DOI: 10.15838/esc.2023.1.85.5
UDC 332.14, LBC 60.050

International and Russian Approaches to Studying the Sustainable Development of Urban Environment: From Theory to Practice

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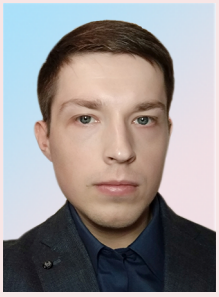

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Abstract. We consider international and Russian approaches to the definition of sustainable development. The report *Our Common Future* was based on a triune concept of the sustainable development – environmental, social and economic. Gradually the emphasis of sustainable development has shifted from the global problems of continents, separate states and regions to studying the sustainable development of urban environment, as currently more than half of the world's population lives in cities. On the one hand, cities determine living standards, the improvement of which is a prerequisite for meeting basic needs for employment, housing, health care, education, and rest; on the other hand, they face problems such as lack of financial resources and jobs, increasing homelessness and poverty, widening the gap between the rich and the poor. We present an analysis of the accepted documents of the UN-Habitat on sustainable human settlements development on the Vancouver Declaration on Human Settlements (1976) to the *World Cities Report 2022: Envisioning the Future of Cities*. We present the European way

For citation: Fauzer V.V., Smirnov A.V. (2023). International and Russian approaches to studying the sustainable development of urban environment: From theory to practice. *Economic and Social Changes: Facts, Trends, Forecast*, 16(1), 85–102. DOI: 10.15838/esc.2023.1.85.5

through the European Charter. The main points and concepts of the sustainable development of big and small cities of Europe are considered from the Aalborg Charter (Denmark, 1994) to the Mannheim Message (Germany, 2020). We analyze northern city ranking, which has been implemented by the Rating agency SGM since 2013. We propose a methodology for assessing the sustainable development of northern cities on eight demographic and labor indicators; conduct a grouping of 115 cities of the Russian North on the types and indicators of the sustainable development, and mark 10 most sustainable cities and 10 – with the worst ranking. The considered theoretical provisions and practical results can be used for comparative studies and planning of territorial development. We suggest the directions for improving the sustainable development of Russia's northern cities.

Key words: UN-Habitat, European Charter, sustainable development of cities, Russian North, demographic and labor sustainability, rating score.

Acknowledgment

The article was prepared within the program BR10965247 "Study of drivers, features and dynamics of demographic processes, migration, urbanization in Kazakhstan, the development of digital maps and forecasts". The source of financing is the Committee of Science of the Ministry of Education of Science of the Republic of Kazakhstan. The authors are grateful to Galina N. Fauzer and Ekaterina A. Chuprova for helping in preparing the manuscript for printing.

Introduction

Despite the wide range of relevant literature, it is hard to say with certainty, who and when first proposed the vision and rationale for sustainable development. Suffering appalling losses from drought or, conversely, from abundant rainfall, lack of breeding and insufficient use of fertilizer in growing crops, ancient farmers concluded that the farming process should be sustainable and it should be managed. In competition with wild animals for meat and game, primitive hunters recognized the necessity to domesticate animals to supplement plant-based diet with meat products in a permanent way. Statesmen understood the desirability of respecting both the rights of all groups of citizens and the rights and sovereignty of economically and politico-military weak states for the purpose of sustainable development (SD).

For the first time, the members of the Club of Rome started speaking systematically about sustainable development. Its first president Aurelio Peccei wrote: "Demographic crisis, unemployment, resource scarcity and mismanagement, pollution, destruction of the biosphere and many other problems have intertwined like the tentacles of a giant octopus and entangled the entire planet". A chain of gradual transitions was proposed: "growth in general – acceptable growth – dynamic equilibrium". Particular attention was paid to the reasonable satisfaction of human needs. "The concept of need must be related to the possibility of its satisfaction, and human demands should be subordinated to the possibility of their reasonable provision. Otherwise we have nothing but chaos and disappointment ahead" (Peccei, 1985).

At the international stage, the concept of sustainable development appeared after the publication Our Common Future in 1987, the report of the UN World Commission on Environment and Development[1]. It first introduced the basic formulation "sustainable development

[1] Our Common Future: Report of the World Commission on Environment and Development. UN. Available at: http://www.un.org/ru/ga/pdf/brundtland.pdf (accessed: November 20, 2022).

is the development in which the needs of present generations are met without compromising the ability of future generations to meet their own needs". It contains the key idea of sustainable development as a balance between generations.

The concept of sustainable development has many aspects. It began with studying ecological, social and economic problems and then moved on to a more detailed study of social problems, including demographic, labor and migration aspects (Demographic and Labor Factors..., 2018), since this is where many of the most important challenges of the 21st century are concentrated. There is rapid population growth in some continents and depopulation in others, uncontrolled migration to European countries has increased. The fight against poverty and indigence has not yielded the necessary results. According to the World Bank, about 46% of the world's population lived on less than 5.50 dollars a day.

At the same time the issues of sustainable development of entire continents or their parts, states and regions began to be considered in relation to the sustainable development of urban space, separate cities. And it was not an idle interest – more and more people on planet Earth began living in cities. In the 1960s, C. Tilly drew attention to the increasing pace of urbanization: "In 100 B.C., less than 1% of the world's population lived in cities; in 1800 it was less than 5%, and only the 20th century is becoming the century of urbanization" (Tilly, 1968). According to Report UN-Habitat's State of the World's Cities – 2022, as "the urban population continues increasing due to higher fertility, especially in lower-income countries, it is projected that the urban population share of the total world population will rise from 56% in 2021 to 68% in 2050"[2]. In recent years, urban populations have been growing at an "average rate of 1.5 million people per week. Although cities occupy only 1% of the landmass, they are responsible for 80% of energy consumption (and carbon dioxide emissions). For this reason, it is cities that are at the forefront of the fight against climate change" (Gil'en, 2022).

With growing importance of cities, the world community has begun adopting a number of fundamental documents on the sustainable development and condition of cities: UN-Habitat (1976), the European Charter of Local Self-Government (1985), the Aalborg Charter (1994) and others. In the Russian Federation, special attention is paid to the development and management of cities. In 2002, the Moscow Declaration was adopted, and in 2003 the Federal Law "On general principles of organization of local self-government in the Russian Federation" was published. In 2016 the passport of the priority program "Integrated development of single-industry towns" was approved. Every year ratings of cities by living standards, wages, amenities, development rate, climate, population, etc. are created. Since 2013 a rating of sustainable development of Russia's cities is published, and since 2022 a ranking of sustainable development of Russia's regions is made.

In the study of social sustainability, we proposed to single out demographic sustainability and labor sustainability into separate research fields, as in the long run they will have a determining influence on social development. Demographic sustainability proceeds from the fact that the quantity and quality of the population determine other types of sustainability; and labor sustainability determines the quality of life and human attitude to ward nature and society. Consequently, increasing the degree of demographic and labor sustainability will raise the overall sustainability of urban space.

