

Prospects for Sustainable Development of Kazan Considering the Assessment of Key Indicators

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Abstract. The article is devoted to development of sustainable development recommendations of the city of Kazan, inclusive of the assessment of key indicators. Today, the development of sustainable development indicators for Russian cities is given little attention. Different author's sustainable development indicators of large cities are characterized by general abstract criteria and have a universal character. Based on official sources, we carried out an assessment of Kazan on a condensed system of sustainable development indicators, proposed by the UN in 2001. Thus, we identified the priority socio-ecological and economic problems of Kazan and formulated its relevant sustainable development indicators. Then we made an assessment for the sustainability of the socio-ecological and economic development of Kazan. The prognosis of the socio-ecological and economic development of Kazan was simulated in the same manner by the indicators that we have identified for 2030. In conclusion, recommendations on sustainable development of Kazan were made.

1. Introduction

"Sustainable development" is development that meets the needs of the present without compromising the needs of future generations. This term was coined by the United Nations World Commission on Environment and Development in 1987. But even today, the search for criteria for sustainable development of countries, regions and human settlements remains an important task [3, 5, 6, 7, 8, 11, 12, 14, 15, 16, 19].

Currently, much attention is paid to the 11th of 17 Sustainable Development Goals, outlined by the UN in the 2030 Agenda for Sustainable Development: ensuring openness, security, resilience and sustainability of cities and human settlements. Analysis of socio-economic development strategies of some large cities of the Russian Federation shows that the environmental component of sustainable development elaborated to the least extent of all the Economy-Ecology-Society triad. At the same time, the underestimation of the environmental factor and environmental restrictions in the preparation of territorial development documents leads to many negative consequences in the use of natural resources [18].

2. Modern state of the problem of choosing sustainable development indicators

To achieve the 11th Sustainable Development Goal, the authors of the world are developing methodological approaches to identify indicators of sustainable urban development, according to which it would be possible to draw a conclusion about the sustainability or non-sustainability of their development [7, 12, 15].



There are two most common methodological approaches to identify sustainable development indicators. The first approach is to build a system of indicators, each of which reflects certain aspects of sustainable development: economic, environmental, social. Recently, more and more often, along with systems containing a lot of indicators, "compressed" indicator systems are being developed. A shortened list of so-called key indicators of sustainable development reflecting important environmental issues is recommended for decision makers who need only the highest priority information on sustainable development and environmental protection. One of the most complete systems of sustainable development indicators is the system developed by the United Nations Commission on Sustainable Development. It consists of 132 indicators, which are divided into 4 main groups. The first group by number of indicators is environmental (55 indicators), followed by social (41), economic (26), institutional (10) [21]. In 2001, at the Conference on European statistics in Canada, a shortened and updated version of the sustainable development indicators system was proposed to facilitate practical application for decision makers at the national level. The system was reduced to 58 indicators [20].

The second approach involves the construction of an aggregate (integral) indicator, which gives the basis for the conclusion about the degree of sustainability of socio-economic development [5, 13, 17]. An aggregated (integral) indicator expressed quantitatively would be ideal for decision makers to take into account the sustainability factor in the development of the region. On one such indicator it would be possible to judge the degree of stability of the territory, the ecological trajectory of its development (by analogy with GDP, through which is now often measured the success of economic development). Some authors consider the Human Development Index (HDI) as such an integral index or modify it by introducing environmental parameters [1, 2, 4, 10]. However, due to methodological and statistical difficulties, there is still no calculation of the globally recognized integral indicator. In our opinion, the methodology of compiling the HDI as an average geometric series of indicators ranging from 0 to 1 is of interest because the index value is very sensitive even to a small decrease in any of the components.

The systems of indicators as well as the components of an integral index proposed by different authors are characterized by general abstract criteria and have a universal character. This allows you to compare different regions or cities with each other. However, the challenge is not to compare cities, but to develop a sustainable development strategy for each city. So we believe that the development of a universal model of sustainable development criteria applicable to all major cities, regardless of whether they have similar or different development factors, is not appropriate. Therefore, the existing system of criteria can be taken only as a starting point in the development of sustainable development criteria for each settlement separately, taking into account its regional characteristics.

