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METHODOLOGICAL APPROACHES FOR ASSESSEMENT PERFORMANCE AND ECONOMICAL EFFICIENCY OF THE RISK-ORIENTED CONTROL AND SUPERVISION OF THE FEDERAL SERVICE ON CUSTOMERS' RIGHTS PROTECTION AND HUMAN WELL-BEING SURVEILLANCE (ROSPOTREBNADZOR)

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Abstract. The methodical approaches to the calculation of actual and avoided as a result of control and supervision economic losses from mortality, morbidity and disability in the population associated with the adverse effects of environmental factors are stated. The method is based on the sequential decision of the chain of problems: establishing causality of health status indicators from habitat quality indicators, quantifying habitat quality control activities of the institutions and the Federal Service on Customers' Rights Protection and Human Well-Being Surveillance (Rospotrebnadzor), calculating episodes of health violations averted as a result of the Service's activity and assessing their economic equivalents. Testing of approaches on the example of the Russian Federation has allowed to establish that as a result of the activities of bodies and institutions of the Federal Service on Customers' Rights Protection and Human Well-Being Surveillance in 2013 a positive trend was observed on 51 indicators of habitat quality, about 160 thousand deaths and more than 2 million cases of diseases were prevented which would be held in the absence of adequate supervision measures in the field of sanitary and epidemiological welfare of the population. Preventing loss of gross domestic product (GDP) by more than 120 billion rubles, tax shortfalls to the federal budget of about 25.7 billion rubles. Taking into account the federal budget expenditures on the activities of the Federal Service on Customers' Rights Protection and Human Well-Being Surveillance in 2013 in terms of sanitary and epidemiological welfare in the amount of 11.386 billion rubles the loss in GDP of 10.56 rubles per 1 ruble of the federal budget expenditures was prevented, the tax shortfall to the federal budget in the amount of 2.28 rubles per 1 ruble of the federal budget expenditures was avoided.
Keywords: ssanitary and epidemiological surveillance, risk-oriented management, economical efficiency.

The RF President Decree №797 of May 15, 2008 On Urgent Measures to Liquidate Administrative Restrictions on Business Activities followed by respective Federal laws1 made a lot of changes to the activities of supervisory and controlling activities of the governmental agencies including the Federal Service on Customers' Protection and Human Rights and Human Well-Being Surveillance.

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[1] Federal Law № 294-FZ of 26 December 2008 «On the Protection of Legal Entities' and Individual Entrepreneurs' Rights in the Course of State Control (Supervision) and Municipal Control»;

Federal Law № 8-FZ of 9 February 2009 «On Providing Access to Information on the Activities of Governmental Bodies and Bodies of Local Self-Government»;

Federal Law № 210-FZ of 27 July 2010 «On Approval of the Federal Tariff Service Regulation»;

Federal Law № 242-FZ of 18 July 2011 «On Amendments of the Invidicual Legislative Acts of the Russian Federation On the Issues of State Control (Supervision) and Municipal Control».

The basic regulatory acts served as a framework for the administrative regulations for the execution of the federal and municipal functions that allowed for systematization of the powers of the local government and their improvement [1, 6, 8–10]. With all that, the risk analysis method was acknowledged as a reliable and effective tool to improve the performance of the supervisory agencies [2–5, 11, 12].

In order to decrease administrative load on the economic entities and improve the performance of Rospotrebnadzor agencies, a risk-oriented supervisory model was developed based on the following principles:

– use health risk assessment methods at all the stages of controlling and supervisory activities;

– classify the supervised entities based on the level of hazard and risk to the public health and well-being;

– use a differentiated approach to the controlling and supervisory activities focusing on the entities that present an impermissible health risk;

– regular information and analytical support of the tasks related to the public health risk assessment and management including socio-hygienic monitoring;

– take into account the economic efficiency indicators of the controlling and supervisory activities and measures related to health risk management;

– optimize the controlling and supervisory activities in the field of health risk criteria, health hazard criteria, and the economic losses.

In general terms, the model is a system of interconnected structural and functional components of the service that use the methodology of health risk analysis (risk assessment and management) at all the stages of collecting, processing, and analyzing the data about the managed entities. Those include the supervised economic entities and, respectively, the living environment and public health.

The controlling and supervisory activities as a management tool are based on:

– health risk assessment results and their economic equivalents;

– determining the health risks created by various economic entities;

– selecting an adequate (in terms of risk) supervision mode (frequency, types, volume and content of supervision).

