SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

ON INCREASING THE EFFECTIVENESS OF THE APPLICATION OF RESCUE UNITS IN LARGE-SCALE EMERGENCY SITUATIONS AND CIVIL PROTECTION TASKS

Kurbanbaev Shukhrat Ergashevich
Head of the Center of the Scientific-Innovation and Testing Research Institute of the Ministry of Emergency Situations of the Republic of Uzbekistan, Doctor of Historical Sciences. (DSc), Professor
Khodzhiev Rustamjon Amonovich
Head of the National Center of the Ministry of Emergency Situations of the Republic of Uzbekistan
Sultanov Sokhibjon Sabirovich
Head of the officer retraining and advanced training course of the Academy of the Ministry of Emergency Situations of the Republic of Uzbekistan, Doctor of Historical Sciences. (PhD), Associate Professor

Abstract: *The article provides an analysis of major emergencies and military operations that have occurred worldwide in recent years, focusing on their scale and the primary tasks involved in conducting rescue and other urgent operations. It also examines international experience aimed at enhancing the effectiveness of deploying rescue forces to protect populations and territories from large-scale natural and technological emergencies. Furthermore, the article offers recommendations for the strategic allocation of these forces to ensure the effective implementation of rescue operations and civil defense responsibilities by rescue units.*

Keywords: *rescue, emergency situations, military conflict, population.*

Introduction. Analysis of the large-scale natural and man-made emergencies observed in the world in recent years, as well as measures aimed at eliminating the damage caused to the population and territories in military

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

operations, requires strengthening measures for the effective use of forces and resources involved in rescue operations and civil defense tasks.

Since the 2000s, in various regions of the world, along with deaths (victims) of the population as a result of emergencies related to climate change, the activation of dangerous natural-technogenic processes and the wear and tear of technological equipment, as well as armed conflicts arising during political crises, the amount and scale of economic damage has been increasing.

In particular, in 2025 alone, in the state of California (11 citizens died, 180 thousand were evacuated to safe areas, 10 thousand buildings and structures were damaged, and the amount of damage amounted to 250 billion US dollars. USA) and forest fires in the Sakha, Tyva Republics, Transbaikal, Primorsky Krai, and Irkutsk Oblast of the Russian Federation (about 3,100 hectares in 50 cases).

Also in the administrative territories of Kunar, Laghman, Nangarhar of Afghanistan (2.2 thousand people died, 3.2 thousand were injured, about 10 thousand buildings and structures were damaged), near the city of Sagayn in Myanmar (3.6 thousand people died, 5 thousand were injured, more than 50 thousand buildings were destroyed), in the Tibet Autonomous Region of China (126 people died, 61 thousand were injured, more than 10 thousand buildings were damaged), in the city of Bogo in the Cebu province of the Philippines (81 people died,

300 people were injured) are among them.

In addition, there are cases of numerous civilian casualties, damage to economic sectors, social sphere and residential facilities, as well as life support systems in armed conflicts in Israel-Palestine (more than 70 thousand people died

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

and 160 thousand were injured), Russia-Ukraine (various sources report tens of thousands of civilians killed and 100 thousand people were disrupted), Iran-Israel (more than 1 thousand people died and 8 thousand were injured), India-Pakistan, Afghanistan-Pakistan, Thailand-Cambodia, and the African continent.

Systematic implementation of large-scale rescue and other urgent work is required to eliminate the consequences of the above-mentioned emergencies and armed conflicts.

This, in turn, requires the presence of fully equipped professional rescue units in constant readiness, in the required number and composition.

In the cases noted in foreign countries, rescue units equipped with modern equipment and tools, personnel who have undergone periodic training and practical experience have successfully completed their assigned tasks in various situations.

On the contrary, as a result of the low effectiveness of the actions of rescue units, whose personnel have not undergone thorough training, lack of practical experience, and insufficient level of material and technical support, there have been cases of an increase in the scale of the disaster and an increase in the amount of damage caused to the population and territories.

In particular, effective actions of rescue forces in Russia, Israel, Ukraine, and Azerbaijan during the performance of their duties in various situations have been noted by a number of industry experts.

Research Methodology. During the analysis of the activities of rescue units, the actions of which were effectively assessed, it was revealed that these units were organized on a territorial-sectoral basis, the number and composition of rescue

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

units were formed taking into account the scale of real sources of danger, and the main attention was paid to their optimal location.

