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METHODOLOGICAL ASPECTS OF ASSESSING AND ANALYSING AGGLOMERATION DEVELOPMENT

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Abstract. This article analyses existing theoretical and methodological approaches to assessing agglomeration processes. The study compares “universal” and “individual” methods for assessing agglomerations, highlighting their respective advantages and limitations. Within the framework of the study, an updated integral index of agglomeration development is proposed. In addition to traditional socio-economic indicators, the proposed index incorporates components related to digital governance and environmental sustainability. This approach provides a more comprehensive framework for assessing contemporary agglomeration development in the context of urbanisation and sustainable urban development.

Keywords. agglomeration, integral index, normalisation, digital governance, environmental sustainability, urbanisation, sustainable cities and communities, assessment methodology, SDG 11.

Аннотация. В статье анализируются существующие теоретические и методологические подходы к оценке агломерационных процессов. В рамках исследования проводится сравнительный анализ «универсальных» и «индивидуальных» методов оценки агломераций с выделением их соответствующих преимуществ и особенностей применения. Предлагается усовершенствованный интегральный индекс развития агломераций, который наряду с традиционными социально-экономическими показателями включает компоненты, связанные с цифровым управлением и экологической устойчивостью. Данный подход формирует более комплексную методологическую основу для оценки современного развития агломераций в условиях урбанизации и устойчивого развития городских территорий.

Ключевые слова. агломерация, интегральный индекс, нормализация, цифровое управление, экологическая устойчивость, урбанизация, устойчивые города и населённые пункты, методология оценки, ЦУР 11.

INTRODUCTION

Assessing the development of agglomerations is a well-established area of research, and various assessment methods have been developed and tested internationally, including in Uzbekistan. These methods offer a number of methodological advantages; however, contemporary conditions of agglomeration

development create opportunities for their further refinement, particularly in terms of assessing the effectiveness of agglomeration development management.

Existing methods for assessing agglomeration development can generally be divided into two groups according to the purpose and scope of the research: “universal” methods, aimed at assessing the development of large groups of agglomerations within a country or macro-region, and “individual” methods, designed to provide a more detailed assessment of one or several specific agglomerations.

In practice, methods of the first type are more widely applied. Their principal advantage lies in their relative simplicity and comparability across a large number of agglomerations. At the same time, the methodological framework of universal approaches provides opportunities for further consideration of the internal structure of agglomerations, including the characteristics of their core and peripheral zones, as well as the diversity of socio-economic processes occurring within them. Universal methods are generally based on a set of key indicators characterising agglomeration development. Accordingly, an agglomeration is usually considered not as a single point but, at a minimum, as a combination of a core and a peripheral zone, although the distinctive characteristics of these components may not always be fully reflected.

Furthermore, ensuring the universal applicability and comparability of such methods generally requires the use of publicly available official statistical data. Although this approach facilitates standardised comparisons, the level of territorial and sectoral detail available in official statistics may influence the comprehensiveness of the resulting assessment. This creates a methodological basis for supplementing traditional statistical indicators with additional sources of information where appropriate.

The second group of methods differs from universal approaches primarily in terms of the depth and scope of analysis. A broader research framework makes it possible to examine the internal structure of an agglomeration and the processes occurring within it in greater detail. Such approaches can also extend beyond conventional official statistics by incorporating alternative data collection and analytical techniques, including sociological surveys, visual observations, and big data analysis.

In many cases, individual methods place particular emphasis on identifying the functional boundaries of an agglomeration, since the analytical tools employed can facilitate a more precise determination of its actual spatial boundaries beyond formal administrative divisions. At the same time, the multi-component nature of this approach enables a comprehensive assessment of agglomeration development. An additional advantage is the flexibility of the composite agglomeration index: depending on the objectives of the study, relevant indicators can be incorporated into its structure. This provides an opportunity to adapt the assessment framework to contemporary dimensions of agglomeration development, including digital governance and environmental sustainability.