The methodology was tested in relation to the northern and Arctic regions. The indicators used and the results obtained are presented in the papers (Fauzer et al., 2018a; Fauzer et al., 2018b). The next research step is supposed to move from the study of regions to urban space and sustainable development of cities.

[2] World Cities Report 2022. Envisaging the Future of Cities. Nairobi: United Nations Human Settlements Programme.

The focus of attention is on the cities of Russia's northern regions. The goal is to assess the labor and demographic sustainability of the cities of the Russian North based on international and Russian approaches to assessing the sustainable development of urban space. For its disclosure, we have set the following tasks:

– to systematize approaches to studying and assessing sustainable development of cities;

– to define a set of demographic and labor indicators to assess sustainable development of cities;

– to work out a methodology for assessing urban sustainable development by labor and demographic indicators;

– to rank the northern cities by demographic and labor sustainability; to give a brief description of the cities of leaders and outsiders in sustainable development, to identify the most important factors promoting sustainability for different groups of cities.

The information base is the data of municipal statistics.

The considered theoretical provisions, the proposed methodology and practical results can be used for cross-country comparisons. The first experience of such a study was obtained when working with colleagues from Kazakhstan[3] (Fauzer, Al'zhanova, 2022).

Theoretical provisions of sustainable development

There are quite a lot of monographic works and research articles on sustainable development from the point of view of environmental, economic and social problems. There are significantly fewer studies on the assessment of demographic and labor sustainability, although these two areas, in our opinion, are key for social development. Without claiming to cover all monographs and dissertations in full, we will name those that have fallen into the sphere of our attention. Earlier in the collective monograph, we made a fairly complete review of publications on sustainable development, including those posted on the platform of the scientific electronic library eLIBRARY.RU (Demographic and labor factors..., 2018).

The first works covering the northern territories include monograph of T.V. Uskova Managing the Sustainable Development of the Region, which examines theoretical and methodological aspects of sustainable development; reveals modern approaches to assessing the sustainability of regional socio-economic systems; shows the role of local self-government in ensuring sustainable development and increasing the regional competitiveness (Uskova, 2009).

The multidimensional monograph of the team of authors Factors in Sustainable Development of the Russian Regions is of interest. It gives approaches to the typology of regions by SD for various reasons, notes that ensuring regions' sustainable development is possible on the basis of stimulating the regional industrial complex, provides experience in studying the SD of Yakutia, the Saratov Oblast and Primorsky Krai (Borisova et al., 2015).

The monograph Social Stability of the Region: Diagnostics and Development Problems reveals the essence, structure, goals, principles and drivers of social stability of the region; systematizes modern approaches to the definition and study of social stability of territories. The rating of Russian's territories on the level of social stability and its components has been compiled. A complex of objective and subjective threats to social stability has been identified (Social Stability..., 2017).

In relation to the North of Russia, the monograph Social Sustainability of the Russian North and the Arctic Regions: Assessment and Ways to Achieve was published. The authors proposed an original methodology for assessing the social

[3] Program BR10965247 "Study of drivers, features and dynamics of demographic processes, migration, urbanization in Kazakhstan, development of digital maps and forecasts".

sustainability of the regions of the North and the Arctic, compiled their ratings, and performed mapping. To achieve social sustainability, a specific mechanism and algorithm of actions were proposed (Social Sustainability..., 2018).

Closer to the topic of our research is the monograph Demographic and Labor Factors Promoting Sustainable Development of the Northern Regions of Russia. It presents the world's systems of indicators for monitoring the Sustainable Development Goals at the intercountry, country and local levels; identifies factors and indicators for assessing demographic and labor sustainability; all northern regions are ranked by the degree of sustainability (high, medium, low, critical); shows the role and impact of population migration on the SD of the northern territories (Demographic and labor factors..., 2018).

The urban theme is raised in the work Sustainable Development of Cities, where a wide range of issues from "territorial and sectoral organization of society" to "accommodation of the population, industries and assessment of the environmental situation" are considered. The research focuses on the study of the "Nature – Man – Production" system and on the problems of the development of single-industry towns (Sustainable development..., 2019).

Of interest is the monograph of I.A. Vershinina Modern Theories of the City: Sociological Analysis, devoted to the analysis of the theories most significant for the sociological understanding of urban space. The author presents a retrospective analysis of the development of urban studies, demonstrating in what perspective social issues were reflected in them, and then proceeds to consider theoretical developments in the field of urban studies that contribute to the enrichment of modern sociological knowledge. The monograph reconstructs the representations of the city as a social phenomenon characteristic of modern urbanism (Vershinina, 2019).

The dissertations of Y.D. Yurkov[4] and M.Y. Osipova[5] are devoted to sustainable development.

There are works on demographic sustainability in foreign scientific literature (Roca et al., 2002; Camarinha-Matos, Afsarmanesh, 2010; Stern, 2013). For example, sustainability characteristics such as population size and density, urbanization degree, migration, gender ratio, age composition, level of education and employment are studied (Roca, Roca, 2014). From the point of view of labor factors, sustainable development is considered in the work of K. van Treeck. The analysis of the distribution of total income between the factors of production makes it possible to assess the degree of achievement of the sustainable development goal "decent work for all"[6]. However, this approach has some disadvantages, since other sustainability factors are ignored.

Principles, concepts and programs of sustainable development of cities

The study of urban space is based on the principles, concepts and programs set out in the documents of the United Nations, the European Charter and regulatory legal acts of the Russian Federation. Let us start with the general UN provisions and finish with the documents of the Russian Federation.

The first document on sustainable development of human settlements was the United Nations Human Settlements Programme, UN-HABITAT to promote sustainable human settlements development. In 1976, the First Habitat I Conference was held in Vancouver, Canada. It was emphasized

[4] Yurkov D.V. (2017). Migration management as a mechanism of sustainable development of territories: Doctor of Sciences (Economics) thesis. Kazan.

[5] Osipova M.Yu. (2017). Development of a static-dynamic approach to the assessment and management of sustainable development of the region: Candidate of Sciences (Economics) thesis. Perm.

[6] van Treeck K. (2017). The Role of Labor in Sustainable Development. Doctoral Thesis. Available at: https://ediss.uni-goettingen.de/handle/11858/00-1735-0000-0023-3FB0-A (accessed: December 1, 2022).

that there is an extremely difficult situation in the field of human settlements, primarily in developing countries; that "the situation in settlements determines the quality of life and determines the possibility of meeting such basic needs as employment, housing, medical care, education and recreation". It was stressed that there is an "uncontrolled urban growth and the resulting conditions of overpopulation, pollution, environmental degradation and psychological tension in large cities"[7].

In 1996, the Second Human Settlements Conference, Habitat II, was held in Istanbul (Turkey). It adopted two resolutions: the Istanbul Declaration on Human Settlements and the Habitat Agenda. The conference was devoted to two topics: "Adequate housing for all" and "Sustainable human settlements development in an urbanizing world". The declaration notes that "among the most serious problems faced by cities and their residents are the lack of financial resources and jobs, the increase in the number of homeless and the proliferation of squatter settlements, the growth of poverty and the ever-widening gap between the rich and the poor, the deterioration of the security situation and the increase in crime, the deterioration of the housing stock, quality of services and infrastructure, lack of healthcare and education institutions, irrational land use, unreliability of land tenure laws, congestion of the road network, increased environmental pollution and a number of others".

