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RISKS ASSESSMENT OF THE NATURAL DISASTERS IN KYRGYZ REPUBLIC

This article deals with the current approaches to the prediction of these processes, taking into account natural and casual in their development, as well as the methodology of assessment and management of natural risks in modern conditions, aimed at continuous reduction of social, economic and other losses of society from dangerous influences of nature.

Key words: *natural hazard, natural risk, vulnerability, risk assessment, risk management*

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ОЦЕНКА РИСКОВ СТИХИЙНЫХ ЯВЛЕНИЙ В КЫРГЫЗСКОЙ РЕСПУБЛИКЕ

Рассматриваются современные подходы к прогнозированию этих процессов, учитывающие закономерное и случайное в их развитии, а также методология и методика оценки и управления природными рисками в современных условиях, направленные на постоянное уменьшение социальных, экономических и других потерь общества от опасных воздействий природы.

Ключевые слова: *природная опасность, природный риск, уязвимость, оценка риска, управление риском*

Макалада мыйзамченемдүү жана чаржайыт кубулуштардагы тобокелдикти баалоонун заманбап мамилеси каралат. Учурдагы шарттарда жаратылыштагы тобокелдикти башкаруу жана баалоо методологиясы сунушталат. Сунушталган ыкма жаратылыштын коркунучтуу таасирлерин жана коомдогу социалдык, экономикалык жоготууларды азайтууга багытталган.

Түйүндүү сөздөр: *коркунуч, жаратылыш тобокелдик, тобокелдикти баалоо, тобокелдикти башкаруу.*

All throughout history, natural disasters have been one of the greatest challenges against development of human societies. Many races, cultures, and civilizations formed, evolved, or demised depending on their knowledge, technology, and capability to cope with adversities of nature. While this may seem to be history, natural or human-caused disasters are still among the serious threats to societies' socioeconomic and political development around the world, even today. Floods, storms, epidemics, earthquakes, droughts, wild fires, and many more interrupt and distort the lives of many around the world repeatedly, in many instances taking lives, ruining investments, and forcing major relocations. Global warming, a human-caused global-scale natural hazard, will soon, if not already, severely and irreversibly impact to our civilization and its future if no serious actions are taken in near future.

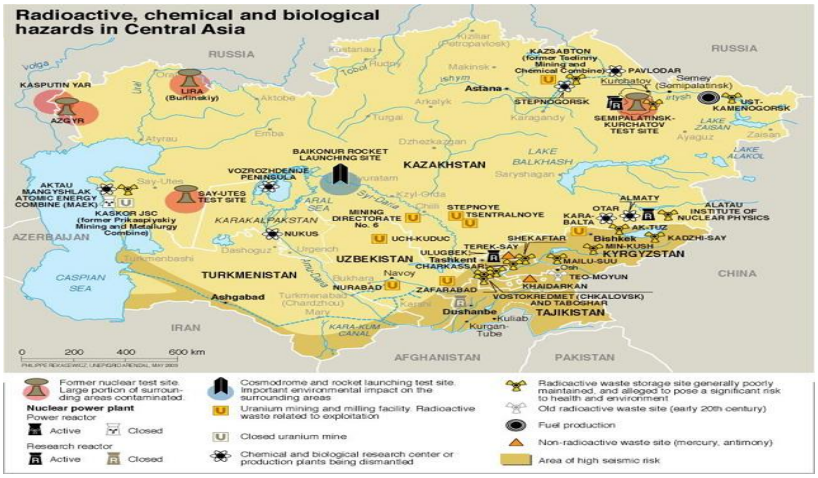


Fig. 1. Natural and anthropological hazards in Central Asia

A steep trend. It rose from just more than one billion dollars in the 1960s to almost 50 billion dollars in the 2000s. Despite the decreasing trend, the low-income countries in OIC have in average endured close to 30% of these costs. It is to not that the decreasing trend in the share of OIC-LI in total financial damages caused by natural disasters in OIC over the last fifty years is concealing a bleaker reality: 52% of about 1.2 billion dollars in the 1960s versus 17% of about 50 billion dollars in the 2000s. Even including the inflation rate over these years is not going substantially change this comparison. The worrying trends in frequency and magnitude of impacts of natural disasters in OIC countries call for action. It is crucial for the purpose of risk management to know whether the difference in frequency of natural disasters across countries is due to being relatively more prone to higher number of natural hazards, which is beyond control, or due to lack of capacities.Conditions for reducing risks and vulnerabilities that lead natural hazards to become disasters, which can improved.

Disaster or its risk arises when hazards (such as storms, droughts, etc.) interact with ice, social, economic and environmental abilities and considerably impact systems rely on. The Earth shaped by a wide of natural processes, many of which can occur in ways that can pose a threat to such systems and hence form a natural hazard. Natural hazards generally cause death, injury, relocation and destruction of or damage to houses, agricultural land, buildings, infrastructure and communities. However, these impacts substantially escalate when hazards affect a vulnerable system, in which case the natural hazard becomes a natural catastrophe or a natural disaster.