In this regard, we will consider research aimed at increasing the effectiveness of rescue units of the Ministry of Emergency Situations, which formed the basis of the Civil Defense troops of Uzbekistan, in eliminating major natural disasters and man-made accidents in peacetime and armed conflicts, reducing their damage through the application of advanced foreign experience.

At the 1st stage of the research, the main attention is paid to the issue of placing rescue units in optimal areas, taking into account possible sources of danger and their scale.

In this case, when choosing the location of rescue units, it is important to comply with the documents defining the procedure for actions in emergency situations and the norms in the field of unit deployment.

When deploying rescue units, the following must be taken into account:

hazardous sections in the territory to which the subdivision is assigned (responsibility);

routes (ways) leading to dangerous sections;

availability and condition of communication, electricity, gas, drinking water, sewerage, and heat supply systems in the area where the unit will be located;

availability and condition of buildings and structures, transport networks (communications) in the territory where the subdivision will be located;

availability of reserves of material and technical resources and the possibility of their use in rescue operations;

Establishment and level of cooperation with the forces and resources of the

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

territorial sub-level of the State Emergency Situations Service.

The process of determining the optimal location of the rescue unit is carried out taking into account the sources of emergencies in the existing (designed) city, district (settlement), or facilities.

The location of the rescue unit is determined in the following stages:

initial stage; calculation stage; conclusion preparation stage.

At the initial stage, the following are determined:

- goals and objectives of the task;

- procedure and sequence for preparing calculations to determine the location of the fire and rescue unit;

- the procedure and amount of information required for the preparation of calculations;

- making a corresponding decision based on the results of the preparation of calculations.

At the end of the current stage, a decision is made to determine the location (object) of the rescue unit.

Location determination is carried out based on local conditions, the specifics of the infrastructure, and the availability of the required information.

1. The procedure for submitting information for determining the location of rescue units is as follows:

for territories - by district (city) khokimiyats or organizations authorized by them;

for objects - by the balance holders of the selected object (enterprise, organization, institution).

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

2. The stage of preparing calculations consists of:

- the type and scale of emergencies that may occur in the territory (object), as well as the study of hazardous areas;

- analysis of the compliance of risk sources in the territory (object) with emergency protection measures;

- consideration of the expediency of the placement of fire and rescue units in the planned area (object);

- agreement with the local administration (object administration) regarding the location of the fire and rescue unit at the selected location.

3. The stage of preparing a conclusion includes the preparation and submission of reporting materials to authorized bodies (persons) for decision-making by responsible persons on the location of the subdivision in the selected territory.

For making a decision on the location of the rescue unit (object), the following are submitted:

Technical, economic, and other important indicators of the territory (object);

sources of increased risk of emergencies, their approximate scale (if possible, with calculation);

Possibility of deploying a rescue unit in the territory (object);

Existing (required) minimum operating conditions in the area (object) where the rescue unit will be located;

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

The conclusion (decision) on the location area (object) of the rescue unit must be approved by the local administration of the location area (object) in agreement with the authorized body.

The possibility of rapid response to emergencies through the optimal deployment of forces and resources in a complex area of the republic with a high risk of natural and man-made emergencies will be considered.

The task of deploying rescue units is an optimal solution in the context of the effective use of available forces.

For example, if the areas of responsibility of two rescue units intersect (are close to each other) or are located far from each other, their location should be determined based on the boundaries of the areas of responsibility.

Otherwise, it will be necessary to optimize these subdivisions or scientifically substantiate their location within a specific area of responsibility.

Therefore, using the example of the Kamchik Pass, the location of rescue units is considered taking into account natural and man-made sources of danger.

From a scientific and practical point of view, there are various methods for solving this problem, and it is advisable to consider some of them.

Heuristic methods are a suboptimal method that provides small-scale solutions in determining the location of rescue units and are mainly effective in performing large-scale tasks. Although this method allows achieving a result close to the optimal solution through simple calculations, the method relies on results based on human experience and intuition, as its name suggests (heuristic).

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

The heuristic method, from the point of view of an experienced specialist, provides for achieving a solution to the problem by abandoning various forms that, in his opinion, are unacceptable in calculations in the solution of the problem.