To address the highlighted problems, it is necessary to resolve the contradiction between "consumption and production"; "uneven settlement and concentration of population in limited areas, accompanied by an increase in poverty, destitution, unemployment, social isolation and a number of other social ills of urban communities". The SD goals require creating conditions for economic growth, social development and environmental protection[8].

In June 2001, the 25th Special Session of the UN General Assembly "Istanbul + 5" was held in New York City, where the Declaration on Cities and Other Human Settlements in the New Millennium was adopted, reaffirming the commitment to the Istanbul Declaration on Human Settlements and the Habitat Agenda, which address "adequate housing for all, sustainable human settlements development, promotion and participation, gender equality, financing of housing and human settlements development, international cooperation and assessment of progress". New initiatives in the spirit of the United Nations Millennium Declaration were also outlined. It was noted that "large and small cities have the potential to maximize the benefits and smooth out the negative effects of globalization. Rationally managed cities can provide an economic environment capable of generating employment opportunities for the population, as well as provide a variety of goods and services"[9].

A new urban agenda was adopted at the UN Conference on Housing and Sustainable Urban Development (Habitat III), held October 17–20, 2016 in Quito, Ecuador. Habitat III members agreed that "cities will be the source of problems rather than their cause. If intelligently planned and efficiently organized, urbanization can be a meaningful tool for achieving SD in both developed and developing countries". The program Habitat III would help "end poverty and hunger; reduce inequality; ensure economic growth and gender equality; increase resilience and protect the

[7] Declaration of Principles: Vancouver Declaration on Human Settlements. Available at: https://www.un.org/ru/documents/decl_conv/declarations/pdf/vancouver.pdf (accessed: November 20, 2022).

[8] Report of the United Nations Conference on Human Settlements (Habitat II) (1996). Available at: https://www.un.org/ru/documents/decl_conv/declarations/pdf/vancouver.pdf (accessed: November 20, 2022).

[9] Declaration on Cities and Other Human Settlements in the New Millennium. Available at: http://www.unhabitat.ru/assets/files/publication/dg.pdf (accessed: November 20, 2022).

environment". The conference asked the Secretary-General to report every four years on the progress of the New Urban Agenda[10].

The new UN-Habitat report (Katowice, Poland, June 29, 2022) *World Cities Report 2022: Envisaging the Future of Cities* aims to "provide greater clarity and understanding of the future of cities based on current trends, challenges and opportunities, and disruptive conditions, including valuable lessons from the COVID-19 pandemic". The report's time frame is defined as the "Decade of Action" window (2020–2030). For sustainable development of cities (SDC), "in low-income countries, urban density should be planned and managed so that future growth does not put pressure on existing open land, infrastructure, and services and result in crowding on the one hand, or unsustainable sprawl on the other". It is noted that "cities create wealth but also concentrate poverty and inequality". Sustainable development of cities will be facilitated by "integration of urban-rural connections". The future of cities will be based "on knowledge, largely through innovation and the widespread use of new technologies, as well as the digitization of virtually every aspect of urban life"[11].

The European states went their own way – through creating charters. The first document on sustainable development of cities can be considered the European Charter of Local Self-Government (Strasbourg, France, October 15, 1985). It emphasized that "local self-government is one of the main foundations of any democratic system", and that "the right can only be exercised at the local level". The document defines local self-government as "the right and real ability of local authorities to regulate and manage a considerable part of public affairs, acting within the framework of the law, under their own responsibility and in the interests of the local population. The charter emphasizes that "changes in the boundaries of territories in which local self-governance is exercised are allowed only by taking into account the opinion of the population of the respective territories, including by holding a referendum where permitted by law. Finally, the principles of financial activity are defined, providing for financial equalization between weak and strong local governments; it is noted that "the subsidies provided are distributed by local governments within their competence and should not come under specific programs"[12]. Russia signed the charter on February 28, 1996.

The foundations of sustainable development of cities and towns were laid during the First European Conference on Sustainable Urban Development in the charter European Cities & Towns Towards Sustainability (Aalborg Charter, Denmark, May 27, 1994). It notes that "achieving the current level of resource consumption in industrialized countries is impossible for all living people, and even more so for future generations, without destroying natural capital. To realize the idea of SDCs, it is necessary "to strive for social justice, a sustainable economy and environmental sustainability. Social justice should inevitably be based on economic sustainability and equality, which requires environmental sustainability". It is noted that "sustainability on the Earth is ensured by the sustainability of local communities". It is suggested that emerging problems be solved at the city level, and if that is impossible, then to take them beyond its borders[13]. In Russia, 16 cities have joined the Aalborg Charter, including Izhevsk, Orel, Perm, Rostov-on-Don, Smolensk, and Stavropol.

[10] New City Development Program. Available at: http://www.unhabitat.ru/assets/files/publication/Documents/NUA-Russian.pdf (accessed: November 20.11.2022).

[11] World Cities Report 2022. Envisaging the Future of Cities. Available at: https://unhabitat.org/wcr/#chapter-1 (accessed: November 20, 2022).

[12] European Charter of Local Self-Government. Available at: https://rm.coe.int/168007a088 (accessed: November 20, 2022).

[13] Charter European Cities & Towns Towards Sustainability (Aalborg Charter). Available at: http://www.ecology.donbass.com/articles-pdf/aalborgcharter_russian.pdf (accessed: November 20, 2022).

In 1996, the Second European Conference on Sustainable Cities & Towns was held in Lisbon, Portugal, which adopted the Lisbon Action Plan: From Charter to Action, including the principle of negotiation, management tools, created North-South and West-East alliances[14].

Further conferences on the sustainable development of European cities and towns were held in Hanover (Germany, 2000); Aalborg (Denmark, 2004); Seville (Spain, 2007); Dunkirk (France, 2010); Geneva (Switzerland, 2013); Basque Country (Spain, 2016).

The last conference was held in Mannheim, Germany, from September 30 to October 2, 2020, online. It discussed the European Green Deal. The central question of Mannheim 2020 was whether Europe could achieve a sustainable transition with the new European Green Deal. The European Commission conference presented the **Mannheim Message**, a local response to the European Green Deal[15].

In the Russian Federation, considerable attention is paid to sustainable development of cities – June 5, 2002 in the State Kremlin Palace in Moscow, Russia held a national meeting "Ensuring the sustainable development of cities in Russia", which adopted the "Moscow Declaration". Legislative framework is actively being created. In 2003, the Federal Law "On General Principles of Organization of Local Self-Government in the Russian Federation" was published. In 2004 the City Planning Code was adopted, and the CIS City Planning Charter (2000) was ratified. In 2016 the passport of the priority program "Integrated development of single-industry towns" was approved. Annual ratings of cities by living standards, wages, amenities, development rate, climate, population, etc. are carried out.

