doi 10.15826/recon.2016.2.4.039
UDC 330.15

Ye. V. Ryumina
Institute of Social and Economic Studies of Population of RAS (Moscow, Russian Federation; e-mail: ryum50@mail.ru)

QUALITY OF LIFE ASSESSMENT: ENVIRONMENTAL ASPECTS [1]

This article deals with the search for indicators that reflect the environmental conditions of life, environmental behavior of people and may be used in the economic analysis. This environmental and economic problem has not yet been solved. The indicators used in many economic papers to measure the emissions and discharges of harmful substances into the atmosphere and water bodies describe the impact on the environment, which will manifest itself in the future periods and cannot adequately reflect its condition. The monitoring of environment by environmental experts provides, in particular, the percentage indicators of air and water samples that exceed MPC (maximum permissible concentration) in the total number of samples. They are already included in a number of statistical compilations. The article describes their practicality and benefits for making the concise records of the state of environment in the economic research. The author has studied the regional values of selected indicators and analyzed various hypotheses of their strong differentiation. Today, it is particularly urgent to include the environmental component in the indicators describing the quality of life, including the human development index. The author proposes to use the percentage of negative water and air samples as an additional, fourth component of the human development index. The article presents the results of calculating the environmentally adjusted human development index for all entities of the Russian Federation, which in a number of regions significantly differs from traditionally used value.

Keywords: environmental indicators, environmental conditions, air and water samples, quality of life, quality of population, human development index, region, state of environment, environmental impact, pollution level

Introduction

For economists and sociologists, the state of environment became an object of study relatively recently, when this state went beyond the equilibrium. In the scientific literature, most of the estimates about this period of time focus on the 1960s. The first scientific studies on the environmental and economic issues began to appear along with the environmental degradation [1–6]. For over 50 years, the main chain of relationships under study has been as follows: "production as a source of pollution — environmental degradation — impact on public health." The studies also deal with shorter chains closed within the process of production: "production as a source of pollution — environmental degradation — production as a recipient of pollution," and the relationships in the system "state of environment — public health."

Therefore, if we consider the state of environment in the social aspect, it represents the interest mainly as a living condition of people, an environmental characteristic of their quality of life.

Much less attention is paid to feedback in these systems — that is, the role of people in environmental degradation. This is not the question of some local environmental flaws in human behavior, such as failure to throw a piece of paper in the litter bin, but the joint responsibility of people for preserving the nature. It should be noted that the population is heterogeneous in terms of its environmental behavior, in particular, due to different forms of its participation in the production processes and its relationship to the means of production. The behavior of all groups of people in their aggregate creates the actual state of environment.

Selecting Indicators to Describe the State of Environment

There is a rather well-established view that the state of environment in the regions depends on the nature and scale of their production activities. However, the reality belies this assertion.

We will consider the emissions of harmful substances into the atmosphere and discharges into the water bodies as the characteristic describing the environmental impact of production activities. However, it should be stressed that at the stage of emissions and discharges these environmental impacts are affected by human activities. For example, the same production facilities (that are similar

[1] Original Russian Text © Ye. V. Ryumina, published in Ekonomika regiona [Economy of Region]. — 2016. — Vol. 12, Issue 4. — P. 1113–1122.

not only by the type of products and production technology but also in terms of used raw materials, their environmental friendliness, etc.) may have different emissions and discharges due to the voluntarism in implementing the clean-up measures that are different in their nature and scope. This is an example of the role played by the human factor because in such a case the requirements to waste neutralization are the same and must be respected.

Let's further assume that the emissions and discharges are the same in the same production facilities. However, even in this case, the state of environment that they contribute to form can vary significantly. This is caused by different background concentrations of pollutants in the environment, different climatic conditions, and other objective factors. But even when these factors are not different, the people may have different conditions of life. For example, while in one region the production facilities are located within the population settlements, in others, they are in the industrial zone. Therefore, the emissions and discharges do not determine the environmental conditions for the population in a uniform way. They describe the impact on the state of environment, but the formation of this state is also affected by the impact of many other factors.

Despite all these difficulties, it is necessary to introduce the environmental indicators describing life and activities of the population in the economic analysis because the nature and economy are closely interrelated, and it is inadmissible to ignore this relationship in the socioeconomic research. This paper sets the task of searching for indicators that reflect the environmental conditions of life and the environmental behavior of people and may be used in the economic analysis.