Thus, the solution to the problem involves selecting the optimal one from a limited number of remaining forms by canceling the alternatives to be evaluated. If, in such a situation, the expert's experience is insufficient or it is necessary to choose one of the disputed solutions, the probability of the final result not being acceptable increases.

With the full implementation method, the determination of the optimal location for the rescue unit is carried out using mathematical programs, and when the data is complete, it is possible to assess each location separately.

For an accurate result when applying the full implementation method, information about each source of risk and its characteristics must be substantiated, and each piece of information must be developed based on accurate calculations.

However, the fact that the main sources of danger in the Kamchik Pass are natural (snow and rainfall, mudflows and flood waters, rockfalls, etc.), the accuracy of their forecasting is limited, and the use of this method in solving the problem increases the likelihood of lower results than expected.

Gravity center detection method is used to determine the location of an object in an area, and the method is convenient for determining the center of gravity of the human body.

The essence of the method is as follows: if the object's marking point coincides with the center of gravity of the area, the optimal location accuracy indicator will be higher.

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

The specified method has one limitation: the distance from the area where the rescue unit is located to the approximate location of the danger sources - the location of the rescue operation - is directly taken into account.

Therefore, the areas under consideration must have developed road networks; otherwise, this method violates the fundamental principle of modeling, namely the principle of selecting the optimal location for the object.

The task of determining the location of the rescue unit in the area based on the model for determining the center of gravity is carried out using mathematical formulas.

In this regard, considering the simplicity of using this method among the mentioned methods, the possibility of performing calculations quickly, we will use the method of determining the center of gravity when determining the location of the rescue unit.

Based on the foregoing, taking into account the sources of natural and man-made hazards in the Kamchik Pass and their approximate scale, we will determine the optimal location of the rescue unit on the pass.

By denoting the coordinates, we denote the coordinates of the center of gravity (X PXO, Y PXO).

Having determined the distance along the abscissa and ordinate axes, we determine the division of the scales based on the scale and reflect the results in Table 1.

Table 1

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

Potential danger of the Kamchik Pass in the Tashkent region is high

Coordinates of the center of gravity in

No.	Potential hazard source	Coordinate X	Coordinate Y	rescue volume
1.	industrial enterprise	26.	52.	20.
2.	highway	46.	48.	10.
3.	railway	77	38.	20.
4.	logistics center	88.	29.	15.
5.	deposit	96.	19.	10.

The coordinates of the area where the rescue unit can be located are determined according to the formula:

Gi - volume of work in i-th conventional unit;

Xi, Yi - coordinates of the i-th potentially hazardous object

n - number of potentially hazardous objects.

Xqb = Xqb = = = 64 km $\frac{4800}{75.}$

Yqb Yqb = = = 40 km $\frac{52*20+48*15+15+38*20+29*10+19*10}{20+10+20+15+10}$ $\frac{3,000}{75.}$

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

Based on the calculations carried out to determine the center of gravity, we will determine the location of the rescue unit in the optimal area in the part of the Kamchik Pass passing through the Tashkent region.

By entering the coordinates of the QB service area on the map, we mark the points where potentially hazardous objects of significant importance are located in the area (in Figure 1, the complexity level of rescue operations is determined by industry experts from 1 to 20, 1 - preventive awareness-raising work with the population, 20 - rescue operations in complex conditions).