Ratings and indicators of sustainable development of cities

The compilation of ratings and indicator systems is one of the most important activities of international organizations, states, and scientists in the framework of sustainable development policy formation. Ratings make it possible to identify the strengths and weaknesses of different countries, territories and settlements, to track progress in achieving the sustainable development goals. They are used in the elaboration of strategic documents of socio-economic development.

Much experience has been accumulated in the field of compiling and scientifically substantiating ratings and indices of sustainable development of cities[16] (Arustamov, 2017; Bobylev et al., 2020). Many methods and approaches have been developed. For example, UN entities have considerable experience in this direction. Back in 1996, the Urban Development Index was developed by the UN Human Settlements Program (UN-Habitat)[17]. Another system of indicators was developed by the UN Commission on Sustainable Development[18].

Based on the UN Sustainable Development Goals adopted in 2015, many countries began creating national systems of indicators. For example, the U.S. evaluated the sustainable development of 124 cities, and a group of Russian and Finnish scientists developed a system of indicators for the Arctic territories (Bobylev et al., 2018).

[14] The Lisbon Action Plan: From Charter to action. Available at: http://www.ecology.donbass.com/articles-pdf/lisbon.pdf (accessed: November 20, 2022).

[15] Program of 9th European conference on sustainable cities & towns. Available at: https://conferences.sustainablecities.eu/mannheim2020/programme/ (accessed: November 23, 2022).

[16] Davis K.E. et al. (Eds.). (2012). *Governance by Indicators: Global Power through Quantification and Rankings*. Oxford: Oxford University Press.

[17] City Development Index. Available at: https://unhabitat.org/ (accessed: November 23, 2022).

[18] *Indicators of Sustainable Development: Guidelines and Methodologies*. Third Edition. New York: United Nations, 2007.

In Russian publications, a significant place is given to the set of indicators and justification of their selection criteria for assessing the degree of sustainable development of cities. Three articles (Shabunova, Leonidova, 2011; Bobylev et al., 2014; Dolgikh et al., 2019) can be referred to as comprehensive works, and two articles – to Arctic topics (Gutman, Basova, 2017; Sergunin et al., 2021).

In Russia, the SGM Rating Agency has been compiling a ranking of sustainable development of cities since 2013, based on the principles of SD and international experience. The rating covers 185 large cities with population over 100 thousand people; it is aimed at highlighting the strengths and weaknesses of municipalities, setting guidelines for authorities and residents, creating incentives to achieve sustainable development goals, highlighting cities-leaders for potential investors.

The number and composition of sustainability indicators in the ranking has changed several times: 2012 – 32, 2013 – 30, 2014 – 32, 2015 – 31, 2016–2018 – 42, 2019–2020 – 43. The system of indicators includes three groups: economy and urban economy, social sphere and environmental situation. The choice of indicators was based on several principles: the openness of data (posting only on the official websites of cities and statistical bodies), completeness (for each indicator data are available for at least 95% of cities) and relevance – compliance with the objectives of sustainable development. We sifted out indicators with low reliability[19].

In 2012 SGM rating base included 19 cities located in the Russian North (Khanty-Mansiysk was excluded – 85.0 thousand), in 2020 – 20 cities (Magadan remained in the base – 98.7 thousand). According to the ranking of the first 50 cities included nine northern cities, and in the top ten – Khanty-Mansiysk and Yuzhno-Sakhalinsk. Except Syktyvkar, eight cities are located in the Asian North. In the rank from 51 to 100 included five cities, except Petropavlovsk-Kamchatsky, four are located in the European North. Five cities are in the 101–150 ranking. Kyzyl, ranked 165, is at the bottom of the ranking scale. We also can note that the ranking and sustainable cities development indices (SCDI) are closely correlated with each other. Only two cities in the first group worsened their ranking and SCDI: Nizhnevartovsk and Novy Urengoy (*Tab. 1*).

In 2020, 14 out of 20 northern cities exceeded the median value in Russia (0.491). However, nine northern cities have worsened their positions; six of the seven leaders are located in the oil and gas producing regions of Western Siberia. Their high indicators are provided mainly by the resource economy, which does not guarantee sustainability in the long term.

It is worth noting that since 2022 SGM Agency for the first time has compiled the Ranking of Sustainable Development of Russian Regions at the regional level. It evaluates all 85 Russian regions on the basis of 43 indicators, united in five blocks: economic development (including innovation), urban infrastructure, demography, social infrastructure and ecology. Of the northern regions, the best position is taken by Khanty-Mansi Autonomous Okrug – 6, the middle by the Republic of Sakha (Yakutia) – 39 and the worst by the Republic of Tyva – 81[20].

Since the existing ratings do not assess the sustainability of small and medium-sized cities, they do not allow drawing conclusions about the vast majority of cities in the Russian North. In addition, they do not adequately represent demographic and labor components, especially important in

[19] Rating of sustainable development of cities of the Russian Federation. Available at: https://www.agencysgm.com/ratings/ (accessed: November 23, 2022).

[20] Ranking of Sustainable Development of Russian Regions. Available at: https://agencysgm.com/upload/iblock/05b/05b0bd931bf3a3023229ca5c429293b5.pdf (accessed: November 20, 2022).

Table 1. Rating and index of sustainable development of cities of the Russian North, 2012 and 2020

City	SGM rating – 2012			SGM rating – 2020			Dynamics, 2012–2020		
	rank	population, thousand people	SCDI	rank	population, thousand people	SCDI	rank	population, %	SCDI
Khanty-Mansiysk	-	85.0	-	2	101.5	0.671	-	19.4	-
Yuzhno-Sakhalinsk	122	186.3	0.468	10	207.3	0.624	112	11.3	0.156
Surgut	34	316.6	0.559	11	387.2	0.618	23	22.3	0.059
Nefteyugansk	24	125.2	0.572	14	128.2	0.604	10	2.4	0.032
Nizhnevartovsk	17	258.8	0.588	19	278.7	0.578	-2	7.7	-0.010
Novy Urengoy	3	112.2	0.642	26	118.1	0.567	-23	5.3	-0.075
Noyabrsk	64	109.2	0.520	30	108.4	0.563	34	-0.7	0.043
Yakutsk	124	278.4	0.465	40	347.2	0.538	84	24.7	0.073
Syktyvkar	112	254.5	0.476	42	259.3	0.535	70	1.9	0.059
Petropavlovsk-Kamchatsky	146*	179.8	0.394*	65	179.4	0.516	81	-0.2	0.122
Murmansk	126	305.0	0.463	68	282.9	0.512	58	-7.2	0.049
Arkhangelsk	113	356.5	0.476	69	352.0	0.511	44	-1.3	0.035
Ukhta	115	121.7	0.475	71	112.3	0.511	44	-7.7	0.036
Petrozavodsk	65	265.3	0.518	82	280.7	0.504	-17	5.8	-0.014
Magadan	118	102.1	0.472	120	98.7	0.467	-2	-3.3	-0.005
Norilsk	107	178.1	0.482	134	183.3	0.452	-27	2.9	-0.030
Severodvinsk	119	191.3	0.471	135	181.8	0.452	-16	-5.0	-0.019
Bratsk	139	243.9	0.445	140	225.0	0.448	-1	-7.7	0.003
Komsomolsk-on-Amur	103	260.3	0.484	146	241.1	0.444	-43	-7.4	-0.040
Kyzyl	148	112.0	0.428	165	120.1	0.420	-17	7.2	-0.008