The environmental processes are very complex, and their simulation requires interdisciplinary research based on the knowledge of not only the environmental science but also meteorology, hydrology, chemistry, biology, etc. These processes also include the impact of the economy and society on the natural environment. For example, to reflect how specific harmful emissions change the environment, it is necessary to perform a simulation based on many economic and natural factors. It is precisely because of these difficulties that the issue of including the environmental factors in the socioeconomic studies has so far no solutions, which would allow assessing the quality of population and quality of life.

The environmental conditions are undoubtedly an important characteristic of the quality of life. However, they are not included in the traditional list of indicators that reflect the quality of life (no doubt, for reasons described above). It is desirable to have a single indicator that would in an aggregated way describe the environmental conditions of the quality of life. The same applies to the environmental characteristics of the quality of population.

In our view, the quality of life and quality of population reflect the level of actual environmental pollution. However, this level is expressed by a number of indicators related, first, to different ingredients of pollution and, second, to different points within the territory. But this approach again significantly overloads the structure of economic models and is acceptable in the environmental and economic models, where the main objective of the study is to describe environmental processes. In such cases, the information for simulation is collected by the developers on their own following the field studies. Including the environmental factor in the multiaspect research of socioeconomic problems requires a more compact representation of environmental processes.

To this end, a number of studies used averaged concentrations of harmful substances in the atmosphere and water bodies calculated as the ratio of emissions and discharges to shared water and air resources, or to surface area of the territory. The required information can be found in statistical compilations on the Russian regions. However, the average indicators of environmental pollution calculated in such a way can significantly distort the real environmental situation.

It should be noted that this article examines only two types of natural environments — atmosphere air and surface water resources — which in most cases determine the general environmental conditions for the population.

We propose to describe the state of these natural environments, viewed as environmental conditions for the population, by the percentage of samples that exceed MPC in the total number of tested samples[2]. We already used these indicators in the studies presented in previous articles [7, 8].

[2] Okhrana okruzhayushchey sredy v Rossii [Environmental protection in Russia]. (2014): Rosstat. Moscow 2014; Gosudarstvennyy doklad «O sostoyanii i ob okhrane okruzhayushchey sredy Rossiyskoy Federatsii v 2013 godu» [State report "On the state and protection of environment in the Russian Federation in 2013". (2014). Moscow: the Ministry of Natural Resources of the Russian Federation].

In this paper, the indicator of negative samples is the main object of study. It considers not only its quantitative values but also the content, advantages, and areas of use.

Percentage of Negative Air and Water Samples: Content, Impact Factors, and Values

It is known that the samples for assessing the extent of water and air pollution are not taken everywhere: for the air, they are taken in places of compact settlements of people, and for the water, at the points of its abstraction from open reservoirs. This implies, first, that such samples identify the real environmental conditions of life, and the studied percentage of negative samples can be considered as an environmental indicator of the quality of life. Second, in the specified points of sampling, the quality of air and water must meet the sanitary requirements, regardless of parameters describing the development of harmful production facilities in the area. One of the restrictions considered during the deployment of such production facilities is their environmental impact. In this context, the existence of samples that exceed MPC can be viewed as environmental violations committed in spite of available possibilities to prevent them; therefore, they can be viewed as an environmental indicator describing the quality of population in a given territory. The analysis of actual values of these indicators confirms their independence from the development of polluting production facilities in the regions: their maximum values are observed in the regions with no such production facilities.

Figure 1 shows that in the five regions the percentage of negative air samples that exceed MPC in the total number of tested samples is greater than 10 %. These are the Republic of Dagestan, the Republic of Ingushetia, the Republic of Khakassia, the Zabaykalsky Krai (21 %), and the Magadan Region.

Since the indicator does not reflect the extent of exceeding MPC, this at first may appear as its disadvantage. A sample is recognized as negative regardless of whether it slightly exceeds MPC or by dozens of times. However, in the latter case, in the case of significantly exceeding MPC, the samples will be also negative in other places where the air is tested in the proximity to the pollution source. Therefore, in the case of significantly exceeding MPC, the number of negative samples will be higher than in the case when MPC is exceeded only slightly.