Today the risk-oriented model is supported by the current regulatory and guidance documents of the Federal Service on Consumers' Rights Protection and Human Well-Being Surveillance drafted by the authorities and agencies of Rospotrebnadzor, Russian Academy of Medical Sciences, and the Ministry of Public Health and Social Development. The documents

refer to the health risk assessment associated with the chemical, biological, and physical environmental impact. Today Rospotrebnadzor agencies and organizations use over 50 documents on various aspects of health assessment and management.

At the same time, the development of methodic approaches to the assessment of economic damages that allow for the assessment of health risks resulting from the violation of sanitary law and the controlling and supervisory activities aimed at their minimization and prevention is still a topic of current interest [7].

The issue has determined the **purpose of the resea**rch: to provide scientific determination for the approaches to the assessment of actual and prevented (as a result of control and supervision) economic losses from mortality, morbidity and disability in the population associated with the adverse effects of environmental factors.

Materials and Methods. Suggested methodic approaches to solve the stated task take into account and further develop The Methodology for the Calculation of Economic Losses from Morbidity, Mortality and Disability of the Nation's Working Population[1]. Economic losses from the above health disorders are determined as follows:

– losses associated with GDP underproduction due to employee leaving the workplace as a result of environmental impact.

– losses associated with decreased federal budget revenues resulting from GDP underproduction due to employee leaving the workplace.

The data of Russia's state statistical recording and Rospotrebnadzor industrial statistical monitoring as well as the results of socio-hygienic monitoring were used as source information.

Calculation of the number of health condition cases associated with the environmental impact and the cases prevented by Rospotrebnadzor is conducted on the bases of modeling of the relationship between the environmental quality indicators, public health indicators, and parameters of Rospotrebnadzor activities.

The general numerical procedure includes the following steps:

– determine the cause-and-effect between the health indicators and environmental quality indicators;

– determine the qualitative indicators for environmental quality management resulting from the activities of Rospotrebnadzor agencies;

– calculate the number of health condition cases prevented by Rospotrebnadzor agencies;

[1] Set by the Decree of April 10, 2012 # 192/323n/45n/113 of the RF Ministry of Economic Development, the RF Ministry of Public Health and Social Development, the RF Ministry of Finance and the Federal State Statistics Service.

– calculate economic losses resulting from deaths, disability and health conditions associated with environmental impact and averted by the control and inspection activities.

When determining the relationship between the public health indicators and environmental quality indicators, the morbidity rate, disability rate, and death rate serve as dependent variables; and environmental quality indicators, for example, the share of environmental samples that do not meet the hygienic requirements serve as independent variables.

The monitoring units can include the following: the RF level – subjects of the federation; the regional level – administrative entities, etc. To increase the model validity, the sample data should include the monitoring results for at least 3 years.

We used multiple regression analysis as a modeling method modified by walking through the line function, quadratic function, and exponential function for the independent variables.

The health environmental quality model in standard form looks as follows (1):

$$y = a_0 + a_1 f_1 (\mathrm{EF}_1) + a_2 f_2 ((\mathrm{EF}_2) + \ldots, \quad (1)$$

where y – dependent variable (death rate, disability rate, morbidity rate, cases per 100 000); EF_1, (EF_2, …) – independent variables – environmental factors; a_0 – intercept in the model that characterizes the controllability limit for the health indicators by changing the environmental quality; a_i – model parameters that characterize the influence of I indicator of environmental quality on the health indicator; f_i (EF_i) – function of the independent variable in the model that has the biggest coefficient of determination.

To calculate the additional cases of health conditions, we used only the models that pass the test of significance and the predictive failure test. The relative number of additional cases of health conditions (morbidity rate, disability rate, death rate) is calculated as a difference between the estimations in accordance with the model with the actual levels of independent variables and the essential observations (target) (2):

$$\Delta y_k = a_1 f_1 ((\mathrm{EF}_{1k}) + a_2 f_2 ((\mathrm{EF}_{2k}) + \ldots, \quad (2)$$

where Δy_k – public health conditions (death rate, disability rate, morbidity rate) associated with the environmental factors in the k observation (region); EF_{1k}, EF_{2k}, … – values of the independent variables for the k observation (region, area).

The absolute indicators are calculated with the account for the population size.

Determination of the relationship between the environmental quality indicators and Rospotrebnadzor control and inspection activities was conducted with the use of the statistical data about environmental quality which is used with assessing the ‘environment-health’ relationship, and the data about the programs and activities of Rospotrebnadzor organizations and agencies collected

as part of the departmental statistical observation: form 1–11 (in 2011), form 1–12 (in 2012) "Data on the results of the federal state inspection by Rospotrebnadzor agencies".