The effects of a natural disaster on an area or community depend on many factors. These include those related to the event itself - its magnitude and frequency - as well as those related to the community: its size and density of population and assets, how prepared the affected population is, and their economic resources to either mitigate a potential disaster and/or recover afterwards.

Risk of disaster is defined here in terms of the potential number of people killed because of natural hazards interacting with vulnerable conditions over a given period. 5 Specifically, natural disaster risk (NDR) is modeled here as a function of risks induced by being prone to natural hazards (NHR), the size of population (Pop), and risks induced by vulnerabilities (VR) according to the following equation (UNDP, 2004): NDR = NHR x Pop x VR.

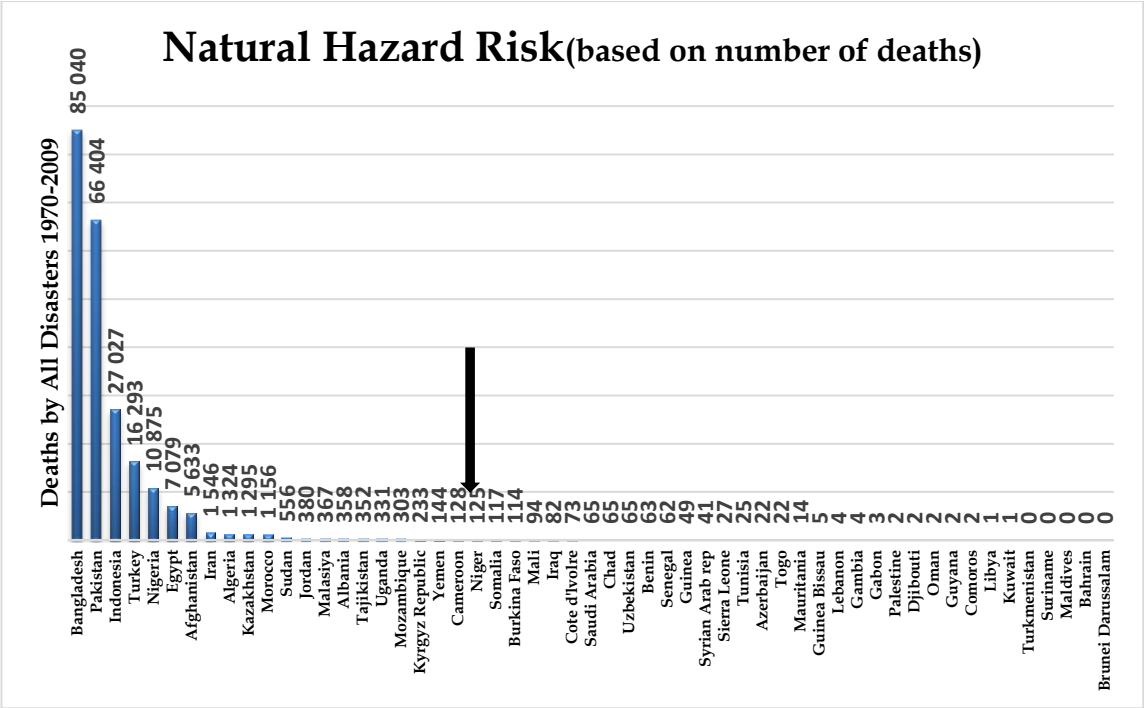


Fig 2. Natural Hazard Risk Index for OIC Countries

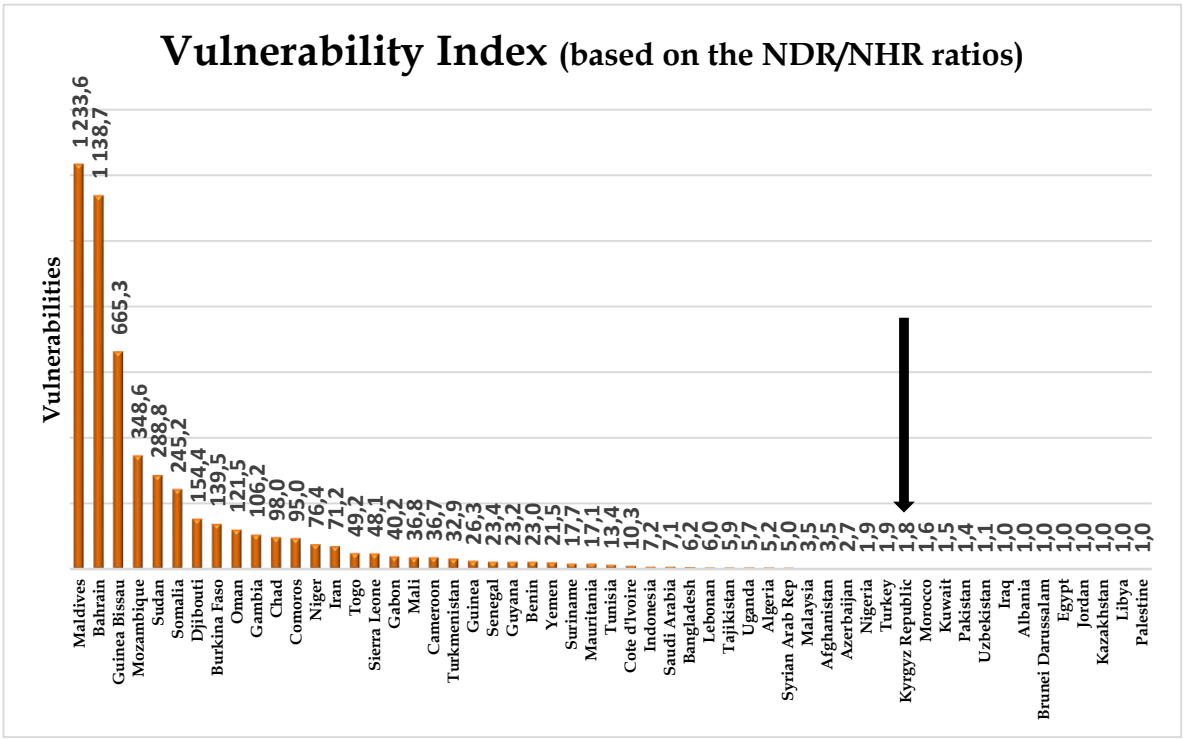