At first glance, the disadvantage of the indicator may also come from the fact that there is no distinction between more hazardous and less hazardous substances. In other words, there is no distinction between exceeding MPC by particularly hazardous and harmful substance or any other substance that is subject to MPC. However, this disadvantage is also untenable because the substances that are different in terms of their harmful effects have different MPC. After all, the samples with different ingredients are compared not with the same permissible concentration but with different concentrations for different substances. It is against these MPCs that harmful substances are weighed in terms of their hazard. MPCs may vary in terms of pollution ingredients by millions of times. Particularly hazardous substances have MPC equal to the millionths of the unit, while for the less

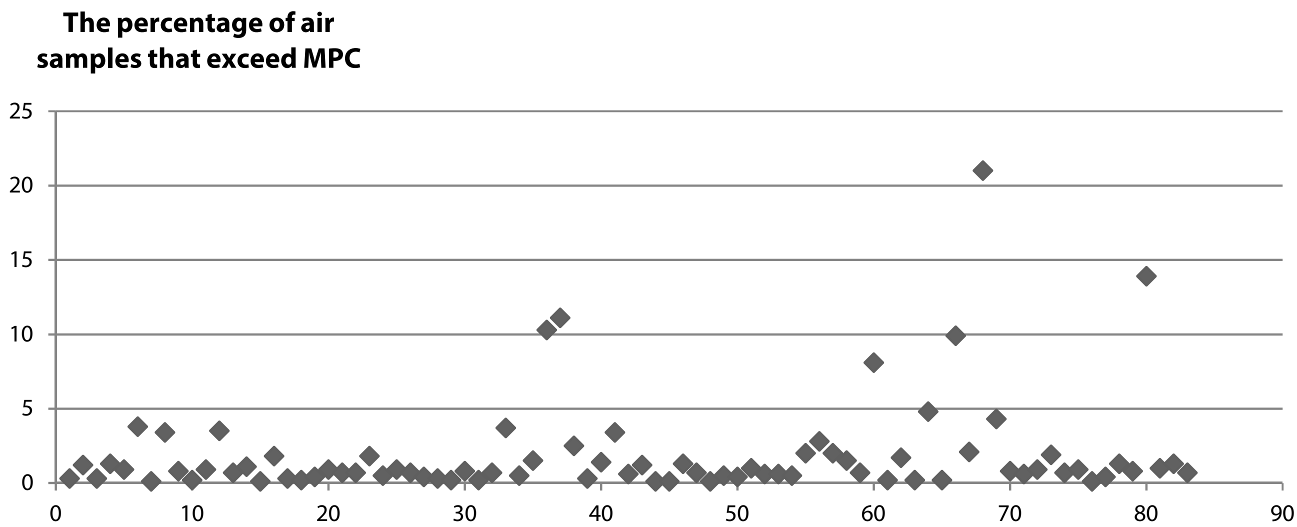

Fig. 1. *The percentage of air samples that exceed MPC in the total number of samples tested in 2013, % (horizontal axis represents the regions) (The chart is based on data from: Environmental Protection in Russia, Moscow: Rosstat, 2014 (in Russian))*

hazardous, it is in the hundredths of the unit. Therefore, the quality of samples is assessed in relative indicators as the ratio of the actual concentration of harmful substances to MPC.

There also may be objections with regard to the fact that the samples are not taken everywhere but only in certain points within the territory. But these points are not selected at random—they are related in the case of air pollution to the places of population settlements, or to the places of water abstraction for drinking and recreation purposes in case of water pollution. It turns out that initially the testing of samples was aimed at assessing the environmental conditions for the population.

Let's analyze the emissions of harmful substances and percentage of negative air samples by taking the example of the Sverdlovsk Region (Table 1). It is obvious that the percentages of samples that exceed MPC in the total number of tested samples have small values. However, one should bear in mind that tens of thousands of such samples are taken over the year. For example, in the Sverdlovsk Region, 105,654 samples were tested in 2013 (in 2010, 142,823 samples). Therefore, even a small percentage of negative samples may indicate an unfavorable environmental situation in many population centers.

Table 1 shows that while the percentage of negative samples varied in the Sverdlovsk Region over 2008–2013 changed by more than 2 times, the emissions of harmful substances into the atmosphere fluctuated insignificantly from year to year—maximum emissions registered in 2008 exceeded by 20 % their minimum volume recorded in 2011.

