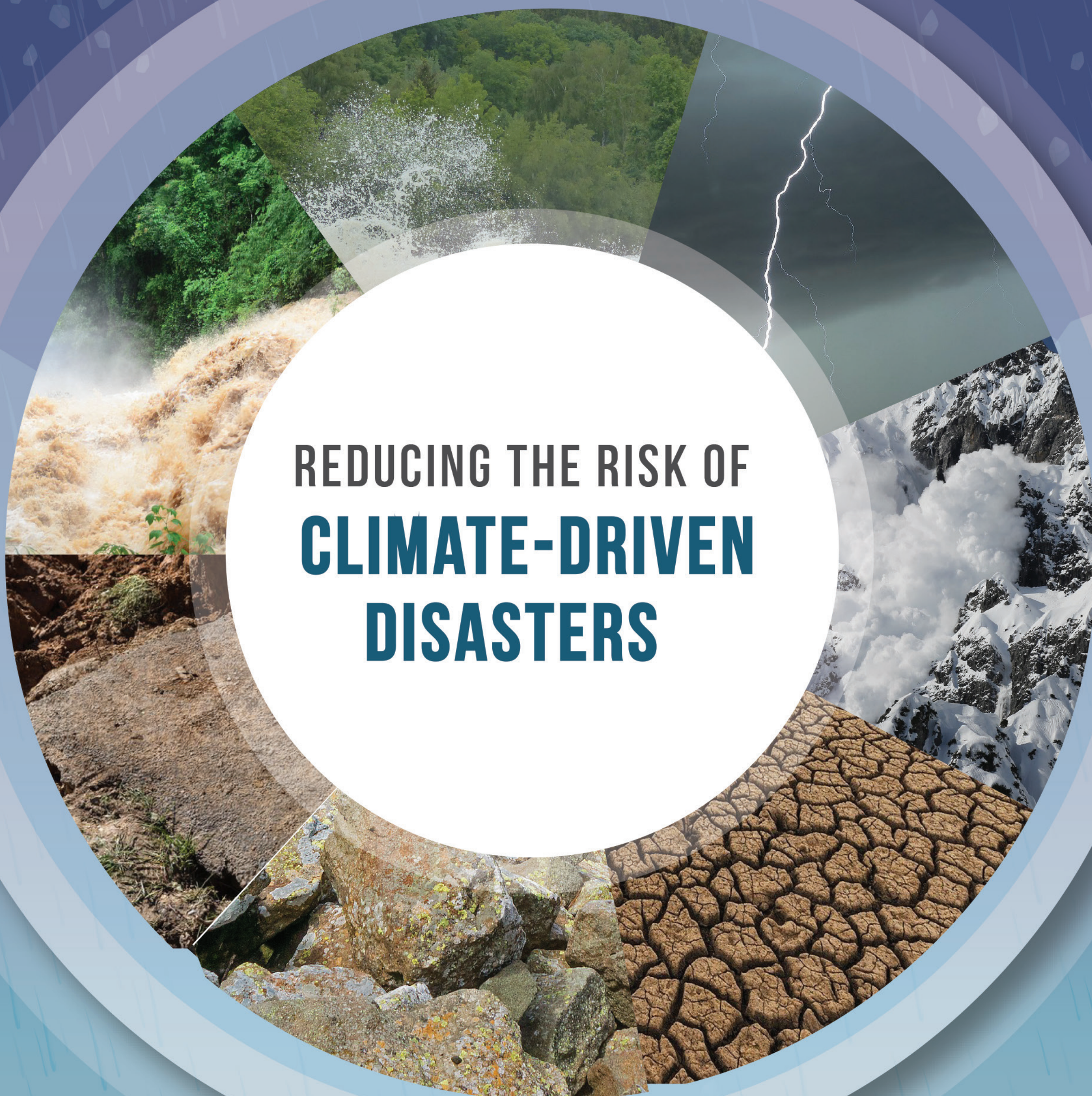
REDUCING THE RISK OF CLIMATE-DRIVEN DISASTERS



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The information brochure has been prepared by the LEPL Center for Environmental Information and Education of the Ministry of Environment Protection and Agriculture of Georgia with the support of the United Nations Development Program (UNDP).

The information in the brochure outlines seven key threats of climate change that pose a particular risk to Georgia - floods, hail, droughts, landslides, stong winds, avalanches and mudflows.

The brochure was prepared within the framework of a large-scale initiative of the government of Georgia and the United Nations Development Program (UNDP), which aims to protect the population from climate change disasters, including the above-mentioned threats, and is carried out in 11 rivers in Georgia - Enguri, Chorokhi-Adjaristskali, Natanebi, Khobi, Kintrishi, Supsa, Mtkvari, Aragvi, Khrami-Ktsia, Alazani and Iori basins.

