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MODERN APPROACHES TO SCIENTIFIC AND METHODOLOGICAL ASSESSMENT OF URBAN AGGLOMERATIONS

Abstract: *The study and evaluation of urban agglomerations is a priority of socio-economic policy in the formation and development of agglomerations. In recent times, rapid and dynamic economic development of urban agglomerations in most countries has created the need and necessity for effective, planned development of urban agglomerations and this optimal, effective strategy is at the centre of scientific and public debate. The economic character of the formation and development of urban agglomerations is that it reflects the need for systematic provision of citizens with high-quality and favorable working and living conditions, in a particular territory, taking into account the various needs and their implementation, possible provision of all engineering, housing, socio-cultural, economic, innovative, political, managerial factors. The issues of urban agglomerations raised by the President of the country in the law «On the development of agglomerations» are currently relevant [1].*

This article reviews the literature on the issues studied, considers the approaches of various authors on the methodology of urban agglomerations assessment. The article presents the indicators of urban agglomerations efficiency, which can be used in the assessment of urban agglomerations in the Republic of Kazakhstan.

Keywords: *urban agglomeration, zoning, social conditions, length, innovativeness, efficiency, agglomerativity.*

■ Introduction

The relevance of the selected research topic is predetermined by the fact that urban agglomerations are one of the main components of the territories of individual, leading regions and the economy of the country as a whole. In recent years, due to changes and intensive growth of urban agglomerations, urbanisation of most countries, there has arisen a special urgency and significance of the problem of reforming and a more thorough study of the positive and negative aspects of agglomeration of territories, as well as its evaluation methods for the implementation of effective measures for the further formation and development of these urban agglomerations.

Ensuring sustainability and stability in the functioning of urban agglomerations is one of the important aspects of their effective life. Achieving a decent level of development of urban agglomerations is of particular importance in the modern policy of the state, which is reflected in the law «On the development of agglomerations» [1].

The aim of the study is to propose different scientific and methodological approaches to the assessment of urban agglomerations and to develop the authors' own assessment of urban agglomerations.

■ Literature review

The study of urban agglomerations, methods of assessment, problems are devoted to the works of such famous economists as Volchkova I.V. [2], Merinov Yu.N., Merinova Yu.Yu. [3]. The issues of managing the economic growth of agglomerations were considered by Ugrumova A.A. [5], geo-urbanistics by Pertsik E.N. [6,15], typology of agglomerations by scientists Naimark N.I., Zaslavsky I.N. [15], and modern

approaches to agglomerations. [15], and modern approaches of intensively developing urban agglomerations Chinese researchers Chuanlin Fang, Danlin Yu. [14] and others.

Materials and methods

The general approaches of scientific cognition, in particular, data collection and research, comparisons, methods of statistical analysis and synthesis, method of scientific abstraction were used in writing the article.

The method of comparison was used in the study of theoretical and methodological foundations.

Results and discussions

The main goal of the urban agglomeration development strategy is the well-being of Kazakhstani citizens and the efficiency of the economy of agglomeration territories and the country as a whole. It should be remembered that the fundamental goal of any urban agglomeration is to provide the population with the vital conditions that would lead to the fruitful development of these agglomerations and to be considered an agglomeration [2-4].

Table 1. Criteria for identifying urban agglomerations

№	Criteria, indicators:	The IGRAN (Institute of Geography of the Russian Academy of Sciences) methodology	Methodology TSNIIP (Central Research and Design Institute for Urban Planning)	Unified methodology	
				Large-city agglomerations	More-urban agglomerations
1	The population of the center.	At least 250 thousand people	At least 100 thousand people	At least 250 thousand people	-
2	Temporary accessibility from the outskirts to the center.	No more than 1.5 hours	No more than 2.0 hours	No more than 1.5 hours	-
3	Accessibility from peripheral large and medium-sized cities to the center.	-	-	No more than 0.5	
4	hours (from large and medium-sized cities)	Not more than 0.5	At least 3	At least 4	At least 4
5	Hours (from medium-sized cities)	at least 50 thousand people	-	-	-
6	The size of the urban population of the agglomeration.	-	at least 110 thousand people.	-	-
7	The share of the population of urban settlements of the agglomeration zone	-	at least 10% of the total urban population	-	-
8	Coefficient of agglomeration development (agglomeration)	at least 1	at least 1	at least 1	at least 2

Source – compiled by the authors on the basis of the source [4].