Ranked by SCDI for 2020.
* 2013 data.
Source: Rating of sustainable development of cities of the Russian Federation. Available at: https://www.agencysgm.com/ratings/

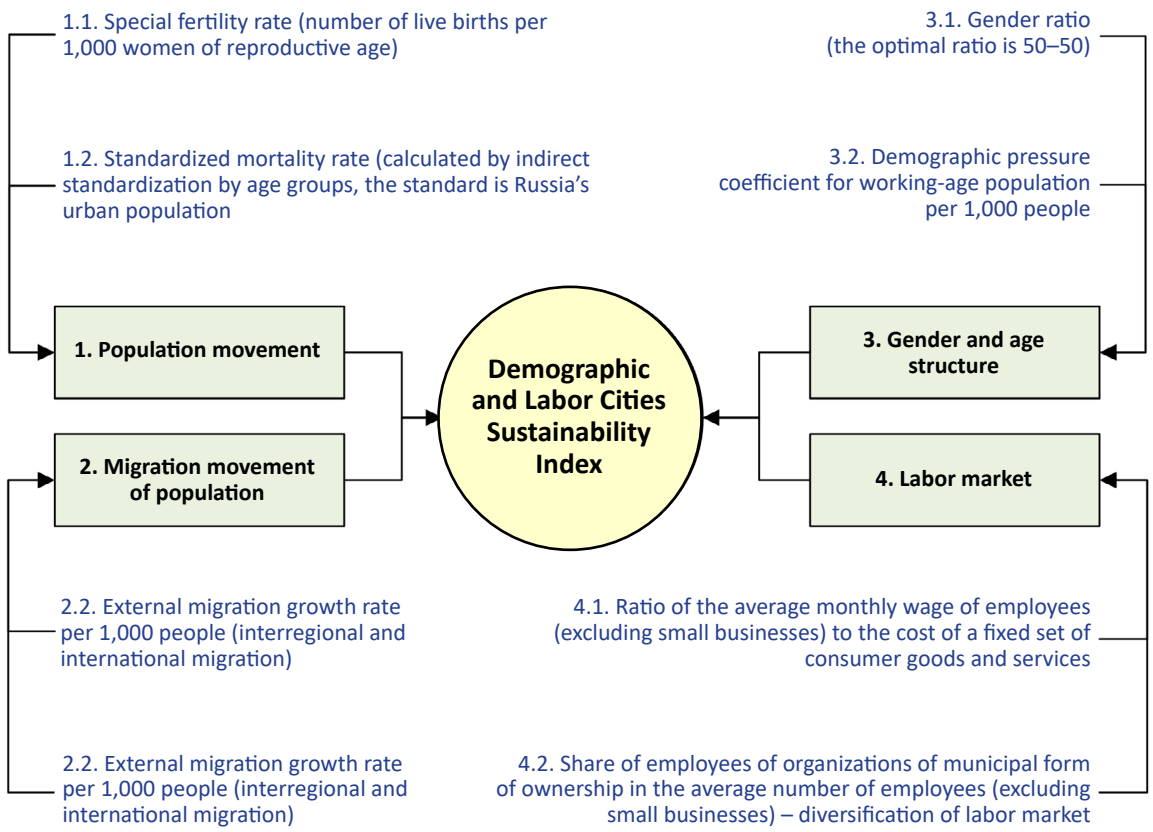
the conditions of the North due to the long-term migration outflow of the population and the large number of single-industry towns.

Methodology for studying sustainable development of cities by demographic and labor indicators

The cities of the Russian North are the research object. In addition to 13 regions, the territories of which are referred to the Far North and equivalent areas, we also considered six northern cities of Krasnoyarsk Krai (Norilsk, Lesosibirsk, Yeniseisk, Dudinka, Kodinsk and Igarka). In 2020, there were 123 towns in the regions under study, of which 107 were small and medium-sized; it means that their population did not reach 100 thousand people, and 16 towns were big and large. Since the statistics on closed administrative-territorial formations is limited, eight cities were excluded from consideration: Severomorsk, Polarny, Gadzhievo, Snezhnogorsk, Zaozyorsk, Ostrovnoy, Mirny and Vilyuchinsk.

For the remaining 115 cities, we calculated eight indicators reflecting the main demographic and labor characteristics of the cities in terms of their sustainable development. The indicators are divided into four thematic blocks (*Fig. 1*). They are selected on the basis of the availability of official statistical data at the city level and compliance not only with the sustainable development goals, but also with the problems of development of the Northern cities. In particular, such problems are the migration outflow of population, which is revealed by two indicators, and insufficient diversification of labor markets – the share of extractive industries is very high.

Figure 1. Indicators of the demographic and labor sustainability index of the Russian North cities



Source: own compilation.

The main source of data for calculating the values was the database of indicators of municipalities of Rosstat. Since the data earlier than 2012 are fragmentary, the study is limited to nine years – from 2012 to 2020. The missing values were determined by interpolation or extrapolation from the nearest known values. Since the database does not contain data at the city level, we made calculations using the most detailed data available. The indicators of the first two blocks are calculated at the level of urban settlements and urban districts, while the rest are calculated at the level of municipal districts, municipal districts and urban districts in which cities are located.

Cities were assigned a rating value between -1 and 1 for each indicator. To reduce the impact on the analysis of statistical outliers, we decided not to take into account the 10% of the lowest and highest values of each indicator. Thus, a rating of -1 corresponds to the 5th percentile of the sample, and a rating of 1 corresponds to the 95th percentile. The zero rating value corresponds to the median value of the sample for all cities (except for migration indicators, where zero migration growth is taken as zero). We used a linear interpolation method to determine the value between -1 and 0 and between 0 and 1. If values were outside the interval, they were equated to 1 or -1. Three indicators (1.2, 3.2, and

4.2) are inverse (the higher their value, the worse). Therefore, their ratings were inverted by multiplying by -1. The final index of each city or group of cities was determined by summing up the corresponding rating values for the eight indicators. The maximum possible value of demographic and labor cities sustainability index (DLCSI) is 8, with any sign.