Our goal is to develop recommendations for sustainable development of a large city (Kazan), considering the assessment of key indicators. In order to unify the quantitative values of indicators with different measurements it is proposed to use a mathematical method of reduction to one.

3. Theoretical part

The object of research – the city of Kazan - is the largest industrial, scientific and cultural center of Russia. The area of the city is 425.3 km², the population - 1231878 people (for 2017). The territory of the city is divided into 7 administrative districts. Located on the left Bank of the Volga river, at the confluence of the Kazanka river, the city is a major port. The city has developed high-rise construction, engineering, food, light, chemical and petrochemical industries.

During the evaluation of sustainable development of Kazan by United Nations indicators we are faced with the challenge of finding and the availability of quantitative data on the specified indicators. In connection with it the quantitative values of the 21 indicator was obtained by simulation on the basis of the regional and national levels [6]. We could not find the values of the other 20 indicators (distance travelled by means of transport, per capita; proportion of children without adequate nutrition; intensity of use of materials, etc.). For some indicators, the assessment of the administrative center was irrational due to the fact that the proposed UN indicators are aimed at assessing sustainable development at the national level (Gini index; external development assistance; ratification of international agreements related to sustainable development, etc.). Since the city of Kazan has no access to the sea,

it is impossible to assess the sustainability of the state on such indicators as "catch of large marine organisms", "population growth in coastal zones", "seaweed development index". Thus, the maximum possible number of UN Sustainable development indicators of Kazan that we can assess is 38, and only for 14 of them we have the factual information on Kazan. These 14 indicators are not "problematic" for the object of study and therefore cannot serve as a basis for characterizing the dynamics of the city development. Moreover, a large number of the UN SD indicators that are favorable for the city does not allow to focus attention on acute issues This result cannot be considered a reliable assessment of the sustainability of Kazan, on which the strategy of sustainable development can be based.

To identify the key indicators of sustainable development of Kazan and the subsequent assessment of the city, we propose to use the following methodology.

1. Based on the analysis of official documents (State reports on the state of natural resources and environmental protection of the Republic of Tatarstan, Strategy of social and economic development of the municipality of Kazan until 2030) we highlight the socio-ecological and economic problems of the city and formulate an indicator for each problem.

2. Find the quantitative values for each selected indicator. If there is no data, we model quantitative values of indicators based on known data.

3. In the calculations we use the mathematical method of reduction to one, as in the calculation of the human development index (HDI), which includes three indicators with different dimensions. The following formula is used to convert a measure to an index whose value is between 0 and 1 [9]:

$$x = \frac{x - \min(x)}{\max(x) - \min(x)}, \quad (1)$$

where $\min(x)$ and $\max(x)$ – respectively, the smallest and largest of the values of the indicator taken among the values of the cities-millionaires of the Russian Federation, x – the current value of the indicator.

According to the logic of the calculation of the index, the closer the indicator value is to 1, the indicator "better", respectively, than the calculated value closer to 0, the value of the indicator of "worse". However, some indicators are formulated in such a way that the value obtained in the calculations, close to 1, testifies to the "bad" state. In this case, we propose the index value to be calculated by the formula:

$$x = \frac{\max(x) - x}{\max(x) - \min(x)} = 1 - \frac{x - \min(x)}{\max(x) - \min(x)} \quad (2)$$

Thus, the final calculated value in the form of the index of sustainable development of Kazan should be interpreted in the same way - the value of the index is closer to 1, the socio-ecological and economic development of the city is closer to the state of stability and vice versa.