Fig. 3. Vulnerability Index for OIC countries based on the ration of Natural Disaster Risk Index to Natural Hazard Risk Index: 45 out of 55 OIC countries are facing staggeringly high vulnerabilities.

It is very important to note that the countries with high vulnerabilities are not necessarily the ones who have already suffered the most in terms of the absolute number of death tolls. As highlighted before, a country like Bahrain with only 111 deaths over the forty years since 1970 - one of the lowest levels among OIC countries - can suffer the most given its level of vulnerabilities - that is second only to Maldives - if the pattern of occurrences changes not in favor of this country. This argument not only applies to Bahrain but to all of the 47 OIC countries with a vulnerability index of higher than one.

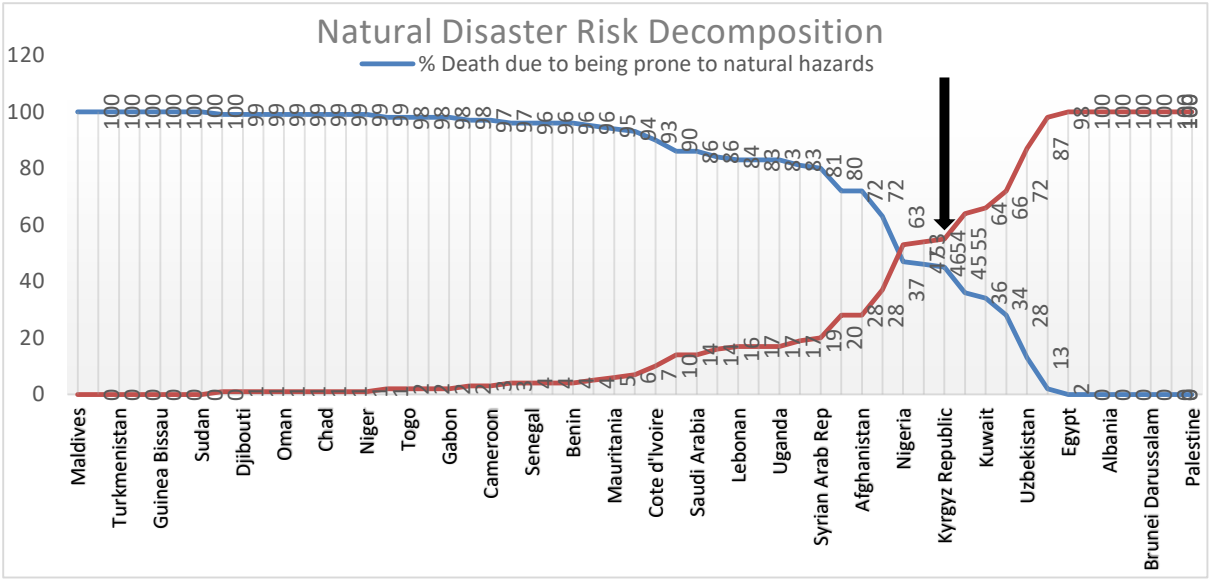


Fig. 4 – Decomposition of Natural Disaster Risk for OIC: In 40 out of 55 OIC countries vulnerabilities, rather than being prone to natural hazards, is the main cause (more than 50% of death tolls is natural disasters.*)

