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Integrative justification of the effectiveness of environmental protection expenditures: the experience of single-industry towns in the Karaganda region

R.A. Salimbaeva[1], A.A. Adambekova[2], S.U. Stamkulov*[3]

[1]*University of Narxoz, Almaty, Kazakhstan*
[2]*Kazakh National University named after Al-Farabi, Almaty, Kazakhstan*
[3]*Almaty Technological University, Almaty, Kazakhstan*

(E-mail: [1]salimbaeva.rasima@narxoz.kz; [2]ainatas0408@gmail.com; [3]kaliash_22@mail.ru)

Abstract. Objective – to assess the effectiveness of current local (municipal) environmental protection expenditures, as well as to propose a methodology for evaluating effectiveness with subsequent implementation and adoption for practical application. Methods – theoretical (analysis and generalization of scientific sources, comparative analysis of domestic and international experience); empirical (study of environmental action plans, case studies, interviews with experts); quantitative (calculation of performance indicators, comprehensive assessment based on environmental and economic indicators); qualitative (content analysis of documents, analysis of established practice). Results – a methodological procedure has been developed to assess the effectiveness of municipal environmental protection expenditures. The economic cost assessment is presented as an important component for determining the priorities of environmental policy, including municipal policy. The calculation of composite indexes and multi-criteria indicators that determine the effectiveness of municipal environmental protection costs and the sustainable development of single-industry towns is given. Conclusions - the authors state the importance of applying the methodology of sustainable development, taking into account the social, environmental and economic components for the development of single-industry towns and city-forming enterprises. The dominant criterion in evaluating effectiveness is a modified method based on three E–Economy (economy), Efficiency (impact) and Effectiveness (effectiveness).

Keywords: single-industry towns, efficiency assessment methodology, municipal environmental protection costs, ecological and economic efficiency, social efficiency.

Introduction

Any production activity has a twofold impact on the environment. The first impact is expressed at the beginning of technological production in the form of depletion of the used natural resource. The second impact is manifested at the end of the technological chain, when, along with the

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[1]***хат-хабар авторы**

finished product, we receive side negative effects in the form of emissions into the atmosphere, discharges into the aquatic environment and waste polluting the soil cover. Due to this twofold adverse impact, all households and the public sector are forced to compensate for this impact and, moreover, bear the costs of prevention and reduction. Otherwise, environmental disasters are inevitable both at the global level and in a single country or municipality. For example, all environmental users are financially responsible for the impact caused, meaning they bear the costs of restoring or preventing environmental pollution. In turn, government agencies and governments bear the costs of ensuring a safe environment and maintaining public health, etc. In addition to financing, governments also use other economic instruments to influence nature users in the form of a system of motivation and subsidies for the production of environmentally friendly products and the provision of environmental services. Since not all participants in the macro- and micro-level production sector can allocate additional funds from their own budget to finance environmental costs.

The main objective of the study is to determine how effective the planned environmental protection measures are at the macro and municipal levels. The result of these activities allows us to characterize the effectiveness of the local government system and evaluate the effectiveness of the invested public funds of the local and national budgets. In particular, the main object of the study is to evaluate the effectiveness of financing in the field of environmental protection using the example of single-industry towns in the Karaganda region. The state of the natural environment and the well-being of the population living in these regions, their health and the right to live in favorable conditions depend on the effectiveness of these measures.

Literature review

The assessment of environmental protection measures includes an assessment of the implementation of the results and an assessment of the impacts of the activities carried out. There is a consensus in the scientific literature that the choice of method should be consistent with the goals set: descriptive monitoring and audits answer questions about the effectiveness of implementation and results, while causality requires development based on an alternative outcome of events. The authors usually distinguish three concepts of performance assessment: implementation effectiveness is measured on the basis of compliance and monitoring reports (Morrison-Saunders et al., 2023;Arkhangelsky et al., 2021). The effectiveness of the results is measured on the basis of environmental indicators, such as the concentration of pollutants, changes in habitat or water quality (Demarchi et al., 2023). The effectiveness of exposure according to (Bonander et al., 2021) is the establishment that the observed results were caused by the intervention, and not by other factors. Without mandatory control and proper monitoring, many methodological approaches cannot be fully applied. Systematic reviews show that many environmental measures bring net benefits when the co-benefits are taken into account. Therefore, the authors (Morrison-Saunders et al., 2024; Sadler et al., 2023) consider economic assessment as important for determining policy priorities, including municipal ones. Composite indexes and multi-criteria approaches are used to summarize the multidimensional effectiveness of many strategies. The authors in (Kim et al., 2024;Burns et al., 2019) note that they make it easier to compare and visualize different strategies, but warn that the choice of weighting coefficients is subjective and may conceal heterogeneity. The indexes should be accompanied by results broken down by category and an analysis of sensitivity to the weighting factors of the evaluated indicators. The authors (Aziz et al., 2024) of the literature devoted to this

study emphasize that methodological complexity must be combined with data availability and institutional capacity. The most convincing assessments combine objective results, alternative arguments, and implementation possibilities. Without these three interrelated elements, statements about the effectiveness of environmental protection measures would be incomplete.