Let’s consider the main approaches to the classification of agglomerations:

1. Typology by population of the core city.

As part of the research in this paper, the main approaches of agglomeration classification are highlighted:

1. Typology by population of the core city. In accordance with the first approach to the allocation of agglomeration, the criterion for classification is the population of the core city (Table 2) [6-8].

Table 2. Typology of agglomerations by the number of core cities

No	Author of the typology	City groups
1	Lappo G.M.	The largest - more than 1000 thousand people; large - 500-1000 thousand people; large - 250-500 thousand people; medium - 100-250 thousand people.
2	Pertsik E.N.	The largest - 500 thousand people. and above, millionaire cities; large - 100-500 thousand people; medium - 20-100 thousand people; small - up to 20 thousand people.
3	Konstantinov O.A.	Large and large cities (over 100 thousand people); medium-sized cities (100–20 thousand people); small towns (less than 20 thousand people); small urban settlements (less than 5 thousand people).

Source - compiled by the authors on the basis of sources [9-11].

2. Typology based on the index of agglomeration. Depending on the agglomeration index, the following types of agglomerations are distinguished: the most developed; highly developed; developed; underdeveloped.

The methodology for assessing the total potential of a particular agglomeration, proposed by Ugryumova A.A. [5, p. 6]. In our opinion, the most acceptable is the method proposed by Schmidt A.V., Antonyuk V.S., Franchini A. [12]. A comprehensive assessment of the urban agglomeration, in addition to territorial and demographic ones, should contain socio-economic indicators of the development of the agglomeration and methodology. The indicators are combined into three groups: indicators characterizing the position of the agglomeration in the development of the region; indicators characterizing the development of the agglomeration as a whole; indicators characterizing the internal development of the agglomeration. Thus, the methodology for studying the urban agglomeration and its role in regional development suggests the following analysis algorithm.

The first stage is a comparative characteristic of the centre and the region in statistics and dynamics by the main indicators of socio-economic development: average monthly nominal accrued wages; agricultural output; housing commissioning; retail trade turnover; investment in fixed capital; value of fixed assets. The resulting indicator of socio-economic development of the centre and the region is the volume of shipped goods of own production, works and services performed by own forces (without small businesses). At the same time, the dynamics of indicators should be assessed by calculating their average annual growth rates.

The second stage - characterisation of the starting position of the agglomeration core on the eve of its formation according to the following indicators: agglomeration type - determined by the number of agglomeration cores and characterising its structural feature (monocentric or polycentric); population density of the agglomeration core - characterised by the number of people living on 1 km²; level of centralisation of the agglomeration core - the ratio of the agglomeration core population to the next most populous city; national composition of the agglomeration core.

Third stage - characterisation of the starting position of the urban agglomeration according to the indicator of crowdedness - the population of the city centre: medium (100-250 thousand people); large (250-500 thousand people); large (500-1000 thousand people); largest (more than 1000 thousand people) [13].

Based on the intensive growth of Chinese agglomeration processes in modern times, Chinese academic researchers in their research work propose 4 stages of urban agglomeration development, shown in Table 3.

Table 3. Analysis comparing four stages of urban agglomerations development

Stages of urban agglomeration development		First extension	Second extension	Third extension	Fourth extension
Name	City	Metropolitan area	Agglomeration belt	The belt of the big metropolis	Megapolis
Spatial coverage	Small	Subregional	Regional	Interregional	National/ international