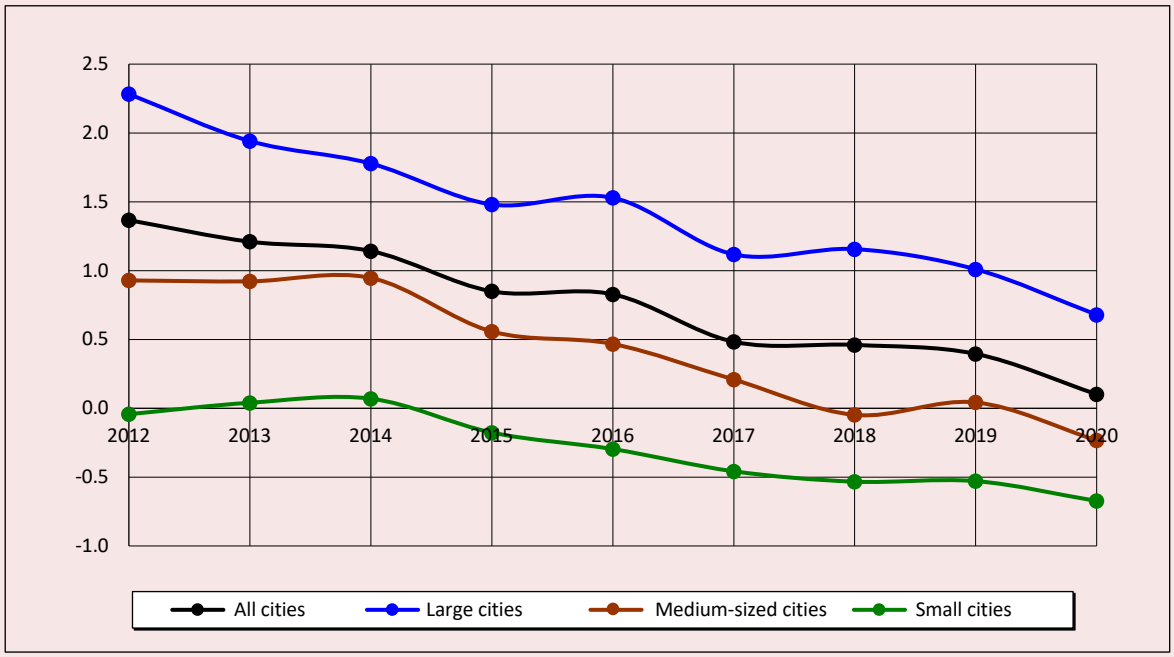
Research results

The obtained data on the demographic and labor sustainability of the northern cities by administrative formations showed that the sustainable development index decreases from large and big to medium and from medium to small cities. There is also a decline in the index in the dynamics from 2012 to 2020. We can also note that the sustainability of big cities is higher than average (*Fig. 2*).

Despite the decrease in the DLCSI, the northern cities as a whole retained positive sustainability, including large and large cities. For small and medium-sized cities, sustainability periodically changed the sign. From 2012 to 2020, all groups of cities worsened their indices, especially big and large cities.

The lowest index of cities by administrative units (less than -1.0) was noted in the Republic of Karelia (-1.89), the Murmansk Oblast (-1.63), the Arkhangelsk Oblast (-1.46) and the Komi Republic (-1.19). All four subjects are located in the European North. Among the regions with a high positive DLCSI we can point out Nenets AO - 2.56, Yamalo-Nenets AO – 2.33, the Republic of Sakha (Yakutia) – 2.09 and Khanty-Mansi AO – 1.94. Out of the top four regions, only Nenets Autonomous Okrug improved its DLCSI by 0.38. The Sakhalin Oblast also improved, with its DLCSI increasing by 0.32. The palm of victory from 2012 to 2020 has passed from Yamalo-Nenets AO to Nenets AO (*Tab. 2*).

Figure 2. Dynamics of demographic and labor cities sustainability index by subjects of the Russian North, 2012–2020



Source: own compilation.

Table 2. Demographic and labor cities sustainability index by subjects of the Russian North, 2012–2020

Subject	Year									
	2012	2013	2014	2015	2016	2017	2018	2019	2020	Dynamics, 2012–2020
All cities, including by population	**1.37**	**1.21**	**1.14**	**0.85**	**0.83**	**0.48**	**0.46**	**0.40**	**0.10**	**-1.27**
big and large	2.28	1.94	1.78	1.48	1.53	1.12	1.16	1.01	0.68	-1.60
medium	0.93	0.92	0.95	0.56	0.47	0.21	-0.05	0.04	-0.23	-1.16
small	-0.04	0.04	0.07	-0.18	-0.30	-0.46	-0.53	-0.53	-0.67	-0.63
By Russia's entities:										
Nenets AO	2.18	1.89	3.10	2.85	1.98	1.64	1.72	2.51	2.56	0.38
Yamalo-Nenets AO	3.65	2.76	2.75	2.07	2.91	2.94	3.06	2.99	2.33	-1.32
Republic of Sakha (Yakutia)	2.53	2.49	2.44	2.25	1.87	1.66	2.15	1.90	2.09	-0.44
Khanty-Mansi AO	3.61	2.74	3.01	2.61	3.05	1.99	2.06	2.03	1.94	-1.67
Krasnoyarsk Krai	1.43	1.11	0.99	1.21	0.94	0.90	0.90	0.89	0.90	-0.53
Kamchatka Krai	2.17	1.90	1.28	1.48	1.17	1.45	1.24	1.04	0.82	-1.35
Chukotka AO	2.66	2.99	2.65	2.85	2.90	2.08	1.25	3.16	0.38	-2.28
Magadan Oblast	0.78	0.85	0.57	0.17	1.18	0.72	0.29	0.56	0.22	-0.56
Sakhalin Oblast	-0.35	0.00	0.15	0.19	0.35	0.24	0.07	0.25	-0.03	0.32
Republic of Tyva	0.51	0.15	-0.51	-0.06	-1.09	-0.62	-0.56	-0.13	-0.39	-0.90
Komi Republic	0.00	0.54	0.40	0.05	-0.17	-0.68	-1.04	-1.20	-1.19	-1.19
Arkhangelsk Oblast without NAO	-0.41	-0.66	-0.47	-0.57	-0.75	-1.23	-1.24	-1.27	-1.46	-1.05
Murmansk Oblast	-0.51	-0.57	-0.81	-1.08	-0.96	-1.08	-1.09	-1.40	-1.63	-1.12
Republic of Karelia	-0.32	-0.44	-0.42	-0.96	-1.08	-1.65	-1.59	-1.40	-1.89	-1.57

Source: Database of indicators of municipalities Rosstat. Available at: https://gks.ru/dbscripts/munst/