4. To calculate the HDI itself, the formula of the geometric mean of three indicators reduced to one is used. We propose to proceed in an analogical way: to apply the obtained by formulas (1) and (2) values of indicators to calculate their geometric mean, which will represent the index of sustainable development of the object of study. The value of this index, concluded between 0 and 1, is interpreted as follows: the closer it is to 1, the closer the state of the city to sustainable development.

5. By the method described above, we make calculations on the proposed indicators of sustainable development for Kazan for 2016. Get some final value enclosed between 0 and 1. Similarly, we make a forecast for 2030, based on quantitative data from official documents (in case of their absence, we model the values).

4. Results and discussion

We calculated each of the 38 UN SD indicators according to the Formula (1) and obtained an average geometric value equal to 0.375058265, which should be the index of sustainable development of Kazan in 2016.

Then using the structure for the allocation of indicators "problem – indicator" we identified 17 indicators of sustainable development of Kazan:

- share of highly qualified population of the city, %
- infrastructure costs per capita, RUB/person;
- unemployment rate, %;
- share of active and responsible population of the city, %;
- energy use intensity, kWh/person;
- share of recycled waste, %;
- number of non-motor and electric motor transport, PCs;
- share of wastewater treated, %;
- number of treatment facilities, PCs;
- green zone share, %;
- number of companies-suppliers of recyclable materials per capita, PCs/person;
- total released into the atmosphere of pollutants coming from the main polluting enterprises of the city, including vehicles, thousand tons per year;
- the number of maximum allowable concentration levels for priority pollutants of underground waters (sulfa-you, chlorides, nitrates, oil products), units/year;
- number of unauthorized dumps, PCs;
- number of violations of water protection legislation, PCs;
- the amount of discharged polluted (without clearing and insufficiently purified) water, %;
- share of recycled and sequentially used water, %

The assessment of Kazan on 17 SD "problem indicators" was carried out and so we obtained the reference value of the index of sustainable development of the city of Kazan. Further, taking from official sources the data on 17 indicators planned for 2030, we predicted the value of this index for 2030 - 0.670990325.

The index value calculated for Kazan by the UN indicators for 2016 exceeds the index value calculated by 17 «problem indicators». The reason is that among the indicators taken into account there are those that have a positive trend for 2016. Due to them, there is a "smoothing" of the problem points, hence the higher value of the index, which indicates a greater stability of socio-ecological and economic development of Kazan than follows from the value obtained by the "problem indicators". The value calculated from 17 key indicators is a value from which we can base further calculations and planning. The value of the Kazan SD index for 2030 indicates that the planned and simulated missing values of some indicators specified in the official documents are aimed at sustainable development of the city.

When further monitoring the dynamics of socio-ecological and economic development of Kazan and forecasting its sustainability, it should be borne in mind that the problems may change from year to year, as a result of which the set of key indicators of sustainable development of Kazan should be regularly adjusted.

5. Conclusions

Based on the study, we can conclude that no common system of indicators, including the UN system of indicators, can serve as a basis for the development of a specific city's sustainable development strategy. Each city needs to develop its own system of key indicators, according to the structure of the "problem-indicator".

As recommendations for sustainable development of the city of Kazan we offer the following:

1. in assessing the sustainability of socio-ecological and economic development of the city to take as a basis our proposed key indicators of sustainable development;
2. start to monitor the dynamics of development on the proposed indicators, which at the moment the dynamics of development is not monitored;

3. to carry out an annual assessment of the current state of sustainability of socio-ecological and economic development of the city of Kazan in order to adjust the development plans and indicators themselves.