Stages of urban agglomeration development		First extension	Second extension	Third extension	Fourth extension
Radius	Municipal	Metropolitan	Intermetropolitan	Subnational	National/ international
Number of cities	1	1	1	Three or more	3 cores with multiple peripherals
Population	5-10 million	5-10 million	5-10 million	More than 20 million	More than 20 million
Spatial structure	1 city	1 city and its immediate surroundings	1 city and influencing periphery	3 or more cities and their periphery	At least 2 major agglomerations and all cities
Transport network	Intra-city network, weak intercity connections	Improved communication between cities	Full long-distance communication	Full intercity service	Extensive connectivity within and between metropolitan areas
Industrial integration	Very weak long-distance integration	Weak long-distance integration	Some inter-city integration	Strong inter-city integration	Fully integrated industrial systems
Regional structure	One core	Single-core multilayer structure	Single-core radiating multilayer structure	Single-core or multi-core multi-layer network structure	Multicore nebula, highly interconnected network structure
Expansion mode	Point Extension	Point-to-circle extension	Expansion along the point axis	Expansion of the axial belt	A bead network radiating expansion
Stages of development	Infancy stage	Initial stage	Middle stage	Mature stage	Final stage
Function	Municipal Growth Centre	Subregional Growth Centre	Regional Growth Centre	National Growth Centre	International Growth Centre

Source - compiled by the authors based on the source [14].

Based on the degree of formation and development of the urban agglomeration area. Here the classifying feature is the agglomerativity index: agglomerativity coefficient - the ratio of the density of the network of urban settlements to the average shortest distance between them. Agglomerativity coefficient - characterises the formation and development of the external environment. It is calculated as the density of the network of urban settlements related to the average shortest distance between them:

$$K_a = \frac{N}{S} \times L, \tag{1}$$

where:

N - number of urban settlements in the agglomeration territory;

S - area of agglomeration territory, km²;

L - shortest distance between urban centres.

Agglomerativity index (I_a) - the ratio of the urban population of the outer zone to the urban population of the whole agglomeration:

$$I_a = \frac{P}{P_a}, \tag{2}$$

where:

P - urban population of the satellite zone;

P_a - urban population of the agglomeration area.

1. Agglomeration population development index:

$$K_{dev.} = P(M \times m + N \times n), \tag{3}$$

where:

P - population of the urban agglomeration (million people);

M - number of cities in the urban agglomeration;

N - number of urban-type settlements in the urban agglomeration;

- share of urban population in the population of the urban agglomeration;

- share of the population of urban-type settlements in the population of urban agglomeration.

In order for a settlement system to be an agglomeration development coefficient ($K_{(dev.)}$) must be greater than 1 [15].

Classes of urban agglomeration development are determined on the basis of the development coefficient value: more than 50 - most developed; - from 10 to 50 - strongly developed; from 5 to 10 - developed; from 2.5 to 5 - underdeveloped; less than 2.5 - least developed; urban agglomerations that do not meet any of the criteria - potential ones.

3. Agglomeration development rate measured by the average annual growth rate of urban population over 20 years. All urban agglomerations are divided into non-dynamic (average annual growth rate of urban population over 20 years is below 1%), low-dynamic (1-2%), medium-dynamic (2-4%), high-dynamic (4-5%), especially dynamic (more than 5%). [16].

The fourth stage - analysing the peculiarities of the internal environment of the agglomeration by main characteristics is carried out by identifying the following factors:

- geographical position, i.e. the location of an urban agglomeration can influence its economic development. For example, an agglomeration located on a major trade route is more likely to be prosperous than an agglomeration located in a remote area;

- sectoral specialisation, looking at the types of industries located in an urban agglomeration can also influence its economic development. For example, an agglomeration that hosts a number of high-tech industries is more likely to be prosperous than an agglomeration that hosts a number of low-wage industries;

- availability and development of good transport infrastructure can contribute to the economic development of the urban agglomeration. This is because it facilitates the movement of goods and people across the agglomeration, which can help to attract investment and create jobs;

- the degree of homogeneity of economic, social and environmental space. The degree of homogeneity of an urban agglomeration can also influence its economic development. A more homogeneous agglomeration is more likely to be prosperous than a more heterogeneous one. This is because a more homogeneous agglomeration is more likely to share a common sense of identity and purpose, which can contribute to economic development [15].

The boundaries of agglomerations will expand, and more and more small towns and rural settlements will fall within the zone of their influence. This means that two principles apply to agglomeration development:

- the territorial principle comes from the city and implies an integrated approach to the organisation of the territory.

- the sectoral principle pursues «sectoral» benefits and does not always take into account territorial interests.