The achievement of the Sustainable Development Goals as a global problem covers all countries of the world and runs like a "red thread" in all areas of human activity. It should be noted that the entire global community is interested in a clean environment, in the well-being of all components of the natural environment and allocates huge financial resources to maintain and improve the environment. Undoubtedly, the financing of environmental protection measures is an important indicator characterizing the interest of state structures in environmental protection both by national governments and at the municipal level in individual regions.

Research methods

The main research question is: how can the effectiveness of environmental protection measures in single-industry towns of Kazakhstan be objectively assessed using ecological and economic indicators?

The hypothesis of the study is that the use of a system of integrative ecological and economic indicators makes it possible to increase the objectivity of assessing the effectiveness of environmental protection measures compared with traditional methods based mainly on financial costs or environmental standards.

This study is based on materials on industrial enterprises of single-industry towns in the Karaganda region, as well as on official Environmental Action Plans and waste management programs approved by akimats (Akimat of Karaganda region, 2025; On the environmental protection action plan for 2022-2024, 2021). These documents are regulatory and managerial acts containing a list of planned measures, the amount of financing, the timing of implementation and the expected environmental effects, which ensures their high degree of reliability as a source of information. The study used quantitative and qualitative data. Quantitative indicators include the dynamics of pollutant emissions, waste generation and disposal, enterprise expenditures on environmental measures, indicators from plans (financing volumes, standards, planned results) for 2022-2025 and forecasts up to 2029. Quality materials include regulatory documents, environmental reports from enterprises, analytical reviews, and expert interviews with representatives of local governments and the industrial sector (Akimat of Karaganda region, 2024).

The course of the study was carried out in the following sequence: collection and systematization of materials, classification of indicators (environmental, economic, ecological-economic), calculation and processing of data, comparison of planned and actual results, as well as interpretation of the results of the analysis.

In general, it should be noted that the methodological basis of the study was based on symbiosis:

– theoretical methods (analysis and synthesis of scientific sources, comparative analysis of domestic and international experience);

– empirical methods (study of environmental action plans, case studies, expert interviews);

– quantitative methods (calculation of performance indicators, integrated assessment based on environmental and economic indicators);

– qualitative methods (content analysis of documents, analysis of implemented practices).

The integrated use of materials and methods ensured the reliability of the results obtained and made it possible to identify patterns and evaluate the effectiveness of environmental policy implementation in the single-industry towns of the Karaganda region.

Results and discussion

The graph shown in Figure 1 shows that the main environmental protection costs in the Karaganda region were set in 2024. However, from the point of view of comparing the rates of change in the implemented environmental protection measures, it should be noted that in 2022 and 2023, the cost structure in these five areas was generally maintained.

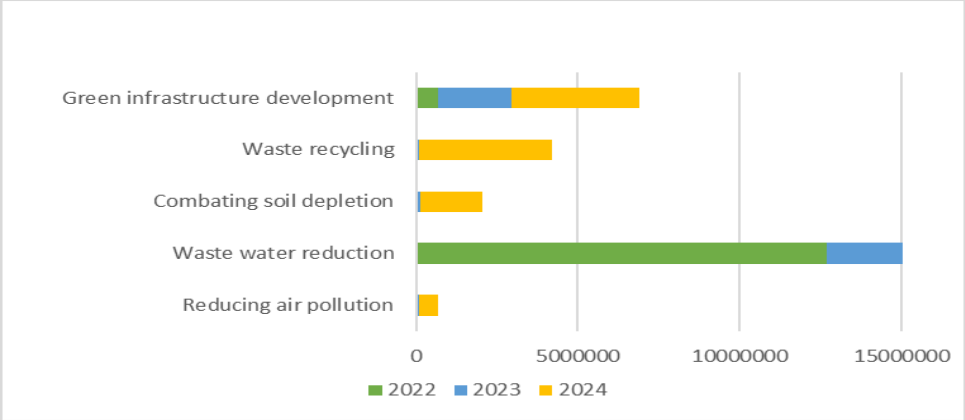

Figure 1 – Results of the budget review of the Environmental Protection Plan of the Karaganda region for the period 2022-2024, thousand tenge

Note: Compiled by the authors

A review of the main problems and unrealized opportunities of the Environmental Protection Action Plan showed that a small budget was allocated for the "Reduction of atmospheric air pollution" direction – 3% of the total amount of funds allocated over three years for environmental protection. This indicates that decarbonization measures are not yet a key guideline for the region (On the environmental protection action plan for 2022-2024, 2021). The key identified risk is the slow updating of equipment that reduces air pollution in single – industry towns. An unrealized opportunity in the framework of the study was the need to scale up the transition to gas boilers in 2025-2029. It should be noted that the direction of "Reducing the volume of wastewater" is the highest priority – 51%. However, according to the submitted report on the implementation of this plan, delays in the construction of wastewater treatment plants remain the main risks. According to the data presented, the direction "Combating soil depletion" has a low budget for 2022-2023, and shows a sharp increase in 2024 (the final budget is 7%).