In other words, the capacities and conditions of each region for devising effective risk management policies and strategies, and implementing pleasures for reducing the impact of hazards on vulnerable local communities. Accurate, well-in-advanced prediction of the time, place, and intensity of natural disasters may be almost possible. Nevertheless, their long-term behavior is well known and is being continuously measure and modeled. While the L citation, severity, and frequency of hazards put a limit to reduction in vulnerability, many g averments have yet to find effective ways of reducing and managing the risks they pose, or are procrastinating investments in this regard. The consequence has been and willbenothing [natural hazards increasingly becoming c disaster risks.

This report clearly illustrated that while c afferent OIC countries suffer from different types of natural hazards, with various f sequences and magnitudes, it is in fact their \ vulnerability to risks, or the lack of conditions a id capacities for properly managing and reducing the risk of disasters, that is the main culprit. It shown that in majority of countries (30 out of 55), the risks induced by vulnerabilities form more than 50% of the natural disaster risks. Moreover, it has been explained let almost 100% of natural disasters and their pacts (fatal, non-fatal, and financial) in low income OIC countries (OIC-LI) during 1960-2009 took place in countries that are also i gentrified as OIC countries with low capacities risk reduction (OIC-LRRC). There is clearly to doubt that there is a real need for cooperation among all OIC countries, with a distance from outside, to offer a hand to the people and governments in such countries to i ;duce their vulnerabilities to natural disasters, and save lives. Investments in response mechanisms and capacities are quite important. However, effective risk management of disasters requires, and

involves, more than just a response mechanism. Reducing the risk of disasters requires viewing disasters as major barriers to sustainable socio-economic development, and managing the risks through investing in and enhancing the capacities for preserving the environment and ecosystems, eradicating poverty and inequality, appropriate rural and urban development, and improving the quality of governance, all of which contribute to vulnerabilities.

Issyk-Kul basin has a length from east to west 240 km, a width of about 100 km. The central part is occupied by Lake Issyk-Kul. The lake is surrounded by plain, narrow coastal strip is covered with sand, sometimes gravel, sometimes composed of cemented sandstone, in some parts swampy. Plain extends to 40-50 km to the east of the lake along the river valleys and TupJyrgalan. On the northern bank of its width from 1 to 10 km on the west - 10-15 km. Only along the south coast, it is sometimes interrupted, giving way to foothill ridges. Foothills Kungei and TeskeyAla-Too folded Mesozoic-Cenozoic sediments, strongly dissected Sais, ravines and river valleys. Length KungeiAla-Too - 280 km. The ridge is located at 3800-4000m. Highest point - Mount Choctaw (4771 m). The central part of the range lies above the snow line, so there are small snowfields and glaciers. Length of the ridge TeskeyAla-Too range of 350 km, it is located in the highest part of the upper reaches of the Ak-Suu and Kara-Kul, where many glaciers. South of the TeskeyAla-Too located Syrty, sparsely populated mountainous area with a characteristic alternation of shallow ridges and intermountain depressions. It is dominated by wavy space surrounded by ridges, covered with eternal snows and glaciers. Risk Register (list of possible natural disasters and man-made disasters on the territory of country), emphasizes the importance of addressing issues at the state level to respond to emergency situations of natural and man-made in the Kyrgyz Republic.

Degree	Probabi-lity	Conse-quence	Risk	risk
high	probably	catastrophic	- Earthquakes 74 settlements classified as seismic, located in the zone of possible sources of earthquakes, the intensity of which can be more than 9 points. They live about 75% of the population. According to preliminary estimates, about 3.3 million people. Live in houses rather unstable to the expected strong earthquakes, which is 66% of the population.	1
high	probably	high	**-landslides** On the territory of the republic there are at least 5000 landslide areas. The most widespread landslides are in the south in the Jalal-Abad and Osh regions (90%). All under the supervision is the most landslide-prone areas 261, which pose a threat to human settlements, roads and engineering structures.	2
high	probably	low	**-Snow Avalanche** Common in many areas of the country, threatening mainly Bishkek-Osh road and other highways of the country highlands, as well as communication lines and power. Avalanche period lasts from November to April, with the peak of activity in February and March.	3
			-Sat down,	4