We used environmental indicators as dependent variables, and inspection parameters as independent variables. The inspection parameters were translated into relative terms (for example: 'the number of inspections of economic entities per 100 thousand population', 'total imposed fines per 100 checkups', etc.)

The model is built with the help of the multiple regression method with the selection of an optimal function for the independent variables. When building a model for the dependent variables, we used one-year lags that helps determine the causality of the relationship: the impact of the activities on the quality of the environment.

The new models that we built have the following characteristics:

– the relationship formula that contains the values of all the coefficients;
– reliability parameters;
– values of the indicators that represent the quality of the model;

The relationship model 'health-environmental quality' in the standard form looks as follows (3):

$$EF_i = b_0 + b_1 f_1 (FA_1) + b_2 f_2 (FA_2) + \ldots, \quad (3)$$

where EF – dependent variable (environmental quality indicator); FA_1, FA_2,… – independent variables (control and inspection activities of Rospotrebnadzor); b_0 – intercept in the model that characterizes the controllability limit for the environmental quality indicators by means of Rospotrebnadzor activities;

b_j – parameters of the model that characterize the influence of i activity indicator on the environmental quality indicator; $f_k (FAz_k)$ –independent variable function that gives the maximum determination coefficient.

In order to calculate the impact of Rospotrebnadzor control and inspection activities on the environmental quality, we used only the models that pass the test of significance and the predictive failure test.

The number of deaths, disabilities, and health conditions averted due to Rospotrebnadzor activities is calculated based on the results of the first two stages of modelling (4):

$$\Delta y_k = a_1 (f_1 (EF_{1k} + \Delta EF_1) - f_1 (EF_{1k})) + a_2 (f_2 (EF_{2k} + \Delta EF_2) - f_2 (EF_{2k})) + \ldots . \quad (4)$$

The absolute number of averted health problems (deaths, disabilities, health conditions) is calculated as follows (5):

$$\Delta Y_k = \Delta y_k \mathrm{PS}_k / 100\,000, \qquad (5)$$

where ΔY_k – the absolute number of health problems (deaths, disabilities, health conditions) averted by Rospotrebnadzor in the k observation (region, area); PS_k – population size of the k region (area).

Economic losses are assessed for the cases of health conditions and deaths among the population involved in the GDP production. The share of the employed working-age population, employed pensioners and teenagers reflects the official statistics or scientific reports published on the official state websites.

Economic losses from deaths determined by the environmental impact and averted due to Rospotrebnadzor control and inspection activities in the reporting year in the RF are calculated as follows (6):

$$\text{ÓÂÃÑ}_{x,s,d} = \\ = \times\text{Ó}_{x,s,d} \cdot \frac{\times\text{Ç}_{x,s}}{\times\text{Í}_{ð,s}} \frac{\times\text{Ç}_{x,s}}{\times\text{Í}_{ð,s}} \cdot \frac{\text{ÂÂÏ}}{\times\text{Ç}} \cdot 0,5 \cdot \text{Ê}_x, \quad (6)$$

где $\text{ÓÂÃÑ}_{ð,s,d}$ – averted losses in the GDP production (the underproduced GDP) resulting from decreased deaths associated with the environmental factors at the age of (x), sex (s), cause (d) in the reporting year, million roubles;

$\times\text{Ó}_{x,s,d}$ – the number of averted deaths at the age of (x), sex (s), environmental cause (d), number of people;

$\times$Ç – total employment in the reporting year, people;

$\times\text{Ç}_{x,s}$ – total employment at the age of (x), sex (s), people;

$\times\text{Í}_{x,s}$ – number of people at the age of (x), sex (s), people;

GDP – the RF's gross domestic product, million roubles;

K_x – adjustment factor to account for the reduced working hours and increased vacation time for the people of age (x) under 18 (for x = 15 K_x= 0.5922, for x = 16 K_x= 0.8636, for x =17 K_x= 0.8636, for x > 17 K_x= 1); 0.5 – the factor that accounts for the distribution of the time of deaths throughout the year.