Table 1

The percentage of air samples that exceed MPC in the total number of samples tested in the Sverdlovsk Region

Years	2008	2009	2010	2011	2012	2013
Percentage of negative air samples	2.1	1.4	2.0	1.6	3.0	1.5
Emissions of harmful substances into the atmosphere, thousand tons	1,824.4	1,673	1,611.4	1,515	1,546.2	1,557.2

Sources: Regions of Russia: Socioeconomic indicators. Statistical compilation, 2009–2014; Environmental Protection in Russia, Moscow: Rosstat, 2009–2014 (in Russian).

Now, let's analyze the actual percentage values of negative samples across 83 entities of the Russian Federation in 2008–2011.

According to the data for 2011, by the regions, the percentage of air samples that exceed MPC in the total number of tested samples ranges from 0.02 % in the Republic of Mordovia to 26.8 % in the Zabaykalsky Krai. This difference of more than 1,000 times has to be explained.

Let's consider the hypothesis that the MPC for the air is usually exceeded by the development of polluting industries in the region—that is, it depends on the nature and scale of economic activities. This hypothesis contradicts the above point that the official permission to operate can be obtained only by companies, the emissions of which do not pollute the environment. If this still happens, the reasons are not the objective circumstances but the environmental violations by the management of companies. Since we consider the number of samples that exceed MPC as a characteristic describing the environmental behavior of the population, the fact that in this case the environmental violations are made by the company managers and not by the entire population can be confusing.

However, first, the company managers are an integral part of the population. Of course, they constitute a minority, but, for example, the murders are committed by an even smaller minority; however, we still consider them as an important characteristic describing the quality of population in terms of antisocial behavior.

Second, environmental violations can be also attributed to car owners (air pollution by transport), land owners (unauthorized discharges of polluted waste water, washings from the fields), residents (unauthorized dumps, etc.).

Despite this, let's still explore how the number of air samples that exceed MPC (with regard to the total number of samples) correlates with economic activities. To this end, we will use the results of cluster analysis of 80 regions (except Moscow, Saint Petersburg, and the Chechen Republic) by their economic indicators [9]. Let's consider two clusters of the most developed regions specializing in the raw materials extraction and processing industries as well as a cluster of the least economically developed regions. Each region is matched with its percentage of air samples that exceed MPC (Table 2).

Table 2 shows that the highest number of unsatisfactory samples is in the regions with the lowest level of economic activities, and generally, no pattern can be traced for the link between the change of this indicator in the regions with different level of activities and the nature of economic development.

Therefore, the regional differentiation of studied indicator cannot be attributed to any industry-specific factor.

Let's examine whether the air pollution is determined by the geographical location of regions. This hypothesis is also not supported by statistics. Within the federal districts, there are quite strong fluctuations in the percentage of negative air samples just like between the regions of different federal districts.

A similar situation is observed for the water samples, but these indicators have a wider variance across the regions than the air samples—from 0 % in the Smolensk Region and the Pskov Region, the Republic of Kabardino-Balkaria and the Republic of Bashkortostan to 100 % in Khanty-Mansi Autonomous District. As we can see, the negative samples are absent in the regions that are significantly different in terms of their economic development. The analysis of data for the aggregate of regions as well as the data in Table 2 shows that there is no dependency of negative water samples on the nature and scale of regional economic development. The same can be said about the impact of geographical location of the regions on the pollution of water bodies.

Table 2

The environmental indicators in individual regions in 2011

Regions	Percentage of air samples above MPC, %	GRP per capita, thousand rubles
Cluster "Very High Level of Development. Resource Sector"		
Khanty-Mansi Autonomous District	4.9	1,536.7
Nenets Autonomous District	0.7	3,961.0
Yamalo-Nenets Autonomous District	0.1	1,775.2
Cluster "High Level of Development. Processing Sector"		
The Samara Region	1.6	259.0
The Nizhny Novgorod Region	1.4	233.3
The Yaroslavl Region	0.7	224.3
The Moscow Region	0.5	313.6
Cluster "Very Low Level of Development. Resource Sector"		
The Republic of Dagestan	13.3	111.9
The Republic of Ingushetia	7.1	61.8
The Tyva Republic	0.2	109.4

Sources: Environmental Protection in Russia, Moscow: Rosstat, 2012; Regions of Russia. Socioeconomic Indicators. 2013: Statistical Compilation, Moscow: Rosstat, 2013 (in Russian).

Introducing Environmental Component into Human Development Index

The percentage of samples that exceed MPC in the total number of samples adequately describes both the quality of population and, even more so, the quality of life.