The implementation of this seven-year program will increase the resilience of the Georgian population to climate threats, reduce the impact of climate disasters on infrastructure and the environment, and provide 1.7 million people with better protection against floods, droughts and other climate threats.

The seven-year initiative **"Reducing the Risk of Climate-Driven Disasters in Georgia"** is funded by the Green Climate Fund (GCF), the Swiss Agency for Development and Cooperation (SDC), and the governments of Sweden and Georgia.

Persons involved in the process of preparing the news publication:

Rusudan Tevzadze - The Author of the Publication, The Project Expert

Teona Julukhadze - Arbiter Samaritan Bund Georgia Program Coordinator

Vano Grigolashvili - Association Regional/Rural Development for Future Georgia (RDFG), Director

Maia Shamugia - The Ministry of Education and Science, Coordinator of Geography Implementation in "New School Model"

Tamar Shervashidze - Environmental Information and Education Centre, Project Coordinator

Tamar Gorjoladze - Designer

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HISTORICAL-GEOGRAPHICAL RETROSPECTIVE OF DISASTERS, KNOWN FACTS AND EVENTS

At the turn of the XX-XXI centuries, protection of the population from natural disasters, safe operation of agricultural-engineering facilities and ensuring a sustainable environment became the most important socio-economic, political and ecological problems for the majority of the planet's population. Consequently, the population of earth is facing many difficult problems. The most important are the challenges that threaten the primary human right and value as well as their life, and these are the increase and strengthening of disasters in time and scale. Life is an inviolable human right and is protected by law (Constitution of Georgia - Article 10).

In the interests of the present and future generations, the dispute over the environment and the rational use of natural resources are ensured by law (Constitution of Georgia - Article 29).

Everyone has the right to timely and complete information on the state of the environment (Constitution of Georgia - Article 29).

In the face of globalization and global ecological change in general, natural or man-made disasters are often catastrophic, resulting in human or material loss.

With this in mind, we think it is crucial to acquire basic knowledge about disaster management and to develop relevant skills.

The guide is designed for high school students to gain knowledge of the above issues and to be able to apply this knowledge in life or practical activities.

At the dawn of the 21st century, when natural disasters occur on a much larger scale under conditions of intense human pressure, there is a sharp imbalance of the environment and an extreme intensification of natural-man made catastrophes, accompanied by unprecedented economic losses and human casualties.

Irrational actions taken by man on the environment, which are a guarantee of material well-being, on the other hand cause substantial and, most importantly, undesirable changes in the environment, which contribute to the development of negative processes. This in itself destroys socio-economic systems through a chain reaction.

It is important to note that the main and most important reason for disasters caused by the increasing natural threats to the Earth is global climate change. Climate change, which usually takes decades or longer, should not be confused with change in weather.

The Earth's atmosphere is made up of a variety of substances, including greenhouse gases. These are the gases that retain and trap heat on Earth. Were it not for these gases in our atmosphere, the night temperature would have dropped to -10^0 degrees Celsius.

Reducing the risk of natural disasters and finding ways to mitigate their consequences has been dictated by the United Nations-led campaign:

- 2002 Johannesburg (South Africa) World Summit,
- 2005 Hyogo (Japan) International Conference,
- 2015 Sendai (Japan) Conferences

The decisions taken were the basic guidelines for disaster risk reduction and mitigation.

Natural disasters are presented with two completely different events and consequences:

1) Dangerous meteorological events in the atmosphere;

2) Natural geological processes occurring on the Earth's surface and in its crust. Therefore, specialists and institutions of the relevant profession are engaged in managing these problems.

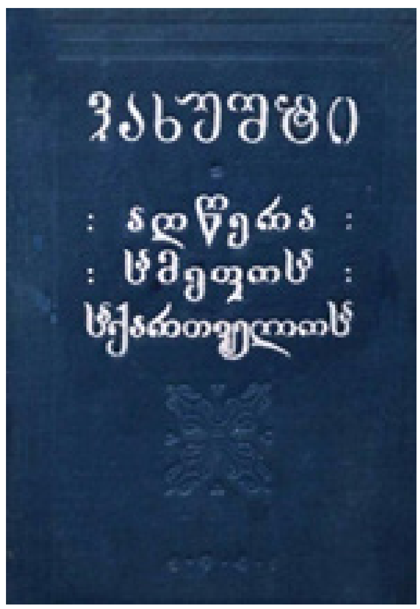
Negative results caused by natural geological processes create particularly difficult situations in mountainous regions. Thousands of settlements, lands, roads, oil and gas pipelines, high-voltage power towers, hydro-technical reclamation facilities, mountain-tourist complexes, etc. are periodically affected by the strong impact of geological disasters (often with catastrophic consequences).

