https://doi.org/10.36719/XXXX-XXXX/2/22-33

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Assessment of Economic Damage and Risk Analysis in Emergencies

Abstract

The article provides basic provisions and information on the assessment of damage caused in the field of economy in emergencies and risk analysis, as well as factors affecting objects. Here, the methodology for assessing economic damage as a result of the occurrence of risks and their analysis are presented.

Risk analysis and management is one of the most important directions in the training of specialists in the field of protection in emergencies, in ensuring the continuity of the development and operation of various national economic facilities in emergencies, in minimizing possible economic damage as a result of malfunctions in the operation of facilities or in ensuring safety in risky situations, including environmental protection.

The main assumptions here are determined on the basis of risk theory, i.e. activities in the field of analysis and management of environmental and economic risks. The methodology is the basis for the formation of factors, determining their stability in accordance with the methods of impact on the object under consideration, assessment of economic damage. Risk management is one of the important elements in ensuring a sufficiently reliable level of operation of the research object, its characteristics and sensitivity to various factors. Moreover, risks should be expressed not only in terms of cost, in the form of economic damage, but also in social and other indicators or forms. Examples include deterioration of the environment or human health, death or illness of animals, etc.

Risk is a combined factor of the probability of an undesirable event and its consequences. Risk can also be understood as a measure of danger characterizing the probability of an accident at a hazardous industrial facility and the severity of its consequences. According to another definition, risk management is a risk-based, purposeful activity aimed at implementing the best possible way to reduce risks to a level considered acceptable by society, based on available resource and time constraints.

Keywords: *economy, emergencies, risk, damage, safety*

Introduction

Currently, the assessment of damage caused to the economy in emergency situations and the development and justification of the most optimal action programs designed to effectively implement security solutions are the main element of such activities. The main element of such activities is the process of ensuring security, as well as the optimal allocation of limited resources to reduce various types of risks in order to achieve such a level of security of the population and the environment that is possible only from the point of view of economic and social factors. This process is based on environmental monitoring and risk analysis.

According to another definition, risk management is a risk-based, purposeful activity aimed at implementing the best possible option for reducing risks to a level that is acceptable to society, based on existing resource and time constraints.

Risk management is usually approached using subjective considerations and largely ignoring socio-economic aspects that determine the level of security of the individual and society.

Risk management is usually approached using subjective considerations and largely ignoring socio-economic aspects that determine the level of security of the individual and society. Ensuring the safety of people and their environment requires a methodology based on a quantitative analysis of the risks and consequences of the decisions made. Additionally, it should be noted that these decisions are made within the framework of a risk management system (Rodionov, 2020, pp. 9-35).

Research

The essence and purpose of monitoring and forecasting the damage caused in the economy in emergencies is to observe, control and predict the dangerous processes and events of nature and technosphere, which are the sources of emergencies, external factors that disrupt stability (armed conflicts, terrorist acts, etc.), as well as the dynamics of the development of emergencies, to organize their prevention and elimination, as well as to minimize the damage caused, and to determine the scale of problem solving. It should be noted that monitoring and forecasting of emergencies of a natural and technogenic nature is multifaceted in terms of its activity. It is carried out by many organizations (institutions) using various methods and means.

Individual dangerous events and potentially dangerous objects are compared with each other based on the scale of individual risk, and critical risks are identified. Protective measures are implemented in a rational volume within the framework of resource limitations arising from the socio-economic situation of the country.

The procedure for assessing technogenic risk for the region can be organized in the following stages:

1. Creation of a database for the studied region, which includes information on the geography, meteorology, topology, infrastructure, population distribution and demography of the region, locations of industrial and other potentially hazardous production facilities and objects, main transport flows, warehouses, industrial and household waste, etc.

2. Identification and inventory of hazardous types of economic activity, selection of priority objects for further analysis. At this stage, types of economic activity in the region are identified and ranked by the degree of danger.