Since the human development indexes (HDI) [10, 11, 14, 15] still do not describe in any way the environmental life conditions of the population, we will expand them for that purpose by using the percentages of negative water and air samples. We used the data for 2013 on the percentage of samples that exceed MPC in the total number of tested air and water samples[3] by the entities of the Russian Federation to build individual indexes in the same way as, for example, the characteristics of illiteracy and share of students in the index of education included in HDI. The maximum percentage of negative samples was assumed to be 100 %, and the minimum, 0 %. The individual air and water indexes for the regions are based on the following rule: the less the number of samples that exceed MPC, the better—that is, the higher the corresponding index:

[3] Okhrana okruzhayushchey sredy v Rossii [Environmental protection in Russia]. (2014) : Rosstat. Moscow 2014; Gosudarstvennyy doklad "O sostoyanii i ob okhrane okruzhayushchey sredy Rossiyskoy Federatsii v 2013 godu" [State report "On the state and protection of environment in the Russian Federation in 2013". (2014). Moscow: the Ministry of Natural Resources of the Russian Federation]..

$$P_i = \frac{x_{\max i} - x_i}{x_{\max} - x_{\min}},$$

where x_i, $x_{\min}$, $x_{\max}$ are, respectively, the actual, minimum, and maximum percentage of negative samples in the region *i*.

Next, we built the index of environmental conditions for life (I_{env}) as the arithmetic average of individual indexes for air (P_1) and water (P_2) and calculated HDI_{env} that now depends not on the three as in [14] but on the four components:

$$HDI_{env} = 1/4\ (3 \times HDI + I_{env}).$$

The information on the values of *HDI* in the Russian regions in 2013 was obtained from [14, pp. 150–151].

Figure 2 shows *HDI*s recalculated with environmental conditions (HDI_{env}) for 80 entities of the Russian Federation in comparison with traditional *HDI*. With this modification, *HDI* has decreased in 26 regions. The biggest decrease of *HDI* is observed in Moscow (11.3 %, No. 18), the Komi Republic (5.1 %, No. 20), the Arkhangelsk Region (4.3 %, No. 21), the Leningrad Region (4.7 % , No. 24), the Novgorod Region (7.7 %, No. 26), Perm Krai (5.1 %, No. 48), and Chukotka Autonomous District (6.3 %, No. 80).

The decrease of *HDI* after the introduction of environmental index occurred in the regions with the largest percentage of water samples that exceed MPC, which is associated with the change of this indicator over a wide range — from 0 in the Smolensk Region to 95.8 % in Moscow. On the contrary, the