The data shown in Figure 2 on the right indicates that Temirtau has the largest budget. Its budget exceeds the budget of the city of Abai by 9.2 times. At the same time, the total budget of all single-industry towns is only 17.9% of the regional budget by the end of 2024.

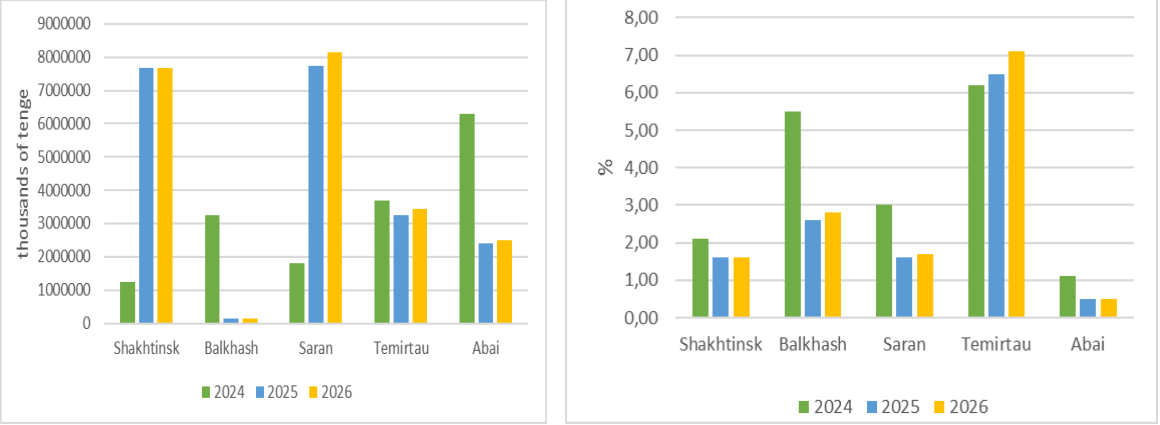

Figure 2 – Budgets of single-industry towns of the Karaganda region under the item "Costs", thousand tenge. The share of the budget of a single-industry town in the regional budget, %

Note: Compiled by the authors

Single-industry towns do not have their own funds to finance the costs of implementing environmental protection measures and are completely dependent on the regional budget.

The key problems can be noted the incomplete coverage of the soil reclamation areas of the region. An unrealized opportunity is the development of a land restoration program on former landfills. In the area of waste recycling, there is a gradual increase in investments – the total budget is 15%. The main problem for all single – industry towns is the lack of sorting lines. This will be discussed in more detail later in the framework of this study in the context of cities. The main solution to the problem of "waste recycling" is to start separate collection and recycling of plastic. In the direction of "Green infrastructure development", significant funds have been allocated for the planting of forests and nurseries in the total amount of 24%. At the same time, it is important to ensure the care of young plantings and control the survival of green spaces.

With the planned level of satisfaction of the population with the environmental quality of life in the city of Karaganda at 66%, the survey results showed a value of 45.8%. The construction of the Sary-Arka main gas pipeline and the phased conversion of residential areas in the cities of Karaganda and Temirtau to 135km of gas has been carried out. Public transport conforming to the Euro-2 standard was purchased for Karaganda and single-industry towns – 190 buses were purchased under the 108 plan. In terms of reducing emissions of pollutants into the atmosphere from stationary sources in large cities by industrial enterprises (the indicator of the National Project "Green Kazakhstan") – to the level of 322 thousand tons, brought to the level of 283.9 thousand tons.

Evaluation of the effectiveness of public or private funds provided by companies aimed at environmental protection, as a rule, has its own specificity. Most scientists involved in the study of these issues recommend using an integrative grade of "3-E". This means that, at certain costs, it is necessary to achieve savings, an effect and a certain specific result. As you know, the term saving implies cost reduction by preventing unwanted expenses, such as payments for environmental pollution. Getting an effect, that is, efficiency, is associated with the monetary expression of the economic effect, that is, getting the maximum benefit from the costs incurred to achieve this result.