3. Quantitative assessment of the risk to the environment and public health, including: quantitative analysis of the impact of hazards throughout the entire activity of the enterprise, taking into account the risk of emergency emissions of hazardous substances, analysis of the impact of hazardous waste and risk analysis for the transportation of hazardous substances.

4. Analysis of the infrastructure and organization of security systems. Includes: analysis and planning of measures during emergencies, taking into account the interaction of various services with state management and control bodies, as well as with the public and representatives of the population; analysis of fire safety systems and services, taking into account the fire hazard of enterprises, high-risk facilities, energy and energy carrier transport systems; analysis of the structure of environmental quality control in the region; examination and analysis of regulatory and legislative documents.

5. Development and justification of strategies and operational action plans designed to effectively implement security solutions and ensure the achievement of set goals.

6. Formation of integrated management strategies and preparation of operational action plans, including: optimization of costs for ensuring industrial safety; determination of the priority of implementing organizational measures to increase the stability of regional facilities during normal operation, as well as during emergencies, and to reduce environmental risks.

The use of the above measures and risk assessment will allow us to search for the type of risk management that will ensure safety both at the enterprise level and at the macro level on the scale of infrastructure and territories, and to make optimal decisions. For this, it is necessary to choose acceptable risk values. Risk is an inevitable accompanying factor of human anthropogenic activity. Risk is, in fact, a measure of danger. Therefore, the goal of risk management is to prevent or reduce injuries, destruction of material objects, property loss and harmful effects on the environment. To manage risk, it is necessary to analyze and assess it. Individual risk is determined by the probability of potential threats occurring in the event of dangerous situations.

The number of risk factors of the economy in emergency situations is determined by the following formula:

$$R_n = P_i (f; t) / L_i (f; t)$$

where R_n is the individual risk; P_i (f; t) is the number of deaths (mortality) from a certain risk factor f for a time unit t; L_i (f; t) is the number of people exposed to the corresponding risk factor f for a time unit t.

Individual risk can be voluntary if it arises as a result of a person's own activities, and mandatory if a person is exposed to risk as part of society (for example, in ecologically unfavorable regions, near sources of increased danger).

Technical risk is a complex indicator of the reliability of technosphere elements. It expresses the probability of an accident or disaster during the operation of machines, mechanisms, the implementation of technological processes, and the economic construction and operation of buildings and structures:

$$R_T = \Delta T(t) / T(f)$$

R_T technical risk factor; $\Delta T(t)$ – the number of accidents per unit of time t in the same technical systems and facilities; T(f) – the number of the same technical systems and facilities exposed to the general risk factor f.

The assessment of economic damage in emergency situations is intended for the prediction of damage caused by accidents of technogenic and natural origin, as well as in the investigation of emergency situations, the development of industrial safety declarations, liability insurance of organizations operating hazardous production facilities, the classification of hazardous production facilities by risk level, etc.

The assessment of economic damage caused at different stages of emergency situations, the problems of predicting emergency situations and planning measures to increase the effectiveness of protecting the population, production personnel and territories from the effects of harmful factors during accidents, disasters and natural disasters, as well as for the assessment of damage caused by emergency situations.

The methodology can be used during the training, design, construction, commissioning and operation of hazardous production facilities located in a separate territory or providing a single technological process, hydraulic structures, vehicles carrying dangerous goods, objects whose operation may include accidents that may cause harm to the life, health or property of other persons and the environment.

The methodology allows for the assessment of socio-economic damage from man-made and natural emergencies at the stages of forecasting and localization of emergencies within a year after the event (Vorobyov, 1998, pp. 3-13).

The assessment of damage from emergencies should be achieved using approaches and methods (techniques) agreed upon and approved for use by management bodies at various levels of the national economy (state, regional, sectoral). At the same time, it is possible to improve and refine industrial methods for assessing damage, develop more justified methods for assessing damage, taking into account new economic conditions, additional information on the impact of damaging factors of emergencies, changes in the regulatory framework and a number of other factors.