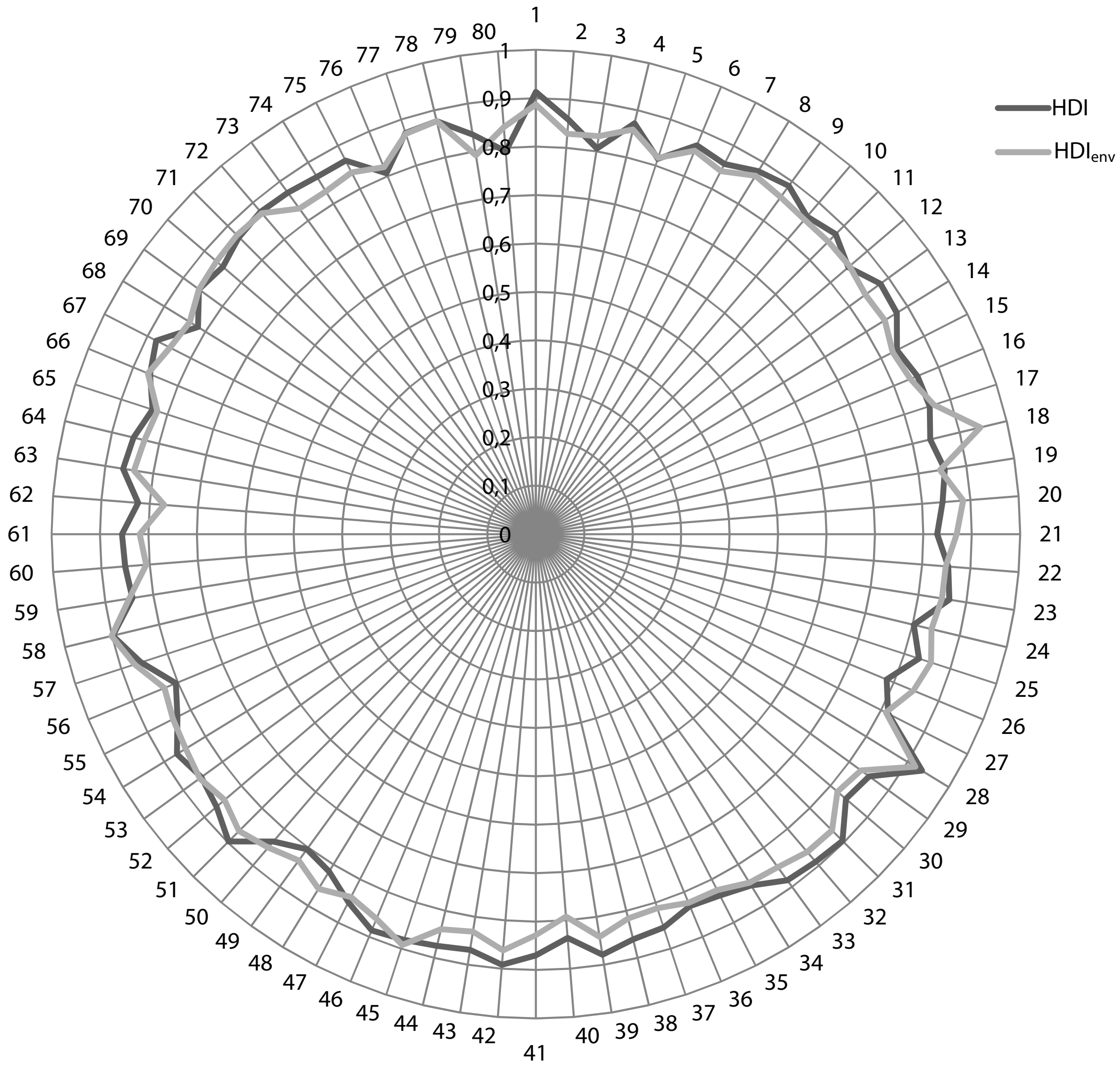

Fig. 2. *Comparing HDI and HDI_{env} by entities of the Russian Federation (HDI values from the 2013 Report on Human Development in the Russian Federation "Sustainable Development: Rio Challenges" [14]; indicators of HDI_{env} calculated by the author)*

individual air index made a weak differentiating impact on the change in the overall *HDI* because, first, the percentage of negative air samples varies within a narrower range—from 0.1 % in the Kostroma Region, the Tver Region, the Republic of Mari El, the Republic of Mordovia, the Chuvash Republic, Kamchatka Krai to 21 % in Zabaykalsky Krai, and second, the individual indexes were built within the minimum value of 0 % and maximum value of 100 %.

The remaining 54 regions improved (some of them significantly) their HDI by including the environmental conditions for the population: the Kabardino-Balkar Republic (5.19 %, No. 37), the Karachay-Cherkessia Republic (5.47 %, No. 38), the Chechen Republic (5.62 %, No. 40), Stavropol Krai (5.03 %, No. 41), the Altai Republic (5.4 %, No. 60), the Tyva Republic (6.7 %, No. 62), Jewish Autonomous Region (5.48 %, No. 79).

These results confirm weak dependency of the state of environment on the scale and nature of economic activities in the regions. With the introduction of environmental component, *HDI* did not decrease in all economically developed regions.

Accordingly, the transition from traditional human development index of the environmentally adjusted index was accompanied by the changes in the ratings of the regions (Table 3).