Furthermore, the risk of these processes increases immeasurably every year. In recent years, the number of natural hydrometeorological events has increased by an average of 15%, while the number of natural geological events has increased by an average of 58%. Consequently, the damage caused by the disaster is also increased. According to the available data, the damage caused by natural geological and hydrometeorological events in 2015 alone amounted to 389 million GEL.

We will start talking about climate change with great pride from the era of Vakhushti Bagrationi. It was Vakhushti, the great geographer and historian, who first made a complex description and assessment of the Georgian climate.

In general, protection of the natural environment is the most important task of the state, so we think that the nature of Georgia, characterized by Vakhushti Bagrationi about 300 years ago, with all its constituent components, including the climate, is essential.

In the Vakhushti era, instrumental observation of the climate was virtually impossible, these processes did not even take place in Europe, and began in Georgia in 1844. Although he did not have the technical equipment for climate monitoring, he still managed to characterize the Georgian climate to the maximum accuracy.
The basis of characterization was the sensory method,



that is, through sensations and personal impressions. As a result, Vakhushti Bagrationi, who was in Russia in 1745, was able to make a complex description of the Georgian climate on the basis of factual materials and personal observations of the Georgian climate, which was reflected in his work - "Description of the Kingdom of Georgia". The terminology used by Vakhushti in characterizing the Georgian climate is interesting: "Unbearable"; "Kind"; "Pretty"; "Beautiful"; "Hot"; "Funny"; "Cool"; "Rainy"; "Snowy".

There are reasoned grounds that allow us to consider Vakhushti Bagrationi as the founder of climatological study in Georgia. He was the first to give us a holistic description of Georgia's diverse climate, which formed the basis of the country's regional climatology and has brought its scientific development to the present day.

VAKHUSHTI BATONISHVILI
1694-1776 YY.

CLIMATE CHANGE

Climate change is the average variability of weather over time and in different regions of the earth, accompanied by changes in average temperatures, winds and precipitation.

The most powerful greenhouse gases are: water vapor, carbon dioxide, methane and ozone. The gases listed above capture solar energy and retain heat. The more greenhouse gases in the atmosphere, the longer the Earth retains heat, although the increase in the concentration of these gases has become the cause of global warming and climate change.

Although the climate has changed throughout the history of mankind, it has been a consistent and dynamic process.



Uncontrolled human impact on the environment has contributed to a number of dangerous and irreversible processes that have accelerated the process of climate change on Earth.

The result was the activation of global warming, which brought many negative consequences. As a result of global warming, the world's ice reserves, which account for 70% of drinking water supplies, are melting at an unprecedented rate, which in turn reduces the population's access to drinking water and, consequently, significantly reduces the share of land surface.

Georgia, with its location, terrain, hydrographic network and environmental conditions, contains both natural (earthquakes, landslides, mudflows, droughts, avalanches and floods) and anthropogenic catastrophes (transport and industrial accidents). Added to this is the high anthropogenic pressure on natural resources, which creates favorable conditions for provoking disasters.

The causes of the increasing number of natural disasters in recent years must also be sought in global climate change. Studies show that climate change is already taking place in the South Caucasus and that it will play a negative role in terms of environmental security. According to the forecasts, as a result of climate change, the average temperature increase in Georgia by 2050 is expected to be 0.9-1.9^{0}C, and by 2100 - 4.1-, 5^{0}C. At the same time, it is expected that the frequency and amount of heat waves will increase, precipitation will change, desertification and further degradation of land resources, sea level rise and other extreme events will increase, which creates the need for urgent measures to adapt to climate change. It also identifies the areas most vulnerable to climate change: The Black Sea coastline - sea levels are rising and the frequency and strength of storm surges are increasing. In the vicinity of Poti, this is compounded by the problems caused by the Rioni River overflow; Kvemo Svaneti, Lentekhi - intensification of soil erosion and increase of natural disasters (mudflows, landslides, avalanches, heavy snow, floods); And Dedoplistskaro, Alazani basin – where the process of desertification is underway.

According to the National Environment Agency, the frequency and scale of catastrophes have increased dramatically in recent years. Disasters in 1995-2008 cost Georgia more than $ 1.3 billion. The disaster affected about 700 thousand people, and the number of victims reached 1000. The increase in the frequency of landslides and avalanches in recent years is due to increased seismic activity, anthropogenic human impacts (unsystematic development of settlements and land, construction of transport facilities and deforestation), and global climate change. The most common natural disasters of geological nature are water erosion processes, landslide-gravity and mudflow events, the number of which is increasing.