It should be borne in mind that both the approaches and methods used in practice, as well as new ones, allow us to obtain an assessment of damage, which is a more or less reasonable approximation to its actual value. In practice, damage is often considered justified when all interested parties agree on its amount (and, accordingly, the calculation method). In this regard, the validity of the damage assessment method can be considered a subjective concept. If all interested parties agree with the assessment obtained on its basis, then this method is not considered valid, its validity must be confirmed by law (law, regulation or other acceptable method).

Table 1.
Sources and factors of individual risk.

№	Source of individual risk	The most common risk factor for death
1	Internal environment of the human body	Hereditary genetic, psychomatic disease, aging
2	Victimity	A set of personal qualities of a person as a victim of potential dangers.
3	Habits	Smoking, alcohol, drug use, irrational eating
4	Social ecology	Poor quality air, water, food, viral infections, domestic injuries, fires
5	Professional Experience	Hazardous and harmful production factors
6	Transport links	Accidents and disasters of vehicles, their collisions with a person
7	Non-professional activities	Dangers caused by amateur sports, tourism, and other hobbies
8	Social environment	Armed conflict, crime, suicide, murder
9	Natural environment	Earthquake, volcanic eruption, flood, landslides, hurricane and other natural disasters

Investments in the regional economy to prevent and eliminate the consequences of emergencies are calculated using the following formula:

$$I_t = I_t^m + I_t^f + I_t^{sf} + I_t^{ss} + I_t^{in} + I_t^{pr}$$

where is investment in the period t for the prevention and mitigation of the socio-economic consequences of emergencies at comparative prices;

I_t – investments in the prevention and mitigation of the socio-economic consequences of emergencies, at comparative prices, in the period t;

I_t^m – investments in the prevention and mitigation of the socio-economic consequences of emergencies, at comparative prices, in the period t;

I_t^f – investments from the federal budget for the prevention and mitigation of the socio-economic consequences of emergencies, at comparative prices, in the period t;

I_t^{sf} – investments within the framework of the federal target program (investment program) for the prevention and mitigation of the economic consequences of emergencies, at comparative prices, in the period t;

I_t^{ss} – investments in the period t for the prevention and elimination of the socio-economic consequences of emergencies at the expense of own funds of enterprises, including attracted funds, at comparative prices;

I_t^{in} – foreign investments in the prevention and mitigation of the socio-economic consequences of emergencies (of a cross-border nature), in comparative prices, in the period t;

I_t^{pr} – other investments in the prevention and mitigation of the socio-economic consequences of emergencies, in comparative prices, in the period t.

The assessment of damage from emergencies should be formulated in such a way as to reflect the entire structure of cause-and-effect relationships from the moment of the emergency to the damage caused to economic entities and individuals.

In general, all approaches and methods for assessing economic damage from emergencies, implementing them, are divided into two main groups: direct calculation methods and indirect assessment methods.

Direct calculation methods, as a rule, reflect all elements of the chain of cause-and-effect relationships that cause economic damage to economic entities. They include the assessment of the effects arising between all links of this chain and the calculation of various components of the losses of the economic entity, expressed in value.

Approaches to the assessment of damage caused by emergencies based on the use of direct calculation methods are quite widely used in the assessment of losses of objects as a result of technogenic accidents and natural disasters, terrorist attacks. This is due to the fact that objects (territorial natural complexes, enterprises, residential areas) damaged by such events are usually characterized by a fairly clear structure, the value of their elements can be estimated more or less accurately (Akimov, 2004, pp. 200-234).

In this case, the loss of elements can usually be correlated with the power of the event (earthquake power, explosion power, fire duration). To obtain a reasonable and objective assessment of damage caused by emergencies (taking into account the causes and factors of damage occurrence), direct calculation methods are used, which predetermine the high accuracy of the damage assessment based on them. However, these methods are quite labor-intensive and difficult and require a large amount of initial information. As a result, their application in practice is not always possible.