Table 3

Ratings of the regions by *HDI* and HDI_{env}

Regions	Rank by *HDI**	Rank by HDI_E**	$HDI - HDI_E$ (column 2 – column 3)	Regions	Rank by *HDI**	Rank by HDI_E**	$HDI - HDI_E$ (column 6 – column 7)
The Belgorod Region	5	2	3	Stavropol Krai	65	24	41
The Bryansk Region	64	38	26	The Republic of Bashkortostan	20	6	14
The Vladimir Region	57	75	–18	The Republic of Mari El	58	25	33
The Voronezh Region	24	21	3	The Republic of Mordovia	52	20	32
The Ivanovo Region	73	73	0	The Republic of Tatarstan	4	11	–7
The Kaluga Region	28	27	1	The Udmurt Republic	23	9	14
The Kostroma Region	49	39	10	The Chuvash Republic	46	49	–3
The Kursk Region	13	15	–2	Perm Krai	25	71	–46
The Lipetsk Region	21	8	13	The Kirov Region	56	77	–21
The Moscow Region	29	35	–6	The Nizhny Novgorod Region	32	63	–31
The Orel Region	30	17	13	The Orenburg Region	15	4	11
The Ryazan Region	31	54	–23	The Penza Region	39	29	10
The Smolensk Region	48	13	35	The Samara Region	26	47	–21
The Tambov Region	40	19	21	The Saratov Region	37	26	11
The Tver Region	66	60	6	The Ulyanovsk Region	47	67	–20
The Tula Region	55	48	7	The Kurgan Region	63	76	–13
The Yaroslavl Region	18	41	–23	The Sverdlovsk Region	10	40	–30
Moscow	1	59	–58	The Tyumen Region	3	3	0
The Republic of Karelia	41	42	–1	The Chelyabinsk Region	33	55	–22
The Komi Republic	6	56	–50	The Altai Republic	77	52	25
The Arkhangelsk Region	11	68	–57	The Republic of Buryatia	72	43	29
The Vologda Region	36	45	–9	The Tyva Republic	80	69	11
The Kaliningrad Region	35	32	3	The Republic of Khakassia	51	33	18
The Leningrad Region	50	78	–28	Altai Krai	60	44	16

The end of the Table on the next page.

The end of the Table 3.

Regions	Rank by HDI^{*}	Rank by HDI_E^{**}	$HDI - HDI_E$ (column 2 – column 3)	Regions	Rank by HDI^{*}	Rank by HDI_E^{**}	$HDI - HDI_E$ (column 6 – column 7)
The Murmansk Region	27	65	–38	Zabaykalsky Krai	69	64	5
The Novgorod Region	42	80	–38	Krasnoyarsk Krai	14	34	–20
The Pskov Region	76	72	4	The Irkutsk Region	38	12	26
Saint Petersburg	2	1	1	The Kemerovo Region	54	70	–16
The Republic of Adygea	62	50	12	The Novosibirsk Region	22	37	–15
The Republic of Kalmykia	71	57	14	The Omsk Region	16	53	–37
Krasnodar Krai	17	5	12	The Tomsk Region	8	28	–20
The Astrakhan Region	19	7	12	The Republic of Sakha (Yakutia)	9	18	–9
The Volgograd Region	34	10	24	Kamchatka Krai	59	22	37
The Rostov Region	43	51	–8	Primorsky Krai	61	31	30
The Republic of Dagestan	67	58	9	Khabarovsk Krai	53	30	23
The Republic of Ingushetia	68	66	2	The Amur Region	70	74	–4
Kabardino-Balkar The Republic	75	46	29	The Magadan Region	12	23	–11
Karachay-Cherkessia The Republic	74	36	38	The Sakhalin Region	7	16	–9
Republic of North Ossetia-Alania	45	14	31	Jewish Autonomous District	78	62	16
The Chechen Republic	79	61	18	Chukotka Autonomous District	44	79	–35

Sources: * 2013 Report on Human Development in the Russian Federation "Sustainable Development: Rio Challenges [14]. Moscow: LLC RA ILF, 2013; ** calculated by the author.

Table 3 shows that the value of $HDI - HDI_{env}$ is positive in most cases for the regions with higher rank in HDI_{env} rating compared to traditional *HDI* rating. This indicates favorable environmental conditions for the population in such regions. On the contrary, a negative value of $HDI - HDI_{env}$ is found in the regions with more strained environmental conditions.

The highest positive change in the rating of regions following the transition from *HDI* to HDI_{env} is observed for such regions, as Stavropol Krai (up by 41 positions), the Karachay-Cherkessia Republic (38), the Smolensk Region (35), the Republic of Mari El (33), the Republic of Mordovia (32). It is obvious that after the modification of HDI the order and list of the regions with the highest improvement in the rating are different from those of regions with the maximum change of absolute values (Fig. 2).

The biggest drop in the rating was observed for Moscow (down 58 positions), the Arkhangelsk Region (57), the Komi Republic (50), Perm Krai (46), the Murmansk and Novgorod Regions (38), the Omsk Region (37), Chukotka Autonomous District (35).