References

- [1] Alyunova T I 2016 Human development index as an indicator of sustainable development. Regulation of sustainable development of the region's economy (Chuvash state pedagogical University) pp 117-124
- [2] Baganov V Y Human 2013 development index as indicator of sustainable development of the region. Bulletin of the Irkutsk state economic Academy (Baikal state University of Economics and law) **4** p 9
- [3] Baibakov E I, Zhurba A O, Filippova E A 2011 Indicators of sustainable development: description, usage, experience *Environmental consulting* **3(43)** pp 15-21
- [4] Biggeri M, Mauro V 2018 Towards a more 'Sustainable' Human Development Index: Integrating the environment and freedom *Ecological indicators* **91** pp 220-231
- [5] Bobylev S N, Chereshnya O Yu, Kulmala M, Lappalainen H K, Petäjä T, Solov'eva S V, Tikunov V S, Tynkkynen V P 2018 Indicators for digitalization of sustainable development goals in peex program *Geography, Environment, Sustainability* **1(11)** pp 145-156
- [6] Bobylev S N, Kudryavtseva O V, Solovyeva S V, Sitkina K S 2018 Sustainable Development Indicators: Regional Dimension *Bulletin of Moscow University. Series 6: Economics* **2** pp 21-33
- [7] Bobylev S N, Kudryavtseva O V, Solovyova S V 2014 Sustainable development indicators for cities *Economy of region* **3(39)** pp 101-110
- [8] Gainutdinov N A 2007 Development strategy of towns and cities: problems, goals, and mechanisms: monograph *Modern Economics and law* (Moscow)
- [9] Kruchina E B 2017 Indices and indicators as a tool for assessing the sustainable development of urbanized territories Environmental management safety in conditions of sustainable development: Proceedings of the International scientific and practical conference (Electronic resource) Irkutsk state University, Geographical faculty pp 290-294
- [10] Ivanova D O, Sigora G A 2018 Human development index as indicator of sustainable development of constituent territories of the Russian Federation Quality Management in education and industry: Collection of articles of the all-Russian scientific and practical conference pp 185-189
- [11] Jennifer A Elliott 2006 An Introduction to Sustainable Development *Taylor & Francis e-Library*
- [12] Kaulins J, Ernsteins R, Kudrenickis I 2017 Indicator systems for municipal sustainable development governance: prerequisites for design and implementation *Ecosystems and sustainable development* **XI** vol 214 pp 35-45
- [13] Khaustov A P, Galiardo V M, Redina M M 2016 Sustainable development assessments of the world: opportunities and challenges for the use of composite indices Earth Charter - a practical tool for solving fundamental problems of sustainable development collection of materials of the international scientific and practical conference dedicated to the 15th anniversary of the principles of the earth Charter in the Republic of Tatarstan pp 78-82
- [14] Kostina N V, Rozenberg G S, Kudinova G E, Rozenberg A G, Pysheva M V 2017 "Brainstorm" of sustainable development indexes and indicators (on the example of the Volga basin) *South of Russia: ecology, development* **2(11)** pp 32-41
- [15] Klopp J M, Petretta D L 2017 The urban sustainable development goal: Indicators, complexity and the politics of measuring cities *Cities* vol 63 pp 92-97
- [16] Manyushis A Yu, Barsukov I E 2016 Regulation of sustainable development of a large region, city: problems, ways of reforming, innovations *The International Union of economists* (Moscow)
- [17] Mingaleva Zh A 2016 The possibility of using an index of sustainable development McKinsey

- cities to Russian conditions *Economics and entrepreneurship* 5(70) pp 1027-1029
- [18] Most E S 2006 Ecological factor of sustainable development of social and economic systems (Samara) <http://www.dissercat.com/content/ekologicheskii-faktor-ustoichivogo-razvitiya-sotsialno-ekonomicheskikh-sistem>
- [19] Strezov V, Evans A, Evans T J 2017 Assessment of the Economic, Social and Environmental Dimensions of the Indicators for Sustainable Development *Sustainable development* **3(25)** pp 242-253
- [20] United Nations Division for Sustainable Development "Indicators of Sustainable Development: Guidelines and Methodologies" (New York) <https://www.uncece.org/fileadmin/DAM/stats/documents/2001/10/env/wp.27.e.pdf>
- [21] Our common future The report of the world Commission on environment and development (MCOR) <http://xn--80adbkckdfac8cd1ahpld0f.xn--p1ai/files/monographs/OurCommonFuture-introduction.pdf>

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