Indirect assessment methods are less labor-intensive. They are based on the principle of transferring general patterns of action of damaging factors to a specific economic object. This principle is implemented using a number of standard indicators that convert the type and magnitude of the impact of the damaging factor into economic damage to the economic entity.

The general part of damage assessment methods consists in determining the distribution zone of damaging factors and their power, taking into account the features of the location of various elements (objects), from which the amount of physical (natural) damage they receive is determined. In turn, based on the structure and scale of natural damage, an estimated cost of damage to the object is obtained. For this, first of all, it is necessary to form a system of initial assumptions that determine the features of the formation of the structure of damage and the assessment of the value of each of its positions (in terms of costs incurred, lost profits, direct losses, etc.).

Ecological risk is the probability of an ecological disaster, disruption of the future normal functioning and existence of ecological systems and objects as a result of anthropogenic impact on the natural environment or a natural disaster. Undesirable ecological risk events can occur both in the direct intervention zones and beyond:

$$R_o = \Delta O\ (t) / O$$

where R_o is the ecological risk; $\Delta O\ (t)$ is the number of anthropogenic ecological disasters and natural disasters per unit of time t; O is the number of potential sources of economic damage to the environment in the area under consideration.

Rom is the scale of ecological risk estimated as the percentage ratio of the area of crisis or catastrophic areas ΔS to the total area of the biogeocenosis S under consideration:

$$R_o^m = (\Delta S * 100) / S$$

An additional indirect criterion of environmental risk can be an integrated indicator of the ecological cleanliness of the territory of the enterprise, associated with the dynamics of population density (number of employees):

$$O_T = \pm\ \Delta L = \pm \Delta M\ (t) / S$$

where O_T – the level of environmental compatibility of the territory; ± ΔL – the dynamics of population density (working); S – the area of the study area; ±ΔM (t) – the dynamics of population growth (working) during the observation period t:

$$\pm \Delta M\ (t) = G + F - U - V$$

where G, F, U, V are the number of people born, arriving in a given territory for permanent residence, dying and perishing, leaving for permanent residence in another territory (dismissed) during the observed period, respectively.

In this formula, the difference (Q-U) characterizes the natural increase in the population of the territory, and (F-V) characterizes the migration (staff turnover) of the population.

Positive values of the environmental compatibility levels allow us to divide territories according to the degree of environmental well-being, and negative values of the levels, on the contrary, according to the degree of ecological disaster. In addition, the dynamics of the level of ecological cleanliness of the territory allows us to judge the change in the ecological situation there over a long period of time, to identify zones of ecological disaster (demographic crisis) or prosperity (Husereau, Drummond, Petrou, 2013, pp. 367-372).

The assessment of damage to material objects from emergencies is carried out on a specific date and is expressed in the currency of the country where the damage was determined.

An expert approach can be used to determine the cost of damage for economic objects of various categories based on the requirements of relevant regulatory legal documents for assessing damage caused by emergencies, direct inspection of the object by an expert, collection and generalization of market data on the cost of similar economic objects (Yang, Wei, Jiang, 2022, pp. 125-138).

The indicator of damage caused by emergencies is given in terms of the current year, the period of operation of the object or the decommissioning of the object.

The final cost of damage caused by emergencies, indicated in the damage assessment act drawn up in accordance with the methodology and in the manner prescribed, may be considered recommended for the purposes of carrying out legal actions (transactions) with the object of assessment, if no more than 6 months have passed from the date of drawing up the assessment act to the date of submission or submission of legal actions (transactions) with the object of assessment.