Within the framework of this study, we have studied the issues of determining environmental and economic, as well as social effectiveness. It should be noted that for a deeper and more

comprehensive analysis, in addition to those mentioned, there are also such concepts as technical efficiency and distribution efficiency. However, these two indicators are not studied in this work. Thus, it should be noted that effectiveness determines the level of consumer value of a product, good or service. For example, we can talk about waste recycling, reducing soil pollution from waste disposal, etc. (Sadler et al., 2023). Having determined all these indicators together, it is necessary to draw a conclusion about the effectiveness of the environmental costs incurred by government agencies and at the local level.

Cost-effectiveness for environmental protection

The governments of the countries allocate huge expenses from the budgets of the country, therefore the issue of their effective application is especially relevant (Novaes et al., 2010). Observing the principles and goals of sustainable development, the task of the state and local authorities is to achieve maximum performance in all three "E" areas. This means achieving performance on these main indicators of a multi-criteria assessment: the social, environmental and economic components. In the process of testing this methodology using the example of single-industry towns in the Karaganda region, we have presented an algorithm for conducting this assessment in Table 1.

Table 1 – Multi-criteria performance assessment based on the principles of sustainable development

Indicator name	UOM	Calculation method
Economic evaluation criteria		
K_E – a comprehensive criterion for evaluating effectiveness:	index	$K_E = E_E + E_{Ef} + E_Q$, where E_E is a comprehensive criterion for evaluating efficiency and savings (cost–effectiveness assessment); E_{Ef} is a comprehensive criterion for evaluating the effectiveness of %; E_Q is a comprehensive criterion for the economic assessment of quality (the quality of environmental goals).
E_E – criteria for evaluating efficiency and savings	index	$E_E = \frac{1}{CEA} = \frac{E}{C} \geq 0$, $E = f(K_{E1}, K_{E2}, ..., K_{En})$, where E is the cost-effectiveness indicator. K_E is a summary indicator for assessing the quality of government budget expenditures, where $K_E = (K_{E1}, K_{E2}, ..., K_{En})$, where K_{Ei} is an indicator characterizing the effectiveness of expenditures; *n* is the number of indicators for which expenditures are made: $CEA = \frac{C}{E} \geq 0 \rightarrow \min$, where C is capital investments for environmental protection measures.

E_{Ef} – a comprehensive criterion for evaluating effectiveness	index	$E_{Ef} = \sum_{i=1}^{n} (w_i)\, K_{Efi}$, where k_{Efi} is an indicator showing the benefits or losses from the costs incurred for the first goal. This indicator is expressed as a percentage (range 0-1); *n* is the number of environmental goals; *wi* is the weighting factor of the goal with the number *i*. 0 ≤ EK Ef ≤ 1 → max
E_Q – comprehensive criterion for the economic assessment of quality (quality of environmental objectives)	index	$EQ = \sum_{i=1}^{n} (w_i) k_{Qi}$, where k_{Qi} is an indicator that evaluates the achievement of the result set in the state program (in%) (range 0-1); n is the number of results according to environmental expenditure data; *wi* is the weight coefficient of expenses according to the *i* indicator.
Environmental assessment criteria		
K_{Eni} – the criterion of environmental efficiency	index	$K_{En} = \sum_{i=1}^{n} (w_i) k_{Eni}$, where k_{Efi} – the criterion that determines the results of these expenditures is the percentage completion of the goal with the number *i* (the criterion takes the values 0-1); *n* is the number of results according to environmental expenditure data; *wi* is the weight coefficient of expenses according to the *i* indicator.
Social assessment criteria		
K_s – the criterion of social effectiveness	%	$K_S = \sum_{i=1}^{n} (w_i) k_{Si}$, where k_{Si} is an indicator that evaluates the social result (in %); *n* is the number of evaluated indicators; *wi* is the weighting coefficient of the *i* indicator.

Note: Compiled by the authors

A brief description of the methodology, which is based on three "E's", can be presented in the following sequence: first, it is an assessment of the effectiveness of achieving the maximum effect of the event, at minimal cost, then an assessment of the achievement of the goal, and an assessment of the quality of the event. Secondly, the environmental result is determined, and finally, thirdly, the assessment of the social effect of the tasks planned in the city programs. Fourth, it is an assessment of the importance of private expenditures in comparison with the total volume of the city budget.

We will evaluate the effectiveness of environmental protection programs using the methodology described above.

The Karaganda region was chosen to test the methodology, in particular the city of Saran and the single-industry towns of Shakhtinsk, Abai, Temirtau, and Balkhash. Table 2 shows a list of

them. For further analysis, we selected a sample for 2024. Data on the amount of household waste, emissions of pollutants into the atmosphere, and discharges of pollutants into water bodies were received from the Ministry of Ecology and Natural Resources of Kazakhstan and the republican state enterprise Kazhydromet. The population dynamics is based on data from the Bureau of National Statistics. In September 2023, the population of Temirtau was 177,285 people (National Bureau of Statistics of the Agency of the Republic of Kazakhstan, 2025). Of these, the urban population is 177,285 people, the rural population is 0 people. Data on expenditures of local budgets of single-industry towns of the Karaganda region for 2023-2025 (indicator E) (section Environmental protection), in thousands of tenge, were used from the source (On the regional budget for 2023-2025, 2022) and are presented in Table 2.