Agglomeration development is a complex process with both positive and negative aspects. However, it is obvious that agglomerations can play a significant role in the economic development of the region. For the formation and development of socio-economic differentiation in an urban agglomeration, it is necessary to assess it with the help of indicators that can characterise the main areas of life in the territory. The sphere of life of the urban agglomeration is very diverse, and there are many factors affecting socio-economic differentiation. Therefore, it is important to determine the composition and structure of such indicators [13].

Thus, the formation and development of agglomerations is a natural process due to the concentration of productive forces and forms of communication. Agglomerations have a positive impact on the economy, as they contribute to the development of inter-settlement transport links, intensification of entrepreneurial activity, and improvement of suburban areas. Agglomerations also ensure equal accessibility of the population to labour markets and social infrastructure facilities.

The development of agglomerations will increase the concentration of human capital, infrastructure and resources in a given territory. This will make it possible to form these territories as zones of advanced economic growth. Implementation of measures to create modern road, transport and logistics infrastructure

will increase the connectivity of territories within agglomerations, improve the mobility of the population, increase the speed of commodity flows, and reduce logistics costs.

To assess the degree of socio-economic differentiation of urban agglomeration, only the management and geographical subsystems are not enough, it is necessary to define a specific set of indicators and methods of their calculation. The most accurate assessment is achieved when building a hierarchically linked system of indicators using appropriate integral indicators. The set of specific indicators used to assess socio-economic differentiation should be stable over time and fully reflect the level of formation and development of urban agglomerations.

With the rapid, intensive economic and densely populated development of the People’s Republic of China, urban agglomerations are actively forming and developing. On the basis of which, the Chinese authors of the study (using the example of the PRC, where the population is very high - more than 1.4118 billion people, data 2023) offer their methodological approach and define an area as an urban agglomeration when it has the following, specific, national characteristics: more than 3 major cities with a population of more than 20 million people, GDP per capita more than 10,000 dollars, non-agricultural population more than 50%, non-agricultural industries accounting for more than 70% of GNP, the central location of the main city of the PRC. These criteria are based on socio-economic tensions and the integration of cities into urban agglomerations. However, the authors recognise that actual regulations may need to be adjusted depending on the specific location of urban agglomerations and are often appropriate for developed, densely populated, innovation-oriented countries, in particular China [14].

Table 4 presents a system of indicators for assessing the degree of socio-economic differentiation of urban agglomerations, proposed by the authors of this article. In this case, to assess the degree of socio-economic differentiation of urban agglomerations, subsystems of indicators are used.

Table 4. Author’s scientific and methodological approach to the evaluation of the system of indicators for assessing the degree of socio-economic differentiation in urban agglomerations.

№	Blocks of indicators	Indicators for assessing the degree of socio-economic differentiation
1	Indicators measuring agglomeration economic development.	Economic subsystem
		Volume of goods and services shipped per capita
		Development of economic sectors
		Retail trade turnover per capitam
		Volume of paid services to the population per capita
		Amount of own budgetary funds per capitam
2	Indicators measuring the availability of resources and infrastructure in the agglomeration.	Resource and Infrastructure Subsystem
		Degree of depreciation of fixed assets in the real sector of the economy
		Share of employment in small enterprises in the total number of employed in the economy
		Ratio of labour demand to the economically active population
		Number of connected cellular mobile communication terminals per capita
3	Indicators measuring social development of agglomeration.	Social subsystem
		Demographic load factor
		Migration growth, population (+), attrition (-)
		Employment rate
		Ratio of average per capita income to average per capita subsistence minimum,
		Housing costs
		Level of housing provision
		Coefficient of provision of the population with housing and communal services.
Quality index of provision of housing and communal services		

№	Blocks of indicators	Indicators for assessing the degree of socio-economic differentiation
4	Indicators measuring the quality of the agglomeration environment.	
		Emission of pollutants into the atmosphere from stationary sources
		Discharge of polluted wastewater
		Degree of waste recycling
5	Indicators determining the innovation environment of urban agglomeration.	
	Innovation subsystem	1. Share of innovative products, number of enterprises total, including those producing innovative products; 2. Volume of R&D, thousand tenge; 3. Number of enterprises with R&D; 4. Number of FEZ; 5. Volume of shipped innovative products of the total volume 6. Volume of output FEZ
6	Indicators determining the external economic environment urban agglomeration.	
	Foreign Economic Subsystem	1. Exports, 2. Import, 3. Foreign trade turnover 4. Inflation/dollar exchange rate
7	Indicators measuring the educational environment of the urban agglomeration.	
	The cultural and educational subsystem	1. Number of schools/number of schoolchildren Number of colleges/number of students Number of universities/number of students, cultural events, festivals, show business, etc.
8	Indicators measuring the budgetary environment of the urban agglomeration.	
	Budget subsystem	Taxes, budget revenues and expenditures, Deficit or surplus Amount of state budgetary funds per capitam
<i>Source - compiled by the authors.</i>		