LITERATURE REVIEW

The theoretical foundations of the economic effects associated with agglomeration processes can be traced to the work of A. Marshall, whose *Principles of Economics*, first published in 1890, developed the concept of external economies. According to Marshall's approach, the geographical concentration of enterprises can generate economic advantages through specialised labour markets, the development of supporting industries, and the diffusion of knowledge¹.

The theoretical understanding of agglomeration economies was subsequently expanded by J. Jacobs (1969), who emphasised that the benefits of spatial concentration may arise not only from specialisation within a particular industry but also from interaction and knowledge exchange among different sectors of the urban economy. These approaches subsequently became associated in the economic literature with Marshallian specialisation and Jacobs-type diversification economies².

The development of New Economic Geography, particularly the works of Nobel Prize laureate P. Krugman, provided an additional theoretical framework for explaining the spatial concentration of economic activity. Krugman's research demonstrated how economies of scale, market interactions, and transportation costs can contribute to the geographical concentration of productive activity and the emergence of economic centres³. Within this framework, such concentration mechanisms are commonly interpreted as centripetal forces shaping the spatial organisation of economic activity.

M. Porter's cluster theory further expanded the understanding of spatial concentration by linking clusters of interconnected firms and institutions with regional competitiveness, productivity, and innovation. From this perspective, agglomerations can be considered not merely as spatial concentrations of settlements and

1 Маршалл А. Принципы экономической науки. – М.: Прогресс, 1993.

2 Джейкобс Д. Экономика городов. М.: Культурное наследие, 2008.

3 Krugman P. Increasing Returns, Monopolistic Competition and International Trade // Journal of International Economics. – 1979. – Vol. 9. – № 4.

economic activity but also as environments capable of supporting innovation, knowledge exchange, and competitive development⁴.

Uzbek scholars, including S.S. Zokirov, Yu.I. Salimova, and S.K. Tashtaeва, have examined various aspects of agglomeration development in Uzbekistan, including urbanisation processes, the formation and development characteristics of urban agglomerations, and the role of agglomerations as an instrument of regional policy⁵. These studies contribute to the development of a national research framework for understanding the territorial, institutional, and socio-economic characteristics of agglomeration processes.

Within the context of ongoing reforms in Uzbekistan, research on agglomeration development is increasingly associated with the improvement of institutional and legal mechanisms for territorial management and the implementation of strategic objectives related to balanced regional and urban development. In this regard, further refinement of the methodology for assessing agglomeration development is important for strengthening the analytical basis of territorial planning, improving management mechanisms, and supporting evidence-based decision-making.

RESEARCH METHODOLOGY

This study employs a combination of theoretical and empirical research methods to assess contemporary approaches to agglomeration development. The theoretical component is based on a systematic review and analysis of relevant academic literature and recent research publications, while the empirical component draws on available statistical data to substantiate the findings.

The methodological framework incorporates systems analysis, induction and deduction, comparative analysis, and grouping methods. Systems analysis is applied to examine agglomeration development as an integrated process encompassing economic, social, infrastructural, digital, and environmental dimensions. Comparative analysis is used to identify similarities and distinctive characteristics among existing approaches to assessing agglomeration development, while the grouping method enables relevant indicators to be classified according to their functional dimensions. Induction and deduction are employed to synthesise the results and formulate theoretically grounded conclusions regarding the improvement of agglomeration assessment methodology.

In the preparation of this study, artificial intelligence (AI) tools were used to a limited extent, accounting for approximately 10% of the overall research process. Their use was primarily confined to language refinement, technical editing, and structural support. The selection of research methods, collection and analysis of statistical data, interpretation of the results, formulation of scientific conclusions, and development of practical recommendations were carried out and verified by the authors.

ANALYSIS AND RESULTS

The analysis of existing approaches indicates that agglomeration development indices commonly incorporate economic, social, and infrastructural indicators, including the level of transport integration, labour market mobility, and the concentration of industrial and service-sector activities. These indicators provide an important basis for assessing the intensity and structural characteristics of agglomeration processes.