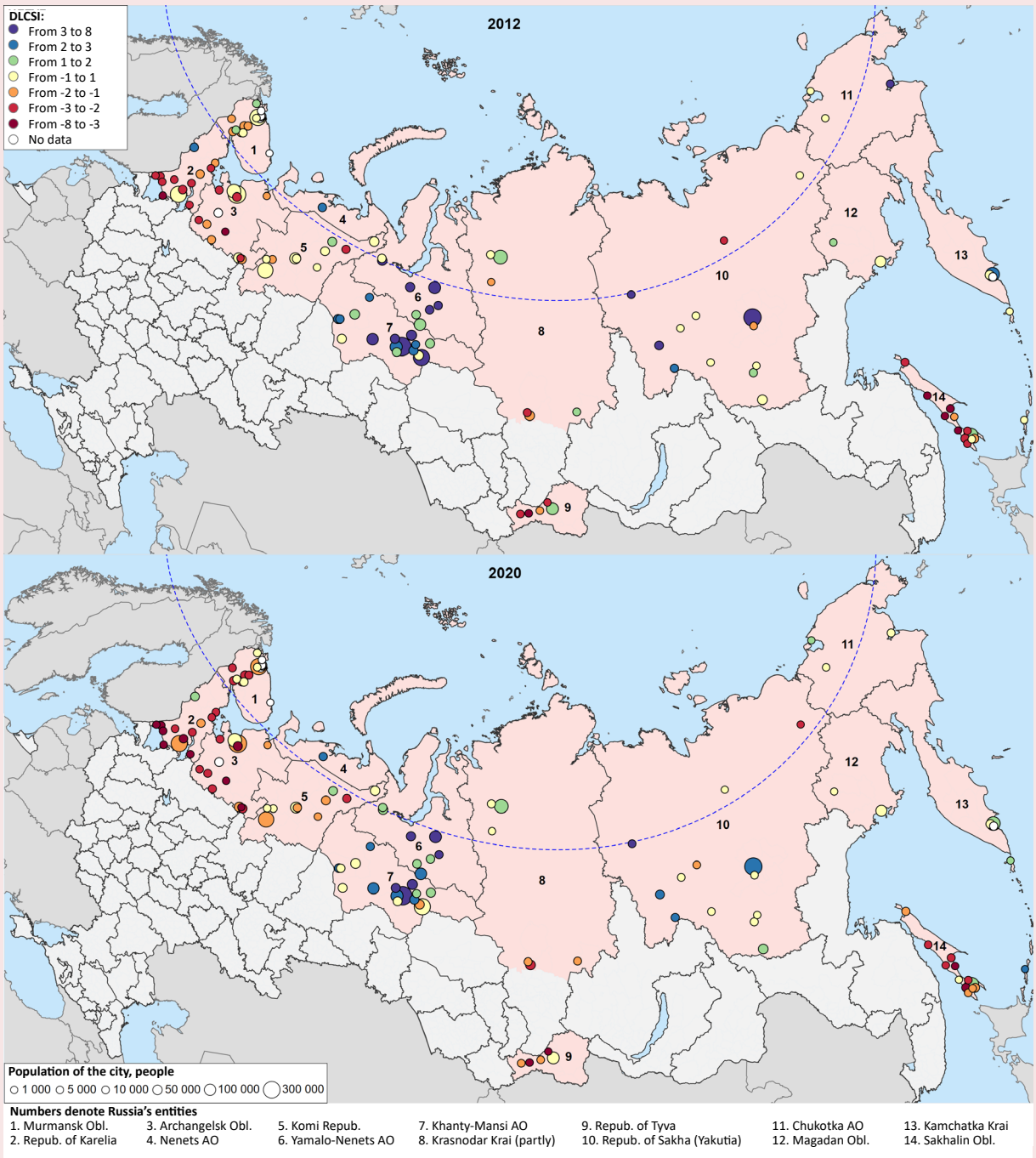
The leading cities in terms of demographic and labor indicators of sustainable development are unevenly distributed in space. The greatest concentration is observed in Western Siberia. The outsiders are located mainly in the European North, as well as in the Tuva Republic and Sakhalin. Only 39 (33.9%) out of 115 cities improved their rating value in 2020 relative to the 2012 level, 10 of them are located in the Sakhalin Oblast, 6 – in Yakutia, 4 – in Yamalo-Nenets Autonomous Okrug (*Fig. 3*).

In each northern region, it is possible to identify a leader in DLCSI (2020): in the Murmansk Oblast it is Polarnye Zori (nuclear power plant), in the Republic of Karelia – Kostomuksha, in the Arkhangelsk Oblast (without NAO) – Severodvinsk, in Nenets AO– Naryan-Mar, in the Komi Republic – Usinsk, in Khanty-Mansi AO – Lyantor, in Yamalo-Nenets AO – Tarko-Sale, in the Republic of Tyva – Kyzyl, in the Republic of Sakha (Yakutia) – Udachny (diamond mining), in the Magadan Oblast – Magadan, in the Chukotka Oblast – Pevek (floating nuclear power plant), in the Kamchatka Krai – Petropavlovsk-Kamchatsky, in the Sakhalin Oblast – Kurilsk, and in the Krasnoyarsk Krai –Norilsk.

Similarly, let us single out the outsider cities: in the Murmansk Oblast it is Olenegorsk, in the Republic of Karelia – Lahdenpokhya, in the Arkhangelsk Oblast – Solvychegodsk, in the Komi Republic – Inta, in Khanty-Mansi AO – Megion, in Yamalo-Nenets AO – Muravlenko, in the Republic of Tyva – Turan, in the Republic of Sakha (Yakutia) – Srednekolyomsk, in the Magadan Oblast –Susuman, in the Chukotka AO – Bilibino, in the Kamchatka Krai – Elizovo, in the Sakhalin Oblast – Makarov, and in the Krasnoyarsk Krai – Lesosibirsk.

Along with the leaders and outsiders in each northern region, let us distinguish the cities in the top ten, and the ten cities closing the SDC rating. Having confidently taken the first position in 2012,

Figure 3. Demographic and labor cities sustainability index in the context of constituent entities of the Russian North, 2012 and 2020



Khanty-Mansiysk by 2016 dropped to the eighth position, and in 2020 it took the 12th place. Kogalym, Novy Urengoy, Surgut, Lyantor, Tarko-Sale and Mirny remained in the top ten in 2020. Only three cities from the bottom ten could not improve their position: Olonets remained in 110th place, and Solvychegodsk and Pudozh worsened their rating (*Tab. 3*).

Table 3. Leaders and outsiders of the demographic and labor sustainability rating of cities of the Russian North, 2012, 2016, and 2020

No.	2012	2016	2020
1	5.19 – Khanty-Mansiysk	5.56 – Novy Urengoy	4.52 – Udachny
2	4.85 – Kogalym	4.96 – Kogalym	4.28 – Lyantor
3	4.81 – Novy Urengoy	4.79 – Mirny	3.89 – Kogalym
4	4.51 – Surgut	4.78 – Surgut	3.72 – Tarko-Sale
5	4.35 – Lyantor	4.58 – Tarko-Sale	3.49 – Nadym
6	4.34 – Salekhard	4.46 – Udachny	3.23 – Novy Urengoy
7	3.99 – Anadyr	4.30 – Anadyr	3.05 – Surgut
8	3.62 – Gubkinsky	3.69 – Khanty-Mansiysk	2.88 – Mirny
9	3.44 – Tarko-Sale	3.43 – Lyantor	2.76 – Noyabrsk
10	3.41 – Mirny	2.77 – Nadym	2.56 – Naryan-Mar
…			
106	-2.88 – Solvychegodsk	-3.00 – Inta	-3.16 – Turan
107	-2.91 – Pudozh	-3.02 – Poronaisk	-3.24 – Kholmsk
108	-2.98 – Belomorsk	-3.10 – Kondopoga	-3.30 – Makarov
109	-3.46 – Poronaisk	-3.21 – Pitkyaranta	-3.33 – Sortavala
110	-3.49 – Olonets	-3.22 – Belomorsk	-3.37 – Olonets
111	-3.56 – Tomari	-3.38 – Uglegorsk	-3.44 – Kondopoga
112	-3.73 – Chadan	-3.40 – Pudozh	-3.52 – Pudozh
113	-3.77 – Uglegorsk	-3.43 – Chadan	-3.54 – Pitkyaranta
114	-4.40 – Shenkursk	-3.69 – Alexandrovsk-Sakhalinsky	-3.74 – Solvychegodsk
115	-5.06 – Alexandrovsk-Sakhalinsky	-3.93 – Ak-Dovurak	-4.16 – Lahdenpokhya