The economic losses determined by the environmental impact and averted by Rospotrebnadzor in the reporting year in the Russian Federation are calculated as follows (7):

$$ÓÂÈ_{x,s,g} = \frac{ÂÂÏ}{\times Ç} \cdot \left[\times È_{x,s,g} \cdot \frac{\times Ç_{x,s}}{\times Í_{x,s}} - \frac{\times ÇÈ_g}{\times È_g} \cdot \times È_{x,x,g} \cdot K_g \right], \quad (7)$$

where $ÓÂÈ_{x,s,g}$ – lost profit in the GDP production (underproduced GDP) resulting from the environmentally determined disability at the age of (*x*), sex (*s*), disability group (*g*) in the Russian Federation, million roubles;

$\times È_{x,s,g}$ – number of the disabled at the age of (*x*), sex (*s*), disability group (*g*) in the Russian Federation, people;

$\times È_g$ –number of people in a disability group (*g*) in the Russian Federation, people;

$\times ÇÈ_g$ –number of the employed disabled, disability group (*g*) in the Russian Federation, people;

K_g – adjustment factor factor to account for the reduced working hours and increased vacation time for the disabled (for $g < 3$ $K_g = 0.8674$, for $g = 3$ $K_g = 0.991$).

Economic losses from morbidity are calculated as follows:

$$ÓÂÇ_{x,s,m} = Çàá_{x,s,m} \cdot \frac{Äë_{x,s,m}}{CÂÍ_{x,s,m}} \cdot \frac{\times Ç_{x,s}}{\times Í_{x,s}} \cdot \frac{ÂÂÏ}{365 \cdot \times Ç}, \quad (8)$$

where $ÓÂÇ_{x,s,m}$ – averted losses in the GDP production (underproduced GDP) due to decreased morbidity determined by the environmental factors at the age of (*x*), sex (*s*), cause (*m*) in the Russian Federation, million roubles;

$Çàá_{x,s,m}$ – heath conditions at the age of (*x*), sex (*s*), caused (*m*) determined by the environmental factors;

$Äë_{x,s,m}$ – days of temporary disability at the age of (*x*), sex (*s*) caused by (*m*), дней;

$CÂÍ_{x,s,m}$ – days of temporary disability, sex (*s*), cause of disability (*m*), in the Russian Federation in the reporting year.

Results and discussion. The use of this method on the basis of the government statistics and the socio-hygienic monitoring results determined that overall in the Russian Federation, dust and gaseous emissions, waste-water discharges, accumulated waste, noise and electromagnetic impact of the industrial entities and transport, collection and recycling of waste, etc. lead to higher public health risks (including impermissible risks). In 2013, the risks caused 52 thousand deaths and resulted in 6.0 million disabilities in the employed population. The economic losses associated with underproduced GDP resulting from environmentally determined deaths, disabilities and

health conditions totaled approx. 200 billion roubles in 2013. Taking into account the losses determined by various socio-economic factors observed within the socio-hygienic monitoring, the economic losses in 2013 totaled over 450 billion roubles.

The structure of GDP economic losses based on harm-producing factors is shown in Figure below.

In 2013, shortfalls to the federal budget totaled over 19 billion roubles in tax revenues.

Control and inspection activities carried out by Rospotrebnadzor curb the growth of the death and morbidity rates as well as the federal economic losses that would have taken place had the activities been cut down.

The following activities are considered the most effective: inspections that revealed violations of the sanitary law, unscheduled audits, inspections with the use of laboratory and instrumental research methods, new rulings ordering administrative punishment, etc.

The analysis of the Rospotrebnadzor inspection and law enforcement activities in the Russian Federation in the field of ensuring public health and sanitary-epidemiological well-being by criteria of change in the share of violations of sanitary and epidemiological requirements that govern the activities of the economic entities from the environmental viewpoint shows that the 51 environmental indicators have positive dynamics. See Table 1 for examples.

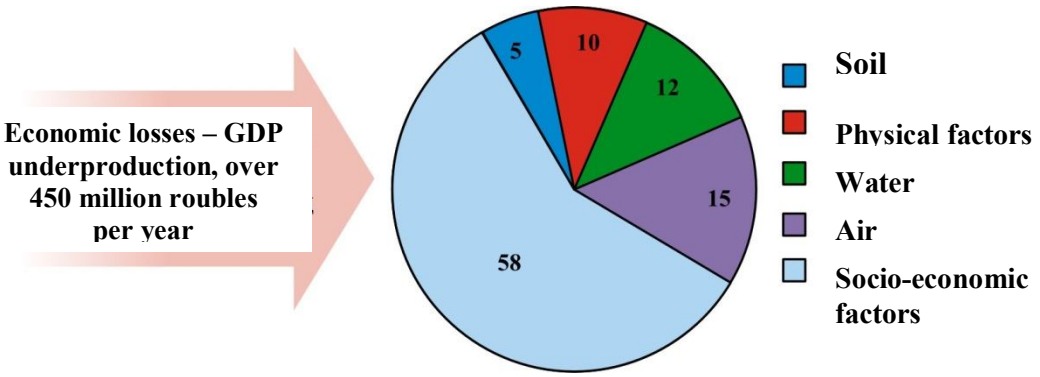

Figure. The structure (%) of GDP economic losses from deaths and health conditions associated with environmental factors