According to Table 4, the indicators in each of the 8 subsystems are used to assess the degree of socio-economic differentiation of urban agglomerations. The results of the assessment can be used to make optimal and effective decisions on the formation, development and reduction of differentiation, as well as to promote sustainable development of agglomeration.

The authors propose to use the method of determining socio-economic differentiation in urban agglomerations of Kazakhstan by combining the numerical data of blocks of indicators into an integral indicator. This method will allow to objectively identify the levels of socio-economic development of urban agglomeration settlements in the period under consideration.

Socio-economic differentiation of urban agglomerations is a complex problem that needs to be solved. One way to assess the degree of socio-economic differentiation is to use a system of indicators. This system should include indicators from different aspects of socio-economic life, such as economy, resources and infrastructure, society, ecology, investment, and the development of economic sectors.

The economic subsystem is the most important block for assessing the degree of socio-economic differentiation of urban agglomeration. This is due to the fact that the economic development of a settlement has a significant impact on other spheres of socio-economic life. The block of resources and infrastructure includes indicators reflecting the state of health care and education facilities, housing and communal services in the urban agglomeration. These indicators are also important for assessing the degree of socio-economic differentiation.

The social subsystem includes such indicators as the demographic load coefficient, migration growth (loss) of population, employment rate, the ratio of average per capita income and average per capita subsistence minimum, etc. These indicators are important for assessing the degree of socio-economic differentiation, as they show how well the population copes with basic needs and quality of life.

The environmental subsystem includes indicators measuring the environmental quality of the urban agglomeration. These indicators are important for assessing the degree of socio-economic differentiation, as they show how the economic development of the agglomeration affects the environment.

The innovation subsystem includes indicators measuring the innovation environment of the urban

agglomeration, such as the share of innovative products, the number of enterprises in total, including those producing innovative products; the volume of R&D; the number of enterprises with R&D; the number of FEZ; the volume of shipped innovative products from the total volume, the volume of output of FEZ products.

The educational subsystem includes indicators measuring the number of schools, colleges, universities and their students, as often most of the students of universities and colleges, having finished their studies, join the population of urban agglomerations, which leads to significant growth, as well as cultural events, festivals, the development of show business attracts to this agglomeration.

The budget subsystem includes the following indicators - taxes, budget revenues and expenditures, budget deficit or surplus, per capita public budgetary resources, which are then financially reflected in the development of urban agglomerations.

As a result, a comprehensive assessment of the socio-economic differentiation of an urban agglomeration should cover all these areas and determine the level of development of the agglomeration under consideration. This will help identify problem areas, weaknesses and strengths and develop policies to address them.

In addition to using a system of indicators, it is also important to use ranking to assess the degree of socio-economic differentiation. The ranking allows the identification of settlements most affected by socio-economic differentiation. This information can be used to target government policies and interventions in these settlements.

Conclusion

For further development of urban agglomerations in Kazakhstan, a full-fledged systemic assessment of these phenomena is needed. The adopted law «On the development of agglomerations» in 2023 is relevant and modern realities require a comprehensive methodological approach to addressing the challenges facing the dynamic development of urban agglomerations in the country. Given the intensity of urban agglomerations development in the Republic of Kazakhstan, it is necessary to rethink the measures for the development of urban agglomerations in order to reduce the burden on the budget and increase various directions for their favourable, low-risk development:

- identification of criteria for urban agglomerations taking into account national characteristics;
- determination of typology by population size, by indicators characterising the development of the region, agglomeration as a whole, taking into account external and internal factors;
- determination of agglomerativity coefficients, agglomerativity indices of individual regions or settlements.
- identification of classes of development and rates of development of urban agglomerations;
- analysing the internal and external environment of urban agglomerations;
- The author's comprehensive assessment of the system of indicators, the degree of socio-economic differentiation in urban agglomerations and the determination of urban agglomerations' development ratings;
- identification of weaknesses, strengths and problems in the development of urban agglomerations.