Social risk characterizes the scale and severity of the negative consequences of emergencies, as well as various types of events and changes that reduce the quality of life of people. In fact, it is a risk for a group or community of people. This can be assessed, for example, by the dynamics of deaths per 1,000 people in the relevant group:

$$R_C = (1000 * (C_2 – C_1) / L) * (t)$$

where R_C is the social risk; C_1 – the number of deaths (deaths) in the study group per unit of time t at the beginning of the observation period, i.e. before the development of emergency events; C_2 – the number of deaths in the same group of people at the end of the observation period, i.e. at the stage of eliminating the emergency; L – the total number of the group (Kokoshkin, 2014, pp. 29-41).

The general scheme for calculating damage during emergencies is as follows:

• calculation of damage caused to individuals;

• calculation of damage to property of individuals and legal entities; calculation of damage to the environment.

In accordance with the existing classification of damage caused, legal and regulatory documents on the assessment of damage from emergencies are divided into four blocks, the application of which is carried out separately or in full - when the fact of causing complex damage is established, depending on the scale and volume of damage caused as a result of the emergency.

Direct damage. Direct economic damage from any impact includes costs, losses and damages expressed in monetary terms by this impact at a certain time and in a specific place. These are one-time costs aimed at carrying out rescue operations; the costs of evacuation, temporary accommodation, relocation of people from the natural disaster zone and the provision of emergency medical care to them; one-time payments to victims and their families; the cost of destroyed or damaged natural resources; the residual value of all movable and immovable property (housing stock, utility infrastructure, communications, goods and unsold products, fixed and current assets of enterprises of all types of property) (Morozov, Shakhramanian, 2012, pp. 87-103).

Direct damage is often proposed to be understood as losses that arise in the economy during the current reproduction period and are expressed in the form of a deterioration in the relevant indicators of socio-economic development based on annual results. All other types of damage are classified as indirect losses, i.e. do not directly affect the economic indicators of the current year. Actual economic damage means losses that occurred as a result of emergency situations and must be estimated in monetary terms.

Direct economic damage, which characterizes the immediate destruction, deterioration, damage to any property and material resources, their removal from economic circulation in other forms (production activities, use for social purposes, etc.).

The components of direct economic damage, as a rule, can be documented at the "primary level" (organization, enterprise, municipality) on the basis of accounting data, property write-off acts and other documents that have a sufficiently high degree of reliability and can be verified.

Therefore, it can be said that direct economic damage is, in principle, documented economic damage.

The main difference between an individual and a legal entity when determining direct economic damage is the lack of accounting data and other official documents that would allow for an inventory of losses and a sufficiently unambiguous calculation of this damage. Therefore, for individuals, expert assessments of physical and economic damage caused as a result of emergencies should be the main ones.

The results of the determination (assessment) of direct economic damage during emergencies by a legal entity or individual are a necessary condition and basis for applying to state bodies or insurance bodies for compensation for the damage caused.

The main information on the scale of direct damage to economic facilities and the population can be obtained as a result of checking the volume of damage at individual facilities immediately after the end of the emergency based on inventory data. Inventory is a physical calculation of the assets of an enterprise and a reconciliation of its liabilities. In emergencies, an inventory of property and financial liabilities is mandatory (Bogdanov, 2001, pp. 230-265).

The peculiarity of the domestic economy is that direct damage to enterprises from emergencies or terrorist acts causes significant indirect damage in the social and household spheres of these enterprises, since in most cases large and medium-sized enterprises of the main industries: the fuel and energy complex, the mining industry, metallurgy, the defense complex, the forestry complex, etc. - perform urban planning functions in relation to districts of large cities, small settlements and villages.

Indirect damage. Economic losses due to any activity include forced expenses, losses, and damages resulting from secondary impacts (actions or inactions resulting from primary actions) of a natural, man-made, or terrorist nature.

Indirect damage, unlike direct damage, can manifest itself long after the moment of the initial action; does not have a clearly defined territorial affiliation and in most cases has the so-called "cascade effect", i.e. secondary actions (inactions) create a chain of subsequent actions (inactions) and, accordingly, indirect damage.