Decreased violations of the sanitary law and prevention of poor environmental health resulted in a decrease in deaths associated with circulatory diseases, respiratory diseases and new growths – over 160 thousand deaths and 3.2 million cases of health conditions were averted due to control and inspection activities aimed at providing sanitary and epidemiological well-being of the population.

Those health conditions include approx. 115.6 thousand death cases and 2.1 million cases of incapacity to work in employed people due to an illness or patient care (Table 2).

Overall, prevention of the GDP losses totaled over 120 billion roubles. Shortfalls to the federal budget in the amount of 25.7 billion roubles were prevented.

In 2013 when part of the federal budget in the amount of 11.386 billion roubles was allocated to the sanitary well-being the GPD losses were averted in the amount of 10.56 roubles per 1 rouble of the federal expenditures, as well tax as shortfalls to the federal budget in the amount of 2.28 roubles per 1 rouble of the federal budget expenditures.

Table 1

Evaluation of the dynamics and results of inspection and control in the field of sanitary law enforcement

Environmental indicator and the state of things with the inspected entity	Share of the sanitary law violations averted due to the Rospotrebnadzor activities (%)		
	2012	2013	2014 (forecast)
The share of sources and water pipes of the drinking water system that do not meet the sanitary norms and requirements	–7,65	–7,87	–8,13
The share of sources and water pipes of the drinking water system that do not meet the hygienic standards in terms of microbiological indicators	–2,86	–3,14	–3,14
The share of sources and water pipes of the drinking water system that do not meet the hygienic standards in terms of sanitary and chemical indicators	–1,66	–1,74	–1,58
The share of air samples with the chemical levels that exceed maximum permissible concentrations	–0,29	–0,32	–0,35
The analysis of the drinking water samples with Chloride and its derivatives that exceed maximum permissible concentrations	–10,35	–13,16	–16,17
The share of analyzed samples in a residential area that do not meet the hygienic norms in terms of sanitary and chemical indicators	–10,038	–10,91	–10,13
The share of communal entities, studied in a lab, that do not meet the sanitary norms in terms of microclimate	–1,63	–1,79	–1,88
The share of communal entities, studied in a lab, that do not meet the sanitary norms in terms of lighting	–0,06	–0,08	–0,04
The share of sources and water pipes of the drinking water system that do not meet the sanitary standards	–7,65	–7,87	–8,13

Table 2

Medical, demographic and economic losses related to environmentally determined deaths and morbidity in the employed population averted due to the Rospotrebnadzor activities

Cause of losses	Averted medical and demographic losses in the employed population		Averted GDP environmental losses, million roubles
	Death cases, thousand	Disability cases, thousand	
Circulatory system diseases	55,834	878,27	54 864,93
Respiratory system diseases	13,814	477,58	22 449,98
Digestive system diseases	20,991	208,11	16 463,78
Malignant growths	18,255	64,49	10 345,40
Eye diseases and and the appendages of the eyes	–	245,028	8 363,91

Endocrine system diseases	–	102,129	3 482,60
Diseases of the blood and blood-forming organs and disorders involving the immunity mechanism	–	82,65	2 818,37
Infectious and parasitic diseases	4,467	10,92	2 365,77
Nervous system diseases	–	36,13	1 232,03
External causes	2,231	5,39	1 179,38
TOTAL	115,592	2110,945	123 566,15

Consequently, the suggested methodological approaches provided support to the risk-oriented model of the inspection activities in the form of economic tool that allows:

– assessing the medico-demographic and economic losses associated with the negative environmental impact on public health;

– identifying the priority risk factors, risk cohorts and priority health violations that determine economic losses;

– assessing the parameters of environmental management by the Rospotrebnadzor agencies;

– assessing the contribution of Rospotrebnadzor to the improvement of the environment and health preservation;

– assessing the economic losses associated with underproduced GDP and tax shortfalls to the budgets of all level (including federal budget) - and averted due to control and inspection activities;

– identifying the most effective inspection activities;

– developing information-and-analytical database to improve the inspection activities in the field of sanitary and epidemiological well-being of the population.

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