Cost-effectiveness and efficiency assessment – EE

Table 2 shows the results of the efficiency assessment for the studied cities of the Karaganda region.

Table 2 – Efficiency assessment (economic aspect of the assessment)

Cities	E	E/C	Rating
Saran	17 485 568	0.86	1
Shakhtinsk	175 145	0.23	5
Abai	352500	0.47	3
Temirtau	45 514 056,65	0.33	4
Balkhash	175000	0.51	2

Note: Compiled by the authors

According to the results of the economic efficiency assessment, the best municipality in terms of municipal waste disposal is Saran, followed by Balkhash and Abai.

Efficiency Assessment-E_{Ef}

The E_{Ef} effectiveness assessment is based on the example of the city of Balkhash. The Waste Management Plan of the city of Balkhash (The decision of the Balkhash city maslikhat, 2024) specifies the following objectives and cost-effectiveness criteria:

1. Equipment of containers and container sites according to current requirements up to 80% by 2027 and 100% in 2028 compared to 2024 – kE_{nf1};

2. Ensuring separate collection of solid waste "at the source of education" by "dry" / "wet" fractions (20% in 2027 and 25% in 2028) – K_{Ef2};

3. Solving the problem of bulky, oversized waste, including construction and wood waste (60% in 2027 and 80% in 2028) – k_{Ef3};

4. Equipping equipment with GPS trackers by 100% in 2025 – k_{Ef4};

5. Construction of a solid waste landfill to meet the requirements of the Legislation – 1 landfill in 2026 – $K_{Ef\,5}$;

6. Criterion related to the assessment of the result of combating natural landfills – $K_{Ef\,6}$;

7. Consumer waste disposal plant, it is planned to implement this measure by 50% in 2027 and by 70% in 2028. – $K_{Ef\,7}$;

8. Installation of incineration equipment at landfills, it is planned to install two installations each year for two years. – $K_{Ef\,8}$.

The weighting factor according to the criteria evaluated above is set as, wi = 0.125.

The Expert Group assigned values to each criterion in Table 4 based on the initial data presented in Table 3 – Baseline indicators of the Municipal Waste Management Program for Balkhash 2024-2028.

Table 3 – Baseline indicators of the Municipal Waste Management Program for Balkhash 2024-2028

№	Indicators	Measure	Period					
			baseline value	2024	2025	2026	2027	2028
1	Equipment of containers and container sites according to current requirements up to 80% by 2027 and 100% in 2028 compared to 2024 – $k_{Enf\,1}$	%	0	20	40	60	80	100
2	Ensuring separate collection of solid waste "at the source of education" by "dry" / "wet" fractions (25% in 2027 and 30% in 2028) – $K_{Ef\,2}$;	%	0	10	15	20	25	30
3	Solving the problem of bulky, oversized waste, including construction and wood waste (60% in 2027 and 80% in 2028) – $k_{Ef\,3}$;	%	0	10	20	40	60	80
4	Equipping equipment with GPS trackers by 100% in 2025 – $k_{Ef\,4}$;	%	0	50	100	100	100	100
5	Construction of a solid waste landfill to meet the requirements of the Legislation – 1 landfill in 2026 – $K_{Ef\,5}$;	%	0	-	-	1	1	1
6	Criterion related to the assessment of the result of combating natural landfills – $K_{Ef\,6}$;	% of detected	100	100	100	100	100	100
7	Consumer waste disposal plant, it is planned to implement this measure by 50% in 2027 and by 70% in 2028. – $K_{Ef\,7}$;	%	0	20	30	40	50	70
8	Installation of incineration equipment at landfills, it is planned to install two installations each year for two years. – $K_{Ef\,8}$.	pieces	0	-	-	-	2	2

Note: Compiled by the authors

The weighting coefficients of the main indicators required to assess the economic effectiveness of environmental expenditures are presented in Table 4 below. These are indicators that characterize the effectiveness of the waste management system at the level of an municipality.