Economic risk is determined by the ratio of benefits and losses that society receives from the type of activity in question (Borisenko, Kovalev, 2003, pp. 55-71):

$$R_Э = (B / K) * 100$$

where RE is the economic risk, %; B – harm to society from the type of activity in question; K – benefit.

In general, it is defined as $B = Z_b + U_{sh}$.

where $Z_б$ is the cost of achieving a given level of safety; Harm is the damage caused by insufficient protection of a person and his environment from hazards.

Income is the sum of all benefits (in monetary terms) received by society from the type of activity in question:

$$P = F - З_б - B > 0 \quad \text{или} \quad P = F - З_п - З_б - M > 0$$

where F is the total income from the type of activity in question; $З_п$ – basic production costs.

Then the economically justified equation of the safety of life activity will have the following form:

$$M < F - (З_п + З_б)$$

In the context of economic activity, it is necessary to find the optimal ratio between security costs and possible damage from insufficient protection. It can be found if we set a certain value for the realistically achievable level of security of KBP production. This problem can be solved by optimization.

A distinction is made between individual and social risks. Individual risk characterizes the danger of a certain type for a particular individual. Social or group – this is a risk for a group of people. Social risk can be defined as the relationship between the frequency of events and the number of people affected.

At the level of an organization (enterprise), economic losses associated with the suspension of production are economic losses incurred as a result of the suspension, cessation, or reduction in the intensity of production and any other economically significant functional activity of the organization (enterprise) in terms of the production of products, the performance of work, and the provision of services of both a production and non-production nature.

From a macroeconomic point of view, the main impact on the most important indicators of the country's socio-economic development, including the volume of industrial production in the industry, the volume of industrial production in the country as a whole, the volume of final products, the volume of GDP, etc. is the suspension of production at enterprises (organizations) (Buyanova, 2007, pp. 14-21).

Unlike documented indicators of direct economic damage, which are obtained primarily on the basis of accounting data, losses associated with the suspension of production are calculated, obtained on the basis of planned economic and financial calculations and assessments. Some components of the damage (for example, an indicator of lost profits due to the suspension of production) can only be obtained at the level of estimates.

At the level of the organization (enterprise), economic damage to “third parties” is economic damage caused to other legal entities and individuals (the so-called “third parties”), economic entities, natural and other objects that are economically related to the reporting enterprise, but are not directly affected by emergency situations.

Among the indicators of this type of indirect economic damage, as an exception, there may be documented indicators (for example, indicators of economic damage due to the failure of the enterprise to fulfill its contractual obligations to related enterprises and consumers of products, indicators of civil liability for damage caused to other persons and objects).

However, in general, economic damage caused to “third parties”, as a rule, can be determined only at the level of assessment of the damage caused. The situation is further complicated by the need to take into account “cascade effects”, i.e. accounting for economic damage caused to related enterprises along the chain.

The problem of accounting for economic damage caused to “third parties” at the macroeconomic level can, in principle, be solved on the basis of systematic economic and mathematical modeling of the economy in emergency situations.

Summing up the indicators of economic damage to “third parties”, carried out by simply reducing (adding) the initial results without taking into account system effects, can lead to an overestimation of the results with the so-called “double counting”.

A significant component of indirect damage resulting from man-made, natural emergencies or terrorist acts is the damage caused to related enterprises in the technological chain, primarily to suppliers and consumers of the enterprise's products that have suffered direct damage as a result of emergencies or terrorist acts. This damage can also be determined only approximately.

A characteristic feature of indirect economic damage is that its components, as a rule, cannot be documented. They are determined using appropriate methods or estimated, including by experts.

In addition, due to the systemic nature of economic damage from emergencies and cascading factors, controversial provisions inevitably arise regarding the inclusion or exclusion of individual components in the composition of indirect economic damage.

In this regard, calculations or assessments of indirect economic damage, especially those that claim to fully take into account all components of the emergency factor, objectively have a sufficiently high degree of uncertainty and insufficient reliability (Buyanova, Inshakov, Lomovtseva, 2007, pp. 5-11).