high		low	More than 95% of settlements and millions of citizens of the republic settled in the vicinity of water sources mainly along rivers, which are under the influence of flood and flood events. Most often these natural processes occur in the foothills and lowland part of the Fergana Range (Osh, Jalal-Abad region), foothill areas Kungey-, TerskeyAla-Too and the Kyrgyz ridge). The monitoring showed that in the territory of the republic under the threat of floods and mudslides exposure is 497 settlements and objects, including the northern part of the country, covering the territory of Bishkek.	
high	probably	low	**-Outbreaks of infectious diseases (EID)** a) .VIZ endangering many people. Such an outbreak could turn into an outbreak of pandemic influenza in humans. b) .VIZ in a localized form, such as an outbreak of an infectious disease transmitted through the water, such as cholera and typhoid. c) .VIZ in animals, such as H5N1 in animals, or foot and mouth disease in cattle results in significant damage to the agricultural sector.	5
high high	probably	catastrophic	**-Radiation Dangerous objects** a) Uranium tailing and dumps: The republic has 50 tailings, which contain more than 100 million m3 of tailings and dumps a significant amount. There is a high risk of radiation-hazardous environmental disasters transboundary nature. b) Toxic substances (SPS) Total in the country, there are 100 objects that use its technology SPS. 19 of them are classified as chemically hazardous objects (Hoo). The most dangerous are: ammonia, hydrochloric acid, sulfuric acid, nitric acid, cyanide, chlorine, trichlorosilane. At the risk of exposure can pose a threat to the population, to farm animals.	6

high	probably	high	- **Breakthrough alpine lakes,** On the territory of the republic are over 300 high-glacial lakes. They are divided into categories of danger: I hazard category (very dangerous) Category II hazards (hazardous) III risk category (less dangerous). These lakes are located in the territory of each region of the country. Breakthrough alpine lakes pose a serious potential threat to the population and economic projects, as their breakthroughs, rapid discharge of water causes the formation of powerful mudflow and flood flows that exit in the densely populated valley can lead to catastrophic consequences.	7

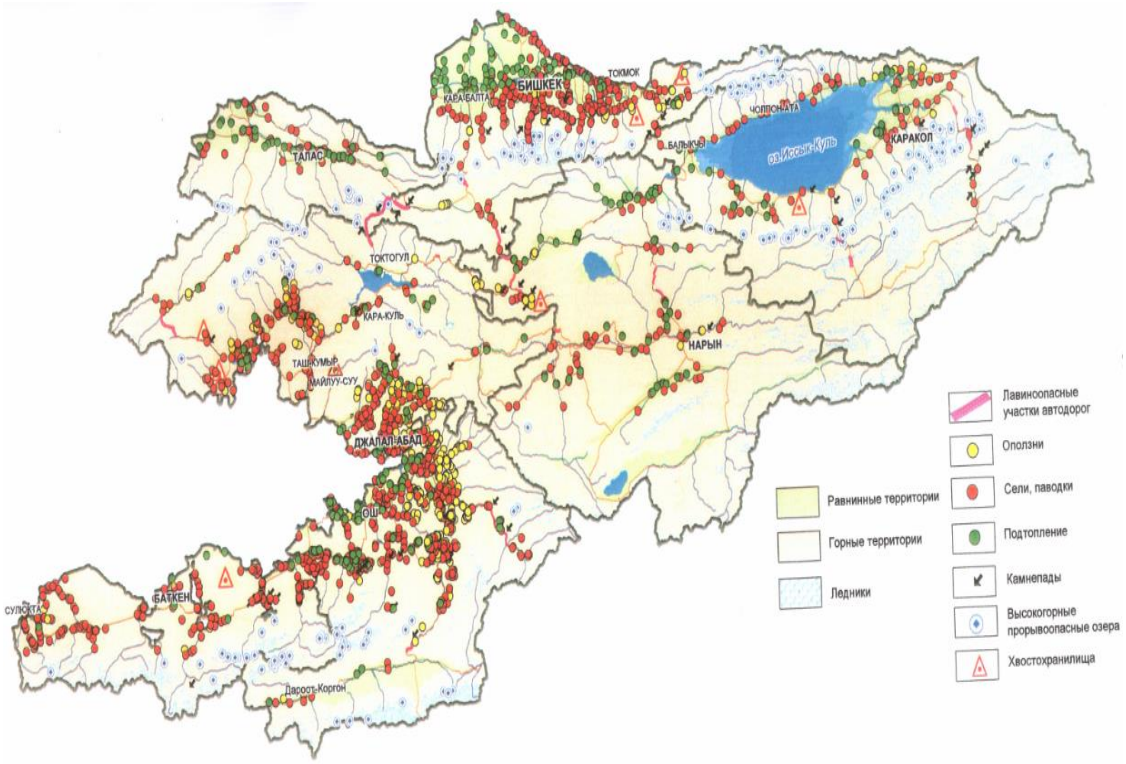
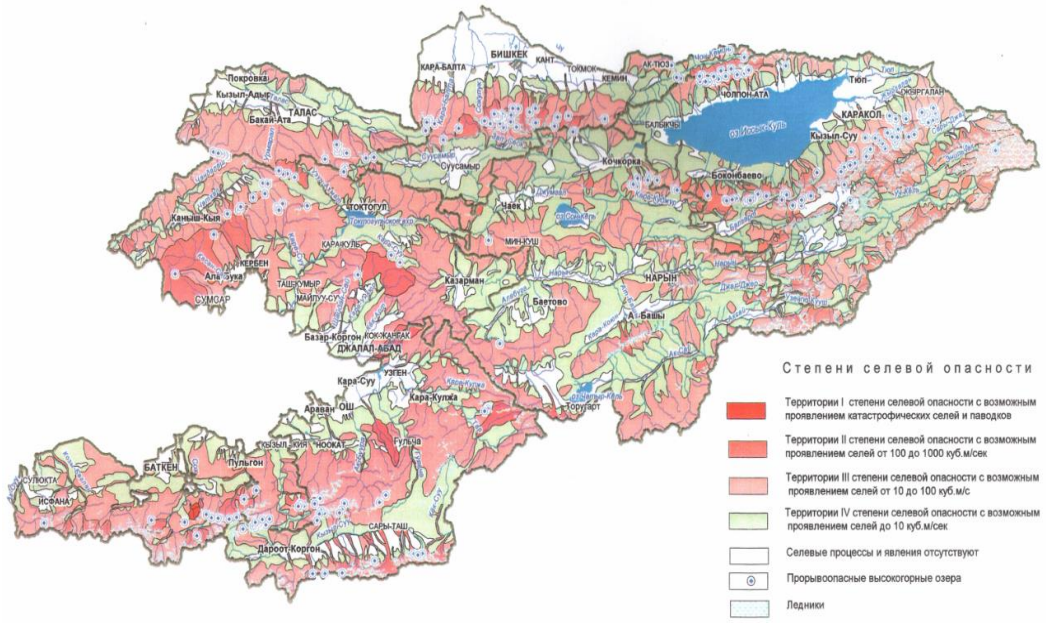