At the same time, the contemporary development of agglomerations is increasingly interconnected with changes in the urban environment, particularly those associated with digital transformation and environmental sustainability. Consequently, traditional economic, social, and infrastructural components can be further enhanced by incorporating indicators that reflect these emerging dimensions of urban and agglomeration development.

Accordingly, within the framework of this study, the agglomeration development index applied in practice is supplemented with indicators of digital governance and environmental sustainability. The inclusion of these components provides a more comprehensive assessment of the current state and development dynamics of agglomerations and facilitates the identification of priority areas for further development.

The proposed approach also contributes to the formation of an analytical database for strategic decision-making and provides a methodological foundation for developing a systematic monitoring framework aligned with contemporary international approaches and the evolving requirements of sustainable urban development.

4 Портер Е. Майкл П60 Конкурентная стратегия: Методика анализа отраслей и конкурентов/ Майкл Е. Портер; Пер. с англ. – М.: Альпина Бизнес Букс, 2005. – 454 с.

5 Зокиров С.С. Ўзбекистонда урбанизация жараёnlарини ривожлантиришнинг институционал жиҳатлари //Стратегическое планирование – важный фактор стабильности устойчивого социально-экономического развития страны и регионов: материалы Форума экономистов/ под общей редакцией. Т. Ахмедова. /Ташкент: IFMR, 2019. – С393-397; Салимова Ю. И. Городская агломерация как инструмент региональной политики //Iqtisodiyot va ta'lim, 2024-yil 1-son. – В. 386-392; Таштаева С. Ўзбекистонда шаҳар агломерацияларининг шаклланиш ва ривожланиш хусусиятлари // Ҳозирги замон географияси: назария ва амалиёт.- Тошкент, 2006.- Б.250-252;

By integrating economic, social, infrastructural, digital, and environmental dimensions into a unified assessment framework, the updated index enables a more comprehensive analysis of agglomeration development and supports evidence-based territorial planning and management (Table 1).

Table 1

Components of the agglomeration development index and their weight⁶

№	Indicators	Unit of measurement	Weight	Maximum indicator
1. Economic				
1.1	GDP per capita	Mln. sum	0,30	60
1.2.	Economic growth rate	%	0,20	8
1.3.	Employment rate	%	0,20	85
1.4.	Foreign direct investment per capita	thousand dollars	0,15	500
1.5.	Small business share of GDP	%	0,10	60
1.6.	Volume of trade and services	Trln sum	0,05	100
2. Social				
2.1.	Average monthly salary	Mln sum	0,20	8
2.2	Education Quality Index	Score (0-100)	0,20	100
2.3	Number of doctors per 10,000 people	Score	0,15	50
2.4	Housing provision	Kv. metr/pn	0,15	25
2.5	Density of cultural sites	100000 person	0,10	30
2.6	Security level	Score (0-100)	0,10	100
2.7.	Social infrastructure	Score (0-100)	0,10	100
3. Infrastructure				
3.1.	Transport infrastructure	Score(0-100)	0,30	100
3.2.	Transit coverage	%	0,20	95
3.3.	Road quality and density	Km/kv.km	0,15	8
3.4.	Water supply	%	0,15	100
3.5.	Power supply	%	0,10	99,5
3.6.	Sewerage system	%	0,10	100
4. Digital control				
4.1.	Internet access	%	0,25	98
4.2.	Electronic government services	%	0,25	90
4.3.	Digital literacy	%	0,20	85
4.4.	Density of IT companies	100000 person	0,15	200
4.5.	Smart City technologies	Score (0-100)	0,15	100
5. Ecological sustainability				
5.1.	Green zones	Kv. m/pn	0,30	25
5.2.	Air quality (AQI)	Score (50-100)	0,25	0-50
5.3.	Waste recycling	%	0,20	70
5.4	Water quality	Score(0-100)	0,15	100
5.5.	Renewable energy	%	0,10	30

The determination of the agglomeration development index is carried out in 5 stages. Its essence lies in calculating the integral indicator of the level of socio-economic development of the agglomeration.