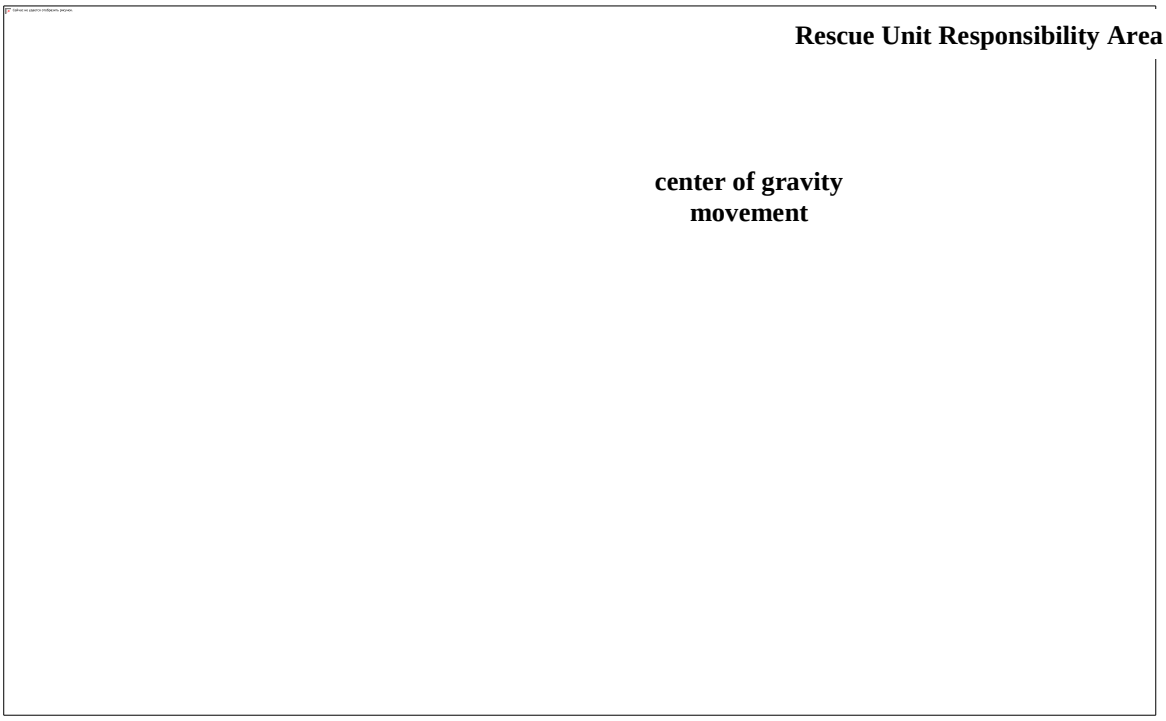

Figure 1. Potential sources of danger in the part of the Kamchik Pass in the Tashkent region

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

Determination of the territory of the RC, taking into account the volume of rescue operations

We will also consider the issue of placing the QB in optimal areas in the part of the Kamchik Pass passing through the Namangan region.

The location of the Kamchik Pass in the southwestern part of the Namangan region, the development of transport networks in this area, the presence of natural and man-made sources of danger, in turn, will allow us to conduct calculations to determine the location of the QB in the optimal territory of the region.

Based on the calculations carried out to determine the center of gravity, we determine the location of the QB in the optimal area of the Kamchik Pass passing through the Namangan region (X PXO, Y PXO).

Taking into account the distance along the abscissa and ordinate axis, as well as the scale of the potential danger source, we record the results in Table 2.

Table 2

Potential danger in the Namangan region of the Kamchik Pass is high

Coordinates of center of gravity in

No.	Potential hazard source	Coordinate X	Coordinate Y	rescue volume
1.	tunnel	36.	62.	30.
2.	highway	87.	48.	30.

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

3.	railway	98.	39.	25.
4.	rockfall	56.	58.	20.
5.	avalanche	106.	29.	20.
6.	communications	116.	15.	10.
7.	industrial site	126.	10.	10.

The coordinates of the area where the rescue unit can be located are determined according to the formula

Gi - volume of work in i-th conventional unit;

Xi, Yi - coordinates of the i-th potentially hazardous object

n - number of potentially hazardous objects.

$$Xqb = Xqb = \frac{\sum_{i=1}^{n} R_i \times X_i}{\sum_{I=1} R_i} = \frac{36 * 30 + 56 * 20 + 87 * 30 + 98 * 25 + 106 * 20 + 116 * 10 + 126 * 10}{} = \frac{11800}{145.} = 81 \text{ km}$$

$$Yqb = Yqb = \frac{\sum_{i=1}^{n} R_i \times Y_i}{\sum_{I=1} R_i} = \frac{62*30+58*20+48*30+39*25+29*20+15*10+10*10}{30+20+30+25+20+10+10} = \frac{6265}{145.} = 43 \text{ km}$$

Calculations for determining the center of gravity show that the optimal area identified in the part of the Kamchik Pass in the Namangan region is located at a sufficient distance from the locations of the PV dislocation.

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

In this regard, it is required, in cooperation with local khokimiyats, to select the territory in accordance with the requirements for the placement of the PS.

By entering the coordinates of the service area of the RES on the map, we mark the points of location of potentially significant sources of danger in the area (in Figure 2, the volume of rescue operations is determined by industry experts from 1 to 20, 1 - preventive awareness-raising work with the population, 20 - rescue operations in difficult conditions).