As a result of emergencies, the production facility, which is the basis for assessing indirect damage in the initial period of the production loss cascade, may be destroyed. This cascade is formed due to the complex nature of inter-sectoral flows of intermediate products aimed at the production of final products in the economy.

One of the possible areas of application of cyclical calculations is the identification of critical nodes and deficit flows of products in inter-industry relations. This is expedient for minimizing the consequences of an earthquake in dynamics and for determining the sequence of measures for such minimization.

In the context of potentially increasing unemployment, indirect production losses are employment losses directly related to the cascade. If we assume a direct relationship between job losses and production reductions, then we can determine the potential indirect loss of unemployment as a result of an emergency in a given place.

In the structure of losses due to emergencies, cyclical losses of production are likely to play a leading role. Therefore, the above assumption about the direct dependence of job losses on production reductions is quite plausible. In reality, wage reductions may be combined with a reduction in employment (part-time work) or job losses and a reduction in employment. However, the complexity of calculations for such options is still controversial and has not yet received legal recognition in the international community.

Total loss. The occurrence of long-term losses from emergencies largely depends on the dynamics of the national economy. The likelihood of long-term consequences increases for the economic crisis situation, so the calculation of discounted losses is very relevant for countries such as Kyrgyzstan. Discounted estimates should reflect the value of future losses today.

The total loss Vk, taking into account the discount, can be calculated by the following formula:

$$V_k = \sum_{r=0}^{R_k} \cdot (V_{kr} / (1 + t)^r$$

where t is the discount rate; R is the period of reconstruction and recovery of the consequences; k is the year of the emergency (Vorobyov, 2010, pp. 10-14).

Total damage is the sum of direct and indirect damage. Total damage is determined at a certain point in time and is intermediate compared to total damage, which will be quantified over a long period of time. The need to take into account the time-distributed or delayed effects of damage is especially important for emergencies related to environmental impacts or exposure to radioactive materials.

Total economic damage accompanying an emergency, based on the above, can be defined as the sum of direct economic damage and indirect economic damage. The calculated dependencies are presented by the formula:

$$U = U^p + (A * U^k)$$

where A is the coefficient of reduction of costs at different times (discount coefficient); U – economic loss from emergencies; Up – direct economic loss; Uk – indirect economic loss.

At the same time, it should be taken into account that the differentiation of direct and indirect damage is to some extent conditional, since the same losses can be mediated in different forms.

Since the uncertainty in the amount of indirect economic damage is high, the amount of total economic damage also has a high uncertainty.

However, it should be taken into account that when solving various practical problems, the results of damage assessment (actual or projected) may differ significantly due to the inconsistency between the objectives of damage assessment, the methodological features of accounting, or the lack of consideration of individual components of economic damage - direct and indirect.

State statistical accounting of emergencies should be carried out on the basis of primary data, i.e. at the “primary level” - data generated in organizations (enterprises) and municipal bodies (Voronin, 2002, pp. 35-87).

At the same time, it is necessary to ensure the coverage of all organizations where systematic statistical observations are carried out in terms of collecting information on emergency situations.

Coverage of all territorial connections, which allows obtaining comprehensive (complete) information on the damage caused by an emergency situation at the level of the subjects of the country, and then at the republican level as a whole, should also be ensured.

The following should be added to the data of the systematic state statistical accounting of emergencies (Guzev, Abramova, 2003, pp. 43-54):

• data obtained from the statistical accounting and analysis of the department;

• results of scientific research, forecasting and analytical developments;

• materials of a private and selective nature obtained in the process of licensing, insurance, development of investment projects, business plans, etc.