In the first stage, we determine the components of each index and their weight, and reflect this in the table (Table 1).

⁶ Author's development

At the second stage, since these indicators are expressed in different units of measurement, they are brought to a single basis (normalized). To achieve this, based on the positive and negative influence of the aforementioned indicators on the agglomeration index, the following formulas are used:

$$X_n = \frac{X}{X_{max}} \quad (1)$$

$$X_n = 1 - \frac{X}{X_{max}} + \frac{X_{min}}{X_{max}} \quad (2)$$

X_n – rating value of the agglomeration indicator n ;

X – value of the agglomeration indicator;

X_{max} – maximum indicator value;

X_{min} – minimum indicator value.

At the third stage, the weight (share) of the ADI components is determined based on their significance. In our opinion, it is advisable to assign the following weights to the aforementioned components (Table 2).

Table 2

Indicators of the proposed agglomeration development index and their weight⁷

No	Indicators	Maximum score
1.	Economic	30
2.	Social	25
3.	Infrastructure	20
4.	Digital control	15
5.	Ecological sustainability	10
Jami	100	

We calculate the development index at the fourth stage using the following formula:

$$ADI = \sum W_i \times I_i$$

Here:

ADI - Agglomeration development index

W_i - weight of each indicator

I_i - the normalized value of each individual indicator.

In our example, the final index is calculated using the following formula:

$$ADI=0,30E+0,25S+0,20I+0,15D+0,10ES$$

At the fifth stage, the results obtained are evaluated, adjusted, and conclusions are drawn. Based on the findings, the strengths and weaknesses of the agglomeration are identified, development directions for each component are developed, and target indicators are developed.

This methodology covers 5 main areas (economic, social, infrastructure, digital management, and environmental sustainability) when determining the agglomeration development index, is based on 28 specific indicators, takes into account international experience, complies with the recommendations specified in the «Uzbekistan - 2030» strategy, and provides a monitoring and evaluation system.

CONCLUSION AND RECOMMENDATIONS

Based on the examination of the methodological aspects of assessing agglomeration processes, the following scientific and practical conclusions can be drawn.

First, the analysis of methodological approaches demonstrates that existing “universal” assessment methods provide a comprehensive basis for comparing agglomerations and identifying general development patterns. At the same time, their methodological framework can be further enhanced to reflect more comprehensively the internal dynamics of agglomerations and the diversity of formal and informal economic linkages. In this regard, the proposed “individual” approach, combined with an integral assessment index, provides opportunities for a more detailed and accurate assessment of the actual development potential and structural characteristics of individual agglomerations.

⁷ Author's development

Second, an important methodological contribution of the study is the development of the Agglomeration Development Index (ADI). The proposed index extends the traditional socio-economic and infrastructural dimensions of agglomeration assessment by incorporating indicators of digital governance and environmental sustainability. This approach is consistent with contemporary Smart City principles and the Sustainable Development Goals, particularly SDG 11 – Sustainable Cities and Communities, and enables agglomeration development to be assessed from a broader and more integrated perspective.

Third, the integral indicator, calculated through the normalisation of selected indicators and the assignment of appropriate weighting coefficients, provides a methodological basis for comparative analysis across agglomerations and regions. The resulting assessment framework can serve as an important analytical and information base for public administration bodies in formulating agglomeration development strategies, identifying priority areas for further development, monitoring territorial dynamics, and supporting evidence-based decision-making.

Overall, the proposed methodological approach contributes to improving the assessment of agglomeration development by integrating economic, social, infrastructural, digital, and environmental dimensions within a unified analytical framework. Its application can support more comprehensive territorial analysis and strengthen the methodological basis for sustainable and strategically coordinated agglomeration development.

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