Table 4 – Efficiency assessment (Balkhash city)

Criteria	k_{Ef1}	k_{Ef2}	k_{Ef3}	k_{Ef4}	k_{Ef5}	k_{Ef6}	k_{Ef7}	k_{Ef8}
The value of the criterion	1	0.95	0.86	1	0.85	0.95	0.65	1

Note: Compiled by the authors

During the provident calculation, the efficiency indicator was estimated, which is equal to: EKEf = 0.9075

The quality indicator is EQ

In accordance with the adopted official document called Waste Management in the Karaganda region, planned indicators have been identified for 25 tasks aimed at solving the problem of waste generation and disposal in the region. The single-industry town of Balkhash has developed its own "Municipal Waste Management Program for the city for 2024-2029" (Decision of the Maslikhat of Shakhtinsk, Karaganda region, 2024), which includes 8 goals, all of which are included in the regional waste management plan. It should be noted that since these indicators are planned in the official plan of the Akimat, this criterion can be equated to one. When calculating the quality indicator of the expenses incurred, we apply these indicators and determine that E_Q is equal to one. Then, for the single-industry town of Balkhash, the integral criterion for assessing economic efficiency will be 2.4175:

$$KE = EE + EEf + EQ = 0.51 + 0.9075 + 1 = 2.4175$$

Assessment of the environmental component

We will assess the environmental effect by estimating the cost of waste recycling using the example of the single-industry town of Shakhtinsk.

To do this, we should determine the share of waste per capita in the city in the national average volume – k_{En1}

The second estimated indicator is the share of waste processing costs in Shakhtinsk compared to the national average – k_{En2}

The weight coefficient of wi = 0.5.

Table 5 shows the data for all indicators.

Table 5 – Assessment of the environmental aspect (Akimats of the cities of the Karaganda region, 2025)

Criteria/ Akimat	k_{En1}	k_{En2}	Weight Sum	Rank
Saran	1.094	0.739	0.914	5
Shakhtinsk	0.843	1.097	0.996	4
Abai	1.028	1.048	1.056	3
Temirtau	1.189	1.079	1.135	1

Balkhash	1.98	1.134	1.124	2

Note: Compiled by the authors

According to the results shown in Table 4, the single-industry town of Temirtau is the best in terms of environmental efficiency, followed by Balkhash and Abai.

Assessment of the social aspect

The introduction of environmental protection measures in the single-industry town of Shakhtinsk may lead to the creation of new jobs in the field of ecology and landscaping. For example, the implementation of the municipal waste management program for 2024-2029, approved by the decision of the Shakhty city Maslikhat dated March 27, 2024, involves solving such tasks as equipping containers and container sites, separate collection of solid waste, arrangement of a landfill, elimination of spontaneous landfills and others. Specialists in the field of ecology and landscaping may be required to perform these works. It is also possible to create new jobs in single-industry towns as part of investment projects that involve the establishment of new and expansion of existing production facilities.

A clean environment is an important indicator of the social well–being of the population and their health. Over the past three years, the city has eliminated unauthorized landfills of solid household waste in the amount of 7,500 tons. The landfill meets the requirements of sanitary regulations.

Each municipality develops its own waste management program. In this regard, it is recommended to use the following indicators to assess the social efficiency of costs associated, for example, with the disposal of municipal waste:

1. Assessment of the possibility of sorting municipal waste – k_{S1} (in %)
2. Jobs – impact on jobs (it does not take into account who provides services - domestic or companies from other regions) – k_{S2} (in %)
3. The level of well–being of the population - shows how costs improve the quality of life of the population of the region – k_{S3} (in %)

When estimating the cost of municipal waste disposal in the single-industry town of Shakhtinsk (the object of an example of previous calculations), experts assigned the following weights to these indicators: $w_1 = 0.4$, $w_2 = 0.3$, $w_3 = 0.3$. The To assess the social aspect, as part of the consolidated assessment of the effectiveness of municipal environmental protection expenditures, indicators were used that characterize the level of provision of the population with social needs – health care, employment, social facilities, and others. These indicators are presented in Table 6.

Table 6 – Baseline data for the assessment of the social aspect

№	Target indicators	Measure	Data source	Indicators				
				2021	2022	2023	2024	2025
1.	The share of solid household waste processing and disposal	%	Calculation according to the data of the Housing and Communal Services Department	0.3	0.4	0.5	0.5	0.6

2	Total mortality (per 1000 population)	%	Reporting	13.4	13.1	12.9	12.8	12.7
3	The average provision of the population with sports infrastructure per 1000 people	%	Calculation according to the data of the Department of Physical Culture and Sports	42	42	42	42	42
4	Number of jobs created	piece	Reporting	585	586	587	750	867

Note: Compiled by the authors

Table 7 shows the costs of environmental protection by region, current and material costs of environmental protection. As well as labor costs and social contributions paid to other companies for providing environmental protection services in municipalities. These indicators are used to determine the weighting factors necessary to evaluate social effectiveness.

Table 7 – Environmental protection costs by region for 2023, thousand tenge

	Environmental protection costs by region	Current costs	Material costs of environmental protection	Labor costs and social contributions for environmental protection	Paid to other companies for the provision of environmental protection services
Karaganda region	41 843 002	37 822 671	14 283 731	8 883 430	14 397 734
Shakhtinsk	233 746	203 405	82 987	35 851	84 567

Note: Compiled by the authors [15].