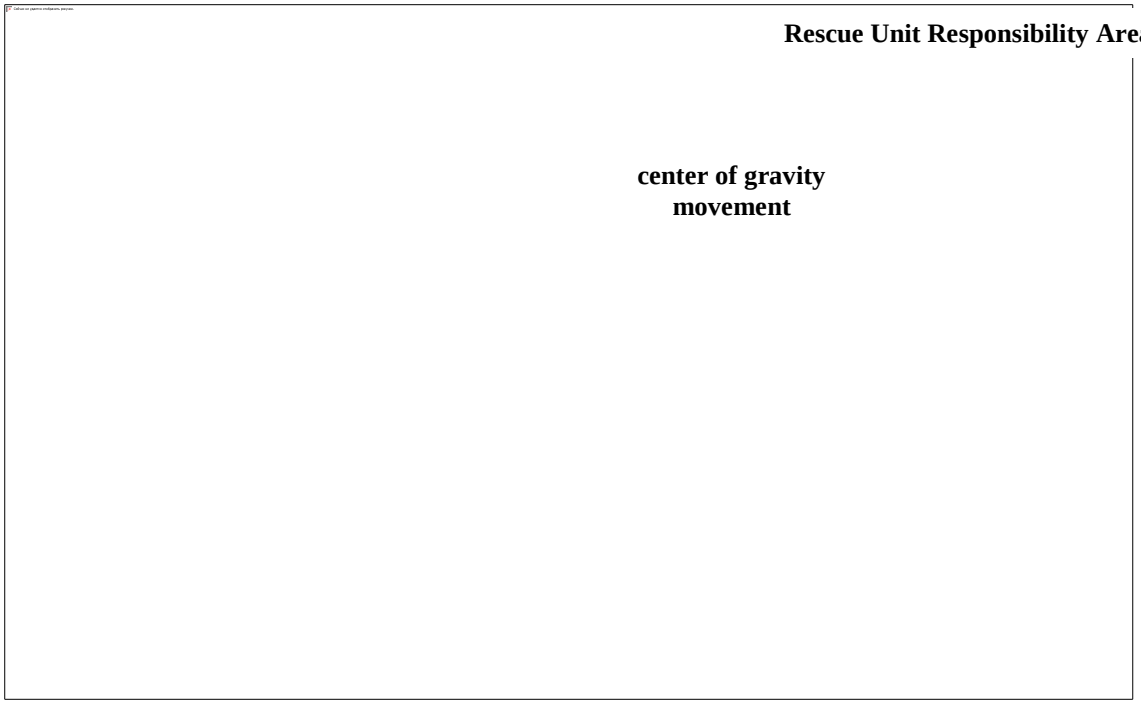

Figure 2. Potential sources of danger in the part of the Kamchik Pass in the Namangan region

and determination of the area of the RB, taking into account the volume of rescue operations

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

Research results. According to the calculations carried out, taking into account the level of risk of emergencies at the Kamchik Pass, we will mark the approximate locations of the forces and resources of the Civil Defense Forces - rescue units in the optimal territory of the Namangan and Tashkent regions and display them on the map (Fig. 3)