Fig. 5. Schematic map of distribution of dangerous processes and the phenomena in the territory



of theKyrgyz Republic./2/

Fig. 6.a. Schematic map of the forecast of torrential danger in the territory of the Kyrgyz Republic /3/.

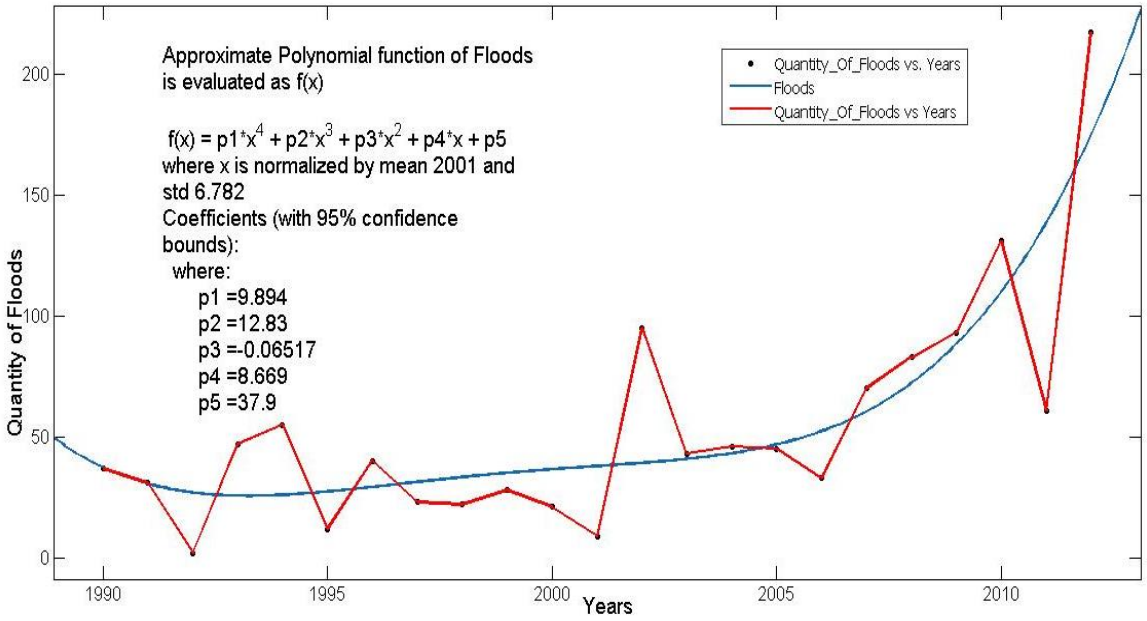