The assessment of the social aspect is presented on the example of the single-industry town of Shakhtinsk, Karaganda region. The initial data on social and environmental costs in the region were used. The expert group assigned weight coefficients to each criterion in Table 8 based on the initial data presented in Table 6 - Initial data for assessing the social aspect and Table 7 - Environmental protection costs by region for 2023, in thousands of tenge.

Table 8 – Assessment of the social aspect (Shakhtinsk single-industry town)

Criteria	k_{S1}	k_{S2}	k_{S3}
The value of the criterion	0.57	0.86	0.85

Note: Compiled by the authors [11].

Then, the indicator of social efficiency of these expenses is equal to: kS = 0.741

Thus, it should be noted that the assessment of the effectiveness of government spending on environmental protection can be assessed similarly by applying the above-described cost-effectiveness assessment methodology (Balaguer-Coll et al., 2007).

Conclusion

The study shows that in order to assess the effectiveness of environmental protection costs, the following indicators must be taken into account:

1. Evaluating the effectiveness of government spending on environmental protection is a very difficult issue. There are many factors and indicators that affect the level of such expenses. In the course of this study, it was determined that the most appropriate recommended tool is a cost-effectiveness analysis based on a multi-criteria approach, depending on the factors influencing the costs associated with environmental services.

2. The methodology under study, based on three "E", is represented by the following stages: first, it is an assessment of the effectiveness of achieving the maximum effect of the event, at minimal cost, then it is assessed how the goal has been achieved, and the quality of the event. Secondly, the environmental result is determined, and finally, thirdly, the social effect of the tasks planned in the city programs. Fourth, the importance of private expenditures is assessed in comparison with the total expenditures of the city budget.

3. Experience tested on the example of the single-industry town of Balkhash, Karaganda region, has shown that conducting a multi-criteria assessment of the profitability of financing certain environmental protection costs is the main indicator evaluating the effectiveness of planned actions. This approach is one of the most suitable for substantiating the effectiveness of the city budget expenditures for the protection of the region's nature. The main problem with evaluation is that many factors affecting the effectiveness of the activities carried out cannot always be objectively assessed correctly in a quantitative format, and they are descriptive in nature.

4. Municipalities need to move from an expensive management model to an effective one, where the key criterion for effectiveness is not the allocation of budget funds, but the achievement of environmental and socio-economic goals.

In connection with the above, generalized recommendations are offered to municipalities for developing solutions:

– Link environmental protection costs with a social development strategy to maximize public benefit;

– use integral indicators and weighting factors as a tool for scientifically based performance assessment;

– to develop local ecological and economic models that take into account the peculiarities of small industrial towns;

– prioritize projects with a high multiplier effect (waste sorting, green infrastructure, monitoring);

– strengthen the potential of municipalities: training specialists, digitalization of processes, development of analytical competencies;

– focus on long-term sustainability rather than short-term budgeting.

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All the authors participated in the discussion of the research results, and also jointly edited and approved the final version of the article.

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Р.А. Салимбаева[1], А.А. Адамбекова[2], С.У. Стамқұлов*[3]

[1]Нархоз Университеті, Алматы, Қазақстан

[2]Әл-Фараби атындағы Қазақ ұлттық университеті, Алматы, Қазақстан

[3]Алматы технологиялық университеті, Алматы, Қазақстан

Қоршаған ортаны қорғауға жұмсалатын шығындардың тиімділігінің интегративті негіздемесі: Қарағанды облысының моноқалаларының тәжірибесі

Аңдатпа. Ұсынылған ғылыми мақаланың мақсаты ағымдағы жергілікті (муниципалды) қоршаған ортаны қорғау шығындарының тиімділігін бағалауды жүргізу, сондай-ақ тиімділікті бағалау әдістемесін ұсыну, енгізу және практикалық қолдануға қабылдау. Әдістері – теориялық әдістер (ғылыми дереккөздерді талдау және жалпылау, отандық және халықаралық тәжірибені салыстырмалы талдау); эмпирикалық әдістер (қоршаған ортаны қорғау жөніндегі іс-қимыл жоспарларын зерделеу, жағдайлық зерттеулер, сарапшылармен сұхбат); сандық әдістер (тиімділік көрсеткіштерін есептеу, экологиялық және экономикалық көрсеткіштер негізінде кешенді бағалау); сапалық әдістер (құжаттарды контент-талдау, енгізілген тәжірибені талдау). Нәтижелері – көп өлшемді бағалау негізінде муниципалды қоршаған ортаны қорғау шығындарының тиімділігін бағалаудың әдіснамалық негіздері ұсынылған. Экологиялық саясаттың, оның ішінде муниципалды саясаттың басымдықтарын анықтаудың маңызды құрамдас бөлігі ретінде экономикалық бағалау жүргізілді. Муниципалды қоршаған ортаны қорғау шығындарының тиімділігін бағалау үшін құрама индекстер мен көп өлшемді көрсеткіштер анықталды. Қорытындылар – авторлар моноқалалар мен қала құраушы кәсіпорындарды дамыту үшін әлеуметтік, экологиялық және экономикалық компоненттерді ескере отырып, тұрақты даму әдіснамасын қолданудың маңыздылығын атап өтеді. Тиімділікті бағалаудағы басым критерий үш E – Economy (үнемділік), Efficiency, (әсер ету) және Effectiveness (тиімділік) негізінде өзгертілген әдіс болып табылады.