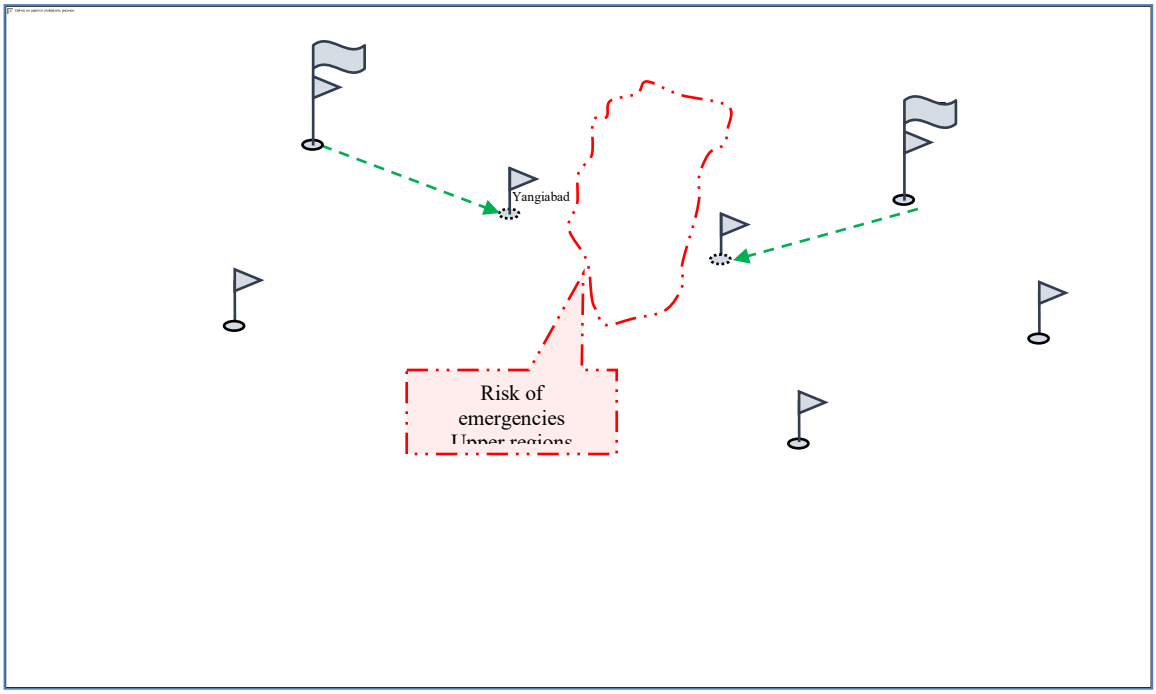

Fig 3. Optimal layout of rescue units at the Kamchik Pass

Thus, in the region of the republic with a high probability of emergencies, the locations for deploying rescue forces and resources were determined with justification, taking into account potential sources of danger that could lead to emergencies.

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

In the process of determining the location of forces and resources at the Kamchik Pass, the method of determining the center of gravity was used.

The use of the method of determining the center of gravity is explained by the ease of using this method in the processing of statistical data and the preparation of operational calculations.

The aforementioned mathematical method can also be used not only for rescue units but also for the deployment of forces and resources by sectoral services (objects) within civil defense forces.

In conclusion, the importance of effectively involving civil defense forces in protecting against emergencies is increasing.

The aforementioned circumstances, in turn, require the establishment and implementation of a set of measures to protect the population and territories and increase the effectiveness of civil defense measures:

taking measures for the optimal placement of each unit, taking into account the nature and scale of natural and man-made hazard sources in the area of responsibility, in the effective organization of the activities of rescue units that form the basis of civil defense forces;

organization of rescue (civil defense) units located in acceptable territories, based on a real classification of sources of danger, with a sufficient number and composition of personnel capable of eliminating and protecting the population and territories from emergencies;

systematic implementation of organizational and practical measures aimed at the continuous improvement of the professional and special training of personnel of rescue (civil defense) units.

SCIENCE AND SOCIETY-
FAN VA JAMIYAT- НАУКА И ОБЩЕСТВО
ILMIY-TAHLILIY JURNAL

Issue - 3(2026) / ISSN 2992-913X Available at www.uznauka.uz

References:

1. United Nations Collection of Discussion Materials on the Increase in Civilian Victims. June 2025.

2. United Nations Disaster Information. May 2025.

3. Discussion of the INSARAG Working Group on the results of 2025.

4. V.V.Mensch, E.V.Shatalov, P.V.Orekhov Algorithm for optimizing the placement of forces and means of ensuring road safety.

5. Semikov V.L., Brushlinskiy H.H. Problems of the Creation and Functioning of Emergency Rescue Services // Results of Science and Technology. Sir. Fire Protection, VINITI. 1991. - Vol. 12.

6. Pranov B.M. Assessment of the complexity of the task of optimal resource allocation // Materials of the scientific and practical conference "Fire Safety-97": Collection of scientific works. M.: MIPB MVD RF, 1997.

7. https://education.yandex.ru/handbook/algorithms/article/polnyj-perebor-i-optimizatsiya-perebora.

8. https://studfile.net/preview/3938003/page:7/.

9. https://cyberleninka.ru/article/n/evristicheskie-metody-resheniya-zadach-v-sovremennoy-shkole.

10. Resolution of the Cabinet of Ministers of the Republic of Uzbekistan dated April 29, 2023 No. 171 "On Measures for the Effective Organization of the Activities of the State System for the Prevention and Response to Emergency Situations of the Republic of Uzbekistan."