Fig.6.b. Amount of flood events based on years in Kyrgyz Republic./3/

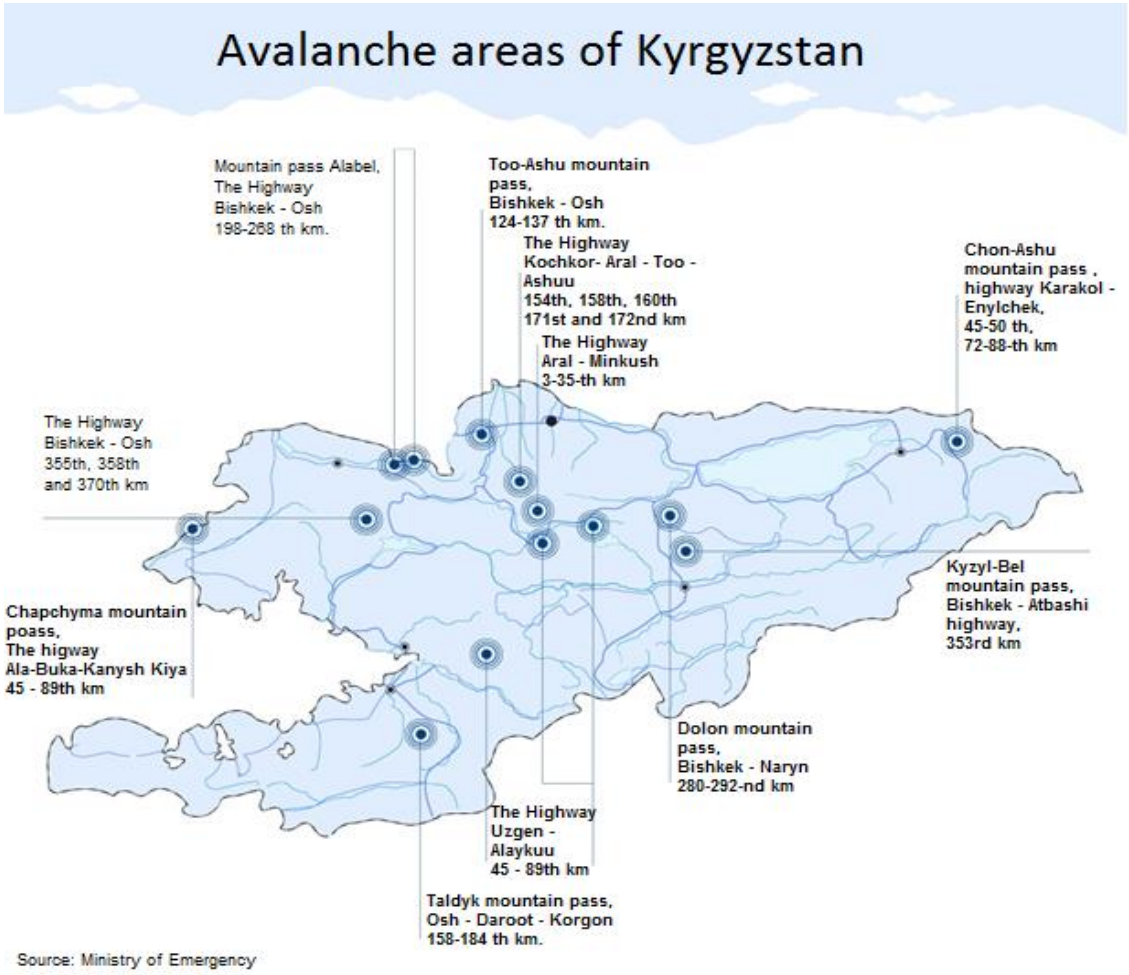


Fig. 7.a The map of Kyrgyz republic according to avalanche coordinates and localization of avalanches

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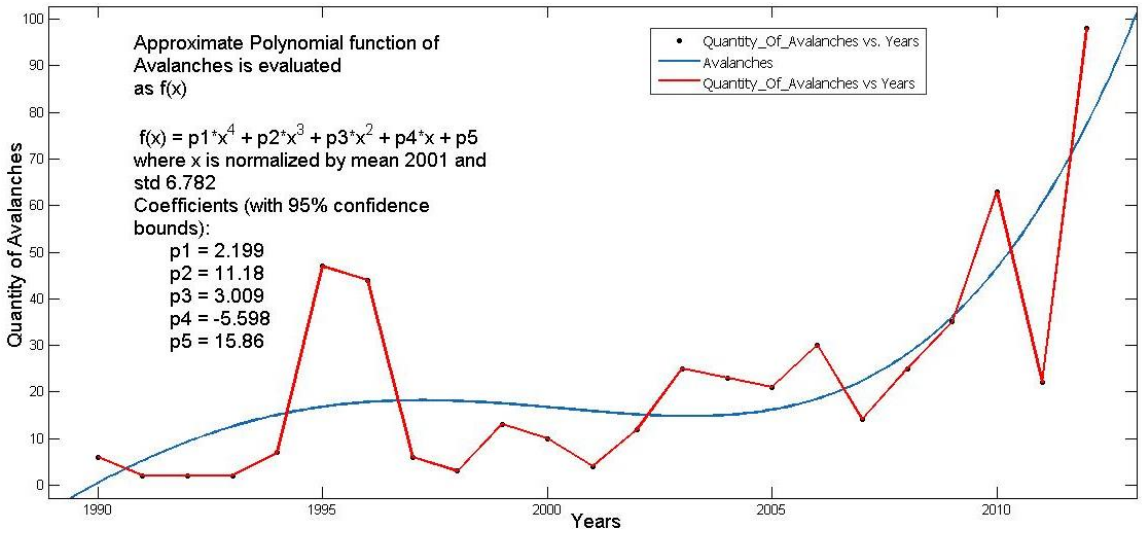