Түйін сөздер: моноқалалар, тиімділікті бағалау әдістемесі, муниципалды қоршаған ортаны қорғау шығындары, экологиялық-экономикалық тиімділік, әлеуметтік тиімділік.

Р.А. Салимбаева[1], А.А. Адамбекова[2], С.У. Стамкулов*[3]
[1]Университет Нархоз, Алматы, Казахстан
[2]Казахский национальный университет имени Аль-Фараби, Алматы, Казахстан
[3]Алматинский технологический университет, Алматы, Казахстан

Интегративное обоснование эффективности затрат на охрану окружающей среды: опыт моногородов Карагандинской области

Аннотация. Цель – провести оценку эффективности текущих местных (муниципальных) расходов на охрану окружающей среды, а также предложить методологию оценки эффективности с последующим внедрением и принятием к практическому применению. Методы – теоретические (анализ и обобщение научных источников, сравнительный анализ отечественного и международного опыта); эмпирические (изучение планов действий по охране окружающей среды, тематические исследования, интервью с экспертами); количественные (расчет показателей эффективности, комплексная оценка на основе экологических и экономических показателей); качественные (контент-анализ документов, анализ внедренной практики). Результаты – разработана методологическая процедура оценки эффективности муниципальных расходов на охрану окружающей среды. Экономическая оценка затрат представлена как важная составляющая для определения приоритетов экологической политики, в том числе муниципальной. Приведен расчет составных индексов и многокритериальных показателей, определяющих эффективность муниципальных природоохранных затрат и устойчивое развитие моногородов. Выводы – авторы констатируют значимость применения методологии устойчивого развития с учетом социальной, экологической и экономической составляющих для развития моногородов и градообразующих предприятий. Доминирующим критерием в оценке эффективности является модифицированный метод основанный на трех E – Economy (экономичности), Efficiency, (воздействия) и Effectiveness (результативности).

Ключевые слова: моногорода, методология оценки эффективности, муниципальные расходы на охрану окружающей среды, эколого-экономическая эффективность, социальная эффективность.

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Information about authors:

***Salimbayeva R.A.* –** candidate of Economic Sciences, Professor of of School of Arts and Social Sciences, Narxoz University, Zhandosova str. 55, 050035 Almaty, Kazakhstan

Adambekova A.A. – Doctor of Economics, Professor of Higher School of Economics and Business, Kazakh National University named after Al-Farabi, Al-Farabi Av. 71, 050040, Almaty, Kazakhstan

Stamkulov S.U. **–** corresponding author, candidate of Technical Sciences, Assistant Professor of chemistry, chemical technology and ecology department, Almaty Technological University, Tole bi str., 100, 050012 Almaty, Kazakhstan

Салимбаева Р.А. **–** экономика ғылымдарының кандидаты, гуманитарлық ғылымдар мектебінің профессоры, Нархоз Университеті, Жандосов көшесі 55, 050035 Алматы, Қазақстан

Адамбекова А.А. **–** экономика ғылымдарының докторы, экономика және бизнес жоғары мектебінің профессоры, Әл-Фараби Атындағы қазақ Ұлттық Университеті, Әл-Фараби даңғылы 71, 050040, Алматы, Қазақстан

Стамқұлов С.Ө. **–** хат-хабар авторы, техника ғылымдарының кандидаты, химия, химиялық технология және экология кафедрасының ассистент профессоры, Алматы технологиялық университеті, Төле би көшесі, 100, 050012, Алматы, Қазақстан,

Салимбаева Р.А. **–** кандидат экономических наук, Университет Нархоз, профессор Школы гуманитарных наук, ул. Жандосова 55, 050035 Алматы, Казахстан

Адамбекова А.А. **–** доктор экономических наук, профессор Высшей школы экономики и бизнеса Казахского национального университета имени Аль-Фараби, проспект Аль-Фараби 71, 050040, Алматы, Казахстан

Стамкулов С.У. **–** автор-корреспондент, кандидат технических наук, ассистент профессора кафедры химии, химической технологии и экологии Алматинского технологического университета, улица Толе-би, 100, 050012 Алматы, Казахстан