Of course, environmental conditions, particularly in the regions with serious violations in the state of environment, affect people's overall assessment of the quality of their life. The absence of this component in the scientific papers on building the quality of life index is always explained by the cumbersome and inadequate nature of environmental indicators system provided in the official statistics. We believe that this study demonstrated the inconsistency of such conclusions.

Conclusion

The article demonstrates the feasibility and effectiveness of using in the environmental and economic analysis of a new indicator describing the percentage of air and water samples that exceed

MPC in the total number of tested samples. This indicator reflects both the environmental behavior of population and environmental conditions for the population.

As an integral characteristic of the quality of life, the percentage of negative samples was introduced into the human development index to become its fourth component. As a result, we obtained an environmentally adjusted *HDI* that substantially modified the rating of the entities of the Russian Federation.

The goal of this study was to draw the attention of scientists and analysts to the environmental indicator that is new for economic research but is already introduced into the official statistical reports. This article only began exploring the possibilities offered by this indicator, and this research can be expanded in the future for setting and achieving new environmental and economic objectives where it can be useful.

Acknowledgements

The article has been prepared with the support of Russian Humanitarian Science Foundation, Scientific Project № 14–02–00141.

References

1. Ayres, R. U. & Kneese, A. V. (1969). Production, Consumption and Externalities. *The American Economic Review, 3,* 282–297.

2. Daly, H. (1968). On Economics as a Life Science. *The Journal of Political Economy, 3,* 392–406.

3. Forrester, J. W. (1971). *World Dynamics.* Cambridge, 142.

4. Leontief, W. (1970). Environmental Repercussions and the Economic Structure, an Input-Output Approach. *Review of Economics and Statistics, 52,* 262–271.

5. Meadows, D. H., Meadows, D. L., Randers, J. & Behrens, W. W. (1972). *The Limits to Growth. A Report for the Club of Rome's Project on the Predicament of Mankind.* New York, 205.

6. Nool, R. G. & Trijonis, J. (1971). Mass Balance, General Equilibrium and Environmental Externalities. *The American Economic Review, 4,* 730–735.

7. Ryumia, Ye. V. (2014). Ekologicheskaya kharakteristika kachestva naseleniya [Ecological characteristic of the quality of population]. *Ekonomika regiona [Economy of region], 3,* 82–90.

8. Lokosov, V. V., Ryumina, Ye. V. & Ulyanov, V. V. (2015). Regionalnaya differentsiatsiya pokazataley chelovecheskogo potentsiala [Regional differentiation of human potential indicators]. *Ekonomika regiona [Economy of Region], 4,* 185–196.

9. Ryumina, E. V., & Anikina, A. M. (2007). Analyzing the Impact of the Natural Resources Factor on the Level of Economic Development of Russian Regions. *Studies on Russian Economic Development, 5,* 523–538.

10. Human Development Report 2013. *The Rise of the South: Human Progress in a Diverse World.* (2014). New York: UNDP, 2014, 216.

11. *Human Development Report 2014: Sustaining Human Progress. Reducing Vulnerabilities and Building Resilience.* (2014). New York: UNDP, 239.

12. Frolov, I. E. (Ed.). (1999). *Chelovecheskiy potentsial: opyt kompleksnogo podkhoda [Human potential: experience of integrated approach].* Moscow: Editorial URSS Publ., 176.

13. *Chelovecheskoye razvitie. Novoye izmerenie sotsialno-ekonomicheskogo progressa [Human development. New measurement of social and economic progress].* (2008). Moscow: Prava cheloveka Publ., 636.

14. Bobylev, S. N. (Ed.) (2013). *Doklad o chelovecheskom razvitii v Rossiyskoy Federatsii 2013 «Ustoychivoye razvitie: vyzovy Rio» [Report on human development in the Russian Federation 2013 "A sustainable development: challenges for Rio"].* Moscow: RA ILF Publ., 202.

15. Grigoryev, L. M. & Bobylev, S. N. (2014). *Doklad o chelovecheskom razvitii v Rossiyskoy Federatsii za 2014 god [The report on human development in the Russian Federation for 2014].* Moscow: Analiticheskiy tsentr pri Pravitelstve Rossiyskoy Federatsii Publ., 204.

Author

Yelena Viktorovna Ryumina — Doctor of Economics, Professor, Chief Research Associate, Institute of Social and Economic Studies of Population of RAS (32, Nakhimovsky Ave., Moscow, 117218, Russian Federation; e-mail: ryum50@mail.ru).