Fig. 7.b. Amount of avalanche events based on years in Kyrgyz Republic./3/
According to the terminology adopted by the UN and has gained acceptance among experts

in many countries, under natural risk refers to the expected loss (from death and loss of health, loss of property and business interruption) resulting from the manifestation of a natural hazard (risk) in the area for a certain period. The calculation of risk is based on an assessment likelihood dangers and damages are expected from the following formula/ 1 /:

$$\boldsymbol{R(A) = PU,} \quad \textbf{(1)}$$

where–R(At) the amount of risk for the time t, P - the probability of a natural hazard,U - damage from this natural hazard.

Risk analysis begins with an assessment of the probability of occurrence of natural hazards and determine the damages. Under natural danger means threatening events developing in the lithosphere, atmosphere or in space, that evaluates the probability of its occurrence for the indication of the place, time, and physical parameters. Source of natural hazard can be any process that develops in geosphere spheres of the Earth and may have a negative impact on people, the objects of the technosphere and the environment. The most important task of risk assessment - the forecast of a hazardous event, that is, the probability of finding its manifestations

An important parameter to assess the damage and risks in general is the people's vulnerability and the technosphere. Vulnerability is the property of the social and material areas totally or partially lose the ability to carry out their natural or specified functions as a result of exposure to hazardous pro-process or phenomenon. Vulnerability - is the ability of individuals, natural and man-made material objects to resist natural hazards. Vulnerability assessment is given in relative units or percentages. The values of social and material losses are directly dependent on the vulnerability. Magnitude of vulnerability are based on the practical experience - analysis of destruction from occurring natural disasters or by computer simulation.

In the social sphere vulnerability reflects the degree of loss of life or injury to a person. When a fatal outcome vulnerability index is equal to 1 (or 100%). For the victims vulnerability is variable quantity (but not more than one) and is determined by the cost of treatment or compensation for disability.

On the basis of vulnerability calculated damages in social and physical spheres. The amount of direct damage is derived by multiplying the value of the vulnerability of the elements of risk at the time of impact:

$$\boldsymbol{U_j = \sum_{j=1}^{n_0} v_j K_j,} \quad \textbf{(2)}$$

where -U_j the amount of total damage from events,j– class, n_0 - the number of elements (people or objects owned) exposed, v_j - vulnerabilityj - element with respect to natural hazards , j- power rank (intensity), and -K_j the valuej - element (with the death of a person or complete destruction of the object).

There are two categories of damages: direct and indirect.

In determining damages in the social sphere is more complex valuation of human life.

Knowledge of the likelihood of a dangerous process and the amount of damage from it allows us to find the mathematical expectation of the risk of damage to any territory for a certain time interval:

$$\boldsymbol{R(\Delta t) = P_j U_j,} \textbf{(3)}$$

where -U_j the amount of total damage from events j- class , P_j- the probability of the event of damage.

In the case where within the study area is the same natural hazard is manifested in different energy levels, the integration is carried risks for different parts of the territories, in accordance with the energy level of danger. Ultimately, this gives you the opportunity to get an overall risk for the entire territory of the time interval:

$$\mathbf{R(\Delta t)=}\boldsymbol{\sum_{j=1}^{n} P_j U_j,} \quad \textbf{(4)}$$

Where $P_j$andU_j - respectively the probability and damage from hazardous events j- of the

energy class. Because of the complex and ambiguous estimating losses in the social sphere, and above all - the value of human life social risk is determined separately. However, he expressed no damage, as an indicator of individual risk, which characterizes the probability of death of a person from a dangerous natural events throughout the year. To do this, on the basis of available statistics or modeling are the number of dead (or injured) people on any territory for a certain period of time (e.g. one year) M(n,t), and knowing the total number of residents living in the area N, assess the individual risk of the expression:

$$\mathbf{V(\Delta t)=\frac{M(n,\Delta t)}{N}} \quad \mathbf{. (5)}$$

The resulting value of individual risk (e.g. 1 x 10^{-3}) shows that during the year within the given area should expect death from natural hazards 1 per 100 inhabitants.

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