Studying the risk of emergencies for the population and territories based on the probabilistic method allows building various risk assessment methods. Depending on the available (used) initial information, these can be the following types of methods:

• statistical, when probabilities are determined on the basis of available statistical data (if any);

• probability-theoretic, used to assess the risks of rare events when statistics are practically absent;

• heuristic based on the use of subjective probabilities obtained as a result of expert assessment (used in cases where not only statistical data, but also mathematical models are lacking in the assessment of complex risks arising from various hazards, or the models are too crude, that is, their accuracy is low) (Zarnadze, 2000, pp. 77-82).

Methods for predicting the occurrence of emergencies are most often developed in relation to emergencies of a natural nature, or more precisely, to the dangerous natural phenomena that cause them. A well-established national monitoring system of natural disasters and precursors of disasters is necessary for their timely prediction and detection at the stage of their occurrence.

Let us consider the features of the forecasting of the assessment of the socio-economic consequences of emergencies. In solving this problem, it is impossible to rely on experiment (with the exception of experimental data on the physical durability of individual technical elements and materials of special exercises). Extrapolation of statistical research data, which is widely used to predict economic processes occurring in the absence of emergencies, is also excluded. These circumstances sharply narrow the range of methods that can be used in forecasting. In fact, when forecasting the socio-economic consequences of an emergency for the country's economy, only heuristic methods and economic-mathematical modeling methods (or rather, an organic combination of these methods) based on the judgments of specialists-experts are used (Kalinina, 2008, pp. 8-14).

The peculiarity of emergencies, especially large-scale events, is that all of them, fortunately, can only be thought out and possible at the preparatory stage. Therefore, all work on the preparation and justification of decisions should be carried out primarily with descriptions and models of real processes at the information level. This implies an exceptional, decisive role of mathematical modeling in solving this problem.

Conclusion

1. As the main result of the study, the analysis of the calculated parameters allows us to assess the degree of impact of the state economic policy in the field of emergency prevention on the development of each subject of our Republic and to develop substantive recommendations for its regulation.
2. Budgetary expenditures on reducing the socio-economic consequences of emergencies and expenditures of extra-budgetary funds on mitigating the economic consequences of emergencies are the predicted control parameters of the regions (empirical parameters), information on these elements of the final demand is taken from the analytical database.
3. A comprehensive assessment is carried out on the basis of comparing the selected indicative indicators of the socio-economic situation of the region with the average level, bringing all indicators to a comprehensive assessment and subsequent analysis of changes in the values of these indicators during the forecast period for certain regions. The parameter indicators used in the field of complex assessment are:
   a. index of the physical volume of industrial production;
   b. share of the region in the total volume of investments;
   c. financial security of the region - regional income per capita;
   d. communication development index (density of roads and telephone communication);
   e. unemployment rate (as a percentage of the economically active population);
   f. share of the population with incomes below the subsistence minimum;
   g. retail trade turnover per capita;
   h. ecological situation (share of emissions into the atmosphere and water).
4. Investments in the regional economy to prevent and eliminate the socio-economic consequences of emergencies can be carried out at the expense of funds from the constituent entities of our Republic, funds from the federal budget, own funds of enterprises, funds from foreign investors and other sources.
5. The basis of the proposed method for analyzing and forecasting the level of change in the gross regional product from the socio-economic consequences of emergencies is the equation characterizing the relationship between its production and use.
6. The complexity of forecasting the economic consequences of emergencies is due to the need for a comprehensive analysis of many interrelated parameters characterizing the socio-economic development of entities with different potential in the time interval from 1 to 15 years. The successful solution of this problem largely depends on the choice of rational methods for its implementation.
7. The main method of forecasting the economic consequences of emergencies is defined as variant economic-mathematical modeling based on the use of modern computer technologies.
8. Each of the methods provides not only the development of the area of economic activity in the current regime, but also its development. The specified areas of development within the framework of the problem under consideration should model the possibilities of preventing and eliminating emergencies and create a basis for quantitative justification of relevant measures and assessment of the necessary volume of resources (including financial funds) attracted for these purposes.

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Received: 23.11.2024
Accepted: 15.02.2025