads to the creation of an uncomfortable environment for human life [7, 8].

We have made a comprehensive assessment of the municipal entities of ICA according to the development factors of the territory which are combined into three classes: economic, social and ecological (table 1)

| Class                                           | Factors                                                                 |
|------------------------------------------------|-------------------------------------------------------------------------|
| Economic (economic potential of the territory) | Existence of large and medium-size production facilities               |
|                                                 | Existence of higher educational institutions                             |
|                                                 | Degree of concentration of commercial facilities and services           |
|                                                 | Degree of transport accessibility                                       |
| Social (availability of the social infrastructure) | Existence of schools and nursery and daycare facilities                 |
|                                                 | Existence of children’s and adult outpatient departments and hospitals  |
|                                                 | Existence of recreational, cultural and sports facilities               |
| Ecological (ecological risks for the population and availability of recreation resources) | Existence of commercial facilities and public catering establishments |
|                                                 | Status of the environment: air, water, soil and noise pollution,         |
|                                                 | proximity to industrial enterprises                                     |
|                                                 | Availability of recreation resources for the population                 |
The economic potential is severely differentiated. There is insufficient capacity for the remote and rural settlements to increase their economy and there are no large and medium-size enterprises; the diversity in selling goods and rendering services is limited. Large industrial centers of the agglomeration (Angarsk and Usolye-Sibirskoe) show a continual decrease in employment in industrial production, an outflow of population from them, and a decline in other economic sectors. The city of Irkutsk has a positive economic potential, with its diversified economic structure and a broad spectrum of the non-production sphere.

In the group of social factors, the lowest level of development is observed in remote rural settlements where the social infrastructure is usually represented by single facilities and large distances between them. A very low level is also characteristic for the new suburban settlements with multi-family housing estates where the social infrastructure is almost completely lacking. The best indicators in this group correspond to large urban settlements (Irkutsk, Angarsk, Shelekhov and Usolye-Sibirskoe), in consequence of a long period of an integrated development of these cities by dense multistoried buildings provided with the social infrastructure as early as Soviet times and improved to date [6, 9].

The main ecological risks for the population include the factors of air, water, soil and noise pollution of the environment. A high degree of ecological risk is typical for the territories of the settlements in which large industrial and energy generation enterprises are located, with a high level of traffic on motor roads. The greatest air pollution is observed in the urban settlements of Angarsk, Shelekhov, Usolye-Sibirskoe and Irkutsk, with a severe noise pollution as well. The limiting factor of development comprises the proximity to industrial facilities, territories of dumps, quarries and cemeteries, and to the zones and facilities of the engineering infrastructure [10-13].

On the basis of a component wise and integral scoring assessment, we identified five groups of ME (figure 1):

- linear arrangement siting along the transport routes;
- leaders (Pravoberezhnyi district of Irkutsk and Molodezhnyi ME) have a high economic potential, good indicators in the social factors and good ecological conditions;
- successful (two urban districts of Irkutsk (Sverdlovskii and Oktjabr’skii), the Angarsk city district, the city of Shelekhov, and Listvyanka, Bol’shaya Rechka and Oek ME). Angarsk and Shelekhov have high indicators of the economic and social factors but low indicators of ecological conditions. This group also includes the settlements located in the natural protected area of Lake Baikal where a restriction on the development of most kinds of economic activity is legislatively imposed; their prospects are associated with tourism and small business development. The Oek ME, in spite of its significant distance from the ICA core, has good indicators in the social and ecological group of factors;
- medium-developed (include the Leninskii district of Irkutsk and Ushakovskoe, Mamony, Smolenshchina, Urik, Dzerzhinsk and Tel’ma ME). There is a positive dynamics of the population increase as well as the existence of cottage settlements, with a shortage of the social infrastructure, however;
- underdeveloped (the city of Usolye-Sibirskoe and Ust’-Kuda, Karluk, Khomutovo, Markovo, Bol’shoy Lug and Olkha ME). The city of Usolye-Sibirskoe has low economic indicators because of the absence of production facilities in operation as well as the worst ecological indicators. In the other ME of this group, the problems facing the population include unemployment and a low level and shortage of cultural services which are being dealt with largely on account of Irkutsk and insufficiently intensely, and
- disadvantaged (Maksimovshchina, Baklashi, Bol’shaya Elan’ and Zheleznodorozhnyi ME). The first two ME were included in this group because of the unfavorable ecological conditions caused by the proximity to industrial enterprise, and the other two ME because of the low economic and social indicators.
Figure 1. Comprehensive assessment of the municipal entities of ICA according to the development factors of the territory.

4. Conclusion
The most representative markers of development of the Irkutsk city agglomeration are changes in the population size, and changes in urban development. They indicate a dynamic process of growth of the suburbs of Irkutsk, based on departures of residents of the oblast center for permanent residence to suburban settlements. Over the last 10-15 years, this process has led to the formation of an extensive belt of settlements around the regional center, differing drastically from the other territory of the urban area by architectural landscape, the system of employment, mobility, etc.

We determined the main development factors for the Irkutsk agglomeration. Nowadays, the determining factors for residence in ICA are still the social and economic factors. The ecological factors have a weak influence to date, although it is one of the priority factors for some residents.

On the basis of a component-wise and numerical score assessment of all factors and of the level of territorial development, we identified five groups of municipal entities of ICA: leaders, successful, medium-sized, underdeveloped and dysfunctional.

Thus, in summary it may be said that the research permitted us to identify the suburbanization features in the Irkutsk agglomeration and determine the trends in its development caused by the economic, social and ecological factors. The ecological indicators have influence upon population changes only in extreme manifestations, namely in the worst and best territories. The suburban territories within the urban agglomeration constitute a complex object undergoing the influence from the central city as well as from nearby settlements forming part of the agglomeration. In spite of the close internal interactions of different factors, it is conceivable that the socio-economic and ecological space is heterogeneous.
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