Source: Rosstat database of indicators of municipalities. Available at: https://gks.ru/dbscripts/munst/

The leading cities, although located in different regions (KMAO, YNAO, NAO and Yakutia), almost all specialize in oil and gas production, while Udachny and Mirny specialize in diamond mining. Salaries, excluding small businesses, in 2020 in urban districts where these cities are located, averaged 106 thousand rubles (from 82 thousand in Kogalym to 141 thousand in Nadym), with the median value of 72 thousand rubles for all the cities in the North. Employment opportunities in high-income industries make these cities attractive for migration, which also affects the age composition, fertility and other indicators. In contrast, in 10 cities from the bottom of the rating the average salary was only 49 thousand rubles (in Turan – 33 thousand). If a number of towns in the Tuva Republic were able to compensate for this with good birth rates, in the Republic of Karelia, where most of the outsider towns are located, the demographic situation is also critical: a high demographic pressure is combined with low birth rates and imbalance in the composition of the population by gender.

Let us consider how sustainable development of the cities was affected by this or that indicator. In 2012, high DLCSI for all cities was provided by demographic burden – 0.677, internal migration – 0.366, labor market diversification – 0.198, life expectancy (LE) – 0.181, wages – 0.147, and slightly fertility – 0.039. In 2020, two of the six indicators (fertility and life expectancy) changed the sign. For the entire group of cities, the value of the DLCSI decreased significantly. From 2012 to 2020, only three indicators had positive gains: external migration – 0.139, wages – 0.190 and labor market diversification – 0.097. Demographic pressure (-0.601), fertility (-0.583), and internal migration (-0.317) influenced the decrease from 2012 to 2020.

In 2012, a high DLCSI of large and big cities was provided by demographic pressure, internal migration, and labor market diversification; medium-sized cities – demographic pressure and internal migration; and small cities received a negative value from demographic pressure. Most of the other indicators either had a negative value or

changed insignificantly. In 2020, big and large cities were provided with the DLCSI by the diversification of the labor market and wages, while the medium-sized cities reduced the negative value of these two indicators. The change in the indicators from 2012 to 2020 shows that for all cities only three indicators had a positive increase: wages, labor market diversification and external migration, and for big and large cities, it was also gender ratio, for small cities – internal migration (*Tab. 4*).

Conclusion

The general line of population settlement around the world is related to the migration of people from rural to urban areas, growing urbanization, and the formation of northern urban agglomerations, a new trend of the 21st century (Fauzer et al., 2021). Along with progress and innovation, cities create problems such as housing shortages and overcrowding, the stratification of society into the poor and the rich, the formation of elite and bedroom communities – slums, shortage of quality water, high concentrations of harmful substances in the air and a number of others.

In the second half of the 20th century, the world community turned its attention to the problem of sustainable development, gradually moving from general issues to the study of sustainable development of urban space. The UN considers the problem of sustainable development more broadly, in the first documents it included all human settlements, and as experience and practice accumulated, it moved exclusively to cities. At the same time, UN-Habitat documents note that sustainable development of cities cannot succeed without the development of adjacent rural areas, since the latter provide cities with food and labor.

In the European charters on sustainable development of cities, at conferences different problems are raised: from the local government and the indivisibility of areas to the New Urbanism Manifesto, from the Lisbon Action Plan to the Mannheim Message – a response to the European Green Deal. Nowadays there are more than a dozen international forums and experimental sites on the problems of sustainable development of cities and they have been created in Russia.

Due to limited municipal statistics, this article considers eight indicators that form the basis for calculating the DLCSI. It is possible to increase the DLCSI by improving the ratio of age groups, birth rate growth and increasing the financing of the resettlement program for persons of retirement age and people with chronic diseases; improving the level and quality of medical care, creating safe working conditions, reducing the number of jobs with harmful and dangerous working conditions, which will have a positive impact on the life expectancy of the population. Regulation of external migration flows by age and education of migrants, attraction of qualified specialists will have a positive impact on demographic and labor sustainability.

Table 4. Indices of demographic and labor indicators of sustainable development of cities of the Russian North, 2012 and 2020

Indicator	2012			2020			Dynamics, 2012–2020		
	big	medium	small	big	medium	small	big	medium	small
General index	**2.283**	**0.929**	**-0.043**	**0.679**	**-0.233**	**-0.673**	**-1.603**	**-1.162**	**-0.630**
1.1. Fertility	0.012	-0.060	0.119	-0.564	-0.787	-0.409	-0.576	-0.727	-0.528
1.2. Life expectancy	0.342	0.015	-0.058	0.110	-0.032	-0.158	-0.232	-0.046	-0.100
2.1. Internal migration	0.685	0.501	-0.216	0.123	0.131	-0.083	-0.563	-0.370	0.133
2.2. External migration	-0.010	-0.437	-0.332	0.046	-0.038	-0.062	0.056	0.399	0.271
3.1. Gender ratio	-0.173	-0.007	0.057	-0.155	-0.037	0.015	0.017	-0.030	-0.042
3.2. Demographic pressure	0.777	0.676	0.468	0.213	0.017	-0.153	-0.564	-0.659	-0.621
4.1. Salary	0.210	0.109	0.030	0.404	0.268	0.224	0.195	0.158	0.194
4.2. Labor market diversification	0.439	0.132	-0.110	0.504	0.245	-0.047	0.065	0.113	0.063

Source: Rosstat database of indicators of municipalities. Available at: https://gks.ru/dbscripts/munst/

In the 21st century, a new step in improving the sustainability of cities will be the transition to "smart cities" designed to solve such problems as "safety, social security, environmental well-being, economic justice" (Popov, Semyachkov, 2020). The development of "smart cities" involves the widespread use of information and communication technologies, the accumulation of the latest advances in digital technology, and the efficient use of resources. Widespread implementation of new technologies and innovations in the management of cities can contribute to their sustainable development.

The presented theoretical approaches to the study of sustainable development of cities allowed looking at the problem comprehensively, to move from theoretical provisions to the rating assessment of sustainable development of northern cities, to identify strengths/weaknesses of demographic dynamics and the labor sphere.

In practical terms, the article can be useful for executive authorities to assess the demographic and labor sustainability of urban space and cities in the territories entrusted to them.

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Received December 5, 2022.