In the future, on the basis of the considered scientific and methodological approaches in this article it will be necessary to carry out calculations on specific urban agglomerations with the development of prospects, strategic programmes, which will give more objective and rational recommendations for their further effectiveness and impetus for the development of this territory.

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ҚАЛАЛЫҚ АГЛОМЕРАЦИЯЛАРДЫ ҒЫЛЫМИ-ӘДІСТЕМЕЛІК БАҒАЛАУДЫҢ ЗАМАНАУИ ТӘСІЛДЕРІ

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Аңдатпа: Қалалық агломерацияларды зерттеу және бағалау агломерацияларды қалыптастыру мен дамытудағы әлеуметтік-экономикалық саясаттың басым бағыты болып табылады. Соңғы уақытта көптеген елдерде қалалық агломерациялардың қарқынды және қарқынды экономикалық дамуы жағдайында қалалық агломерацияларды тиімді, жүйелі түрде дамыту қажеттілігі туындады және бұл оңтайлы, тиімді стратегия ғылыми және қоғамдық талқылаулардың орталығында. Қала агломерацияларының қалыптасуы мен дамуының экономикалық сипаты оның жүзеге асырылуын ескере отырып, азаматтарды белгілі бір аумақта тұру, жұмыс істеу және тұру үшін сапалы және қолайлы жағдайлармен жүйелі қамтамасыз ету қажеттілігін көрсететіндігінде. әртүрлі қажеттіліктер және оларды жүзеге асыру, барлық инженерлік, тұрғын үй, әлеуметтік-мәдени, экономикалық, инновациялық, саяси, басқарушылық факторлармен мүмкін қамтамасыз ету. Қазіргі уақытта ел Президентінің «Агломерацияларды дамыту туралы» заңында атап өткен қалалық агломерация мәселелері өзекті болып отыр [1].

Бұл мақалада зерттелетін мәселелер бойынша әдебиеттер қарастырылады, әртүрлі авторлардың қалалық агломерацияларды бағалау әдіснамасы бойынша көзқарастары қарастырылады. Қазақстан Республикасындағы қалалық агломерацияларды бағалауда пайдаланылуы мүмкін қалалық агломерациялардың тиімділік көрсеткіштері келтірілген.

Түйін сөздер: Қазақстан Республикасы, қала агломерациясы, аймақтарға бөлу, әлеуметтік жағдайлар, ұзындық, инновация, тиімділік, агломерацияның даму коэффициенті (агломерация)

СОВРЕМЕННЫЕ ПОДХОДЫ К НАУЧНО-МЕТОДИЧЕСКОЙ ОЦЕНКЕ ГОРОДСКИХ АГЛОМЕРАЦИЙ

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Аннотация: Изучение и оценка городских агломераций является приоритетом социально-экономической политики при формировании и развитии агломераций. За последнее время с быстрым и динамичным экономическим развитием городских агломераций в большинстве стран появилась потребность и необходимость в эффективном, планомерном развитии городских агломераций и данная оптимальная, результативная стратегия находится в центре научных и общественных дискуссий. Экономическая природа формирования и развития городских агломераций заключается в том, что оно отражает необходимость системного обеспечения граждан качественных и благоприятных условий проживания, труда, жизнедеятельности в определенной территории с учетом реализации всевозможных потребностей и реализации их, возможным обеспечением всех инженерных, жилищных, социально-культурных, экономических, инновационных, политических, управленческих факторов. На данный момент актуальны вопросы городских агломераций, упомянутые Президентом страны в законе «О развитии агломераций» [1].

В данной статье проведен обзор литературы по исследуемым вопросам, рассмотрены подходы различных авторов по методике оценки городских агломераций. Приведены показатели эффективности городских агломераций, которые могут быть использованы при оценке городских агломераций в Республике Казахстан.

Ключевые слова: Республика Казахстан, городская агломерация, районирование, социальные условия, протяженность, инновационность, эффективность, коэффициент развитости агломерации (агломеративности)