In 2009, there were 53 thousand areas affected by landslide-gravitational events or were under threat of activation, which occupies two thousand settlements and 25-30% of the transport infrastructure. The economic damage caused by mudflows is up to $ 100 million a year, not to mention human casualties.

The coastal zone is the most vulnerable system to climate change in Georgia. Its leaching, which began as early as the 1980s, posed problems for the Gagra, Akhali Atoni, Ochamchire, Anaklia, Poti, Kobuleti and Adlia sections, where sediment was artificially stored until 1992 to form the coast. Particularly sensitive are the Rioni and Chorokhi river deltas, where anthropogenic impacts combine with sea level rise and climate change. For example, in 2005-2007, the sea seized the Adlia domestic highway and posed a direct threat to the runway of Batumi Airport.



In February 2007, the Dutch Environmental Impact Assessment Commission issued a recommendation for the placement of material extracted from the Chorokhi River on the eroded coastal area, as well as for an environmental assessment, preliminary studies and a sustainable long-term restoration plan for the coastline.

The commissioning of hydropower plants planned for the territory of Turkey for 2015-2018 will reduce the transportation of sediment in the Black Sea by the river Chorokhi by 83%. Construction of hydroelectric power plants on the river Chorokhi and the river Adjaristskali is also planned in Georgia. In case of planned construction of hydropower plants on the territory of Georgia, practically no more sediment will be deposited in the Black Sea, which will further increase the impact on the Black Sea coast.

The water level near Poti rose by 0.7 m from 1925 to 2009. This poses a threat to Poti, which is located 1.5-2 m below the level of the Rioni River. As a result of storms and anthropogenic intervention from the 1920s to the present, the sea has taken over a 3.5 km wide coastline, much of which has been occupied by hippodromes, houses and farmland. It is predicted that in the near future (2030-2050) the expected increase in storms and an increase of sea level by another 0.2-0.3 m, storm surges will have catastrophic consequences.

At the same site, there is a sharp increase in sedimentation (the Rioni River is fed by glacial runoff), which has intensified the flow of both riverbeds (Poti canal, Nabada), which has further weakened their permeability. The debris brought by the Rioni River is mainly deposited on the north coast and dug into the land by the sea, while the sea south of Poti has already covered an area of about 600 ha.

Georgia's Second National Communication to the Framework Convention on climate change emphasizes that the duration and intensity of droughts in eastern Georgia will increase, and so will the demand for water. At the same time, except for western Georgia, throughout the South Caucasus, at least a 10-40% decrease in the flow of major rivers is expected. Declining water resources may also increase the risk of both intra-state and interstate conflicts. This is especially true of transboundary rivers such as the Alazani, Khrami-Debeda and Mtkvari. According to the forecast, the water level in Alazani is expected to decrease by at least 26-35%, and in Khrami-Debeda - by 45-65%.

It is noteworthy that in Dedoplistskaro district, as a result of wind erosion, the humus content decreased from 7.5 to 3.2% between 1986 and 2006, soil fertility fell almost twice, and the average annual temperature increased by 0.6^{0}C, which in turn significantly increased use of irrigation water.

According to the forecast, a significant reduction in rainfall in the region, in the near future, will increase the uncertainty of the local climate and turn the semi-arid landscapes here into semi-deserts and deserts. Accordingly, by 2100, the demand for irrigation in Dedoplistskaro district will increase by 114% for winter wheat, 82% for pasture and 50% for sunflower.

At the beginning of 2015, the Strategy for Agricultural Development of Georgia for 2015-2020 was approved, which defines the strategic vision for the development of agriculture in Georgia, based on the principles of sustainable development. This document contains a chapter on climate change, which is a major step forward in the integration strategy of the sectors of the economy.

DISASTERS CAUSED BY NATURAL HAZARDS

FLOODS

A flood is a significant inclusion of an area into a river, lake, or sea as a result of rising water levels caused by abundant water runoff, snowmelt, torrential rains or water receding from winds, river disturbance, and other events. Land can be flooded by rivers or the sea, hence the separation of river and sea floods. Floods threaten three-quarters of the earth. Floods kill thousands of people, and the material damage caused by it is more significant than other disasters. Namely: destroyed settlements, drowned cattle, eroded and devastated lands, various kinds of disease and famine.

River Floods

People often confuse the river bed with the river valley. The riverbed is the natural ravine of a river in which water flows for most of the year. The river valley includes its bed and a wide floodplain. A floodplain is a part of a valley that is flooded or swamped by a river. When the bed is several tens or hundreds of meters wide, the width of the valley reaches tens of kilometers. The water level in the riverbed varies according to the season of the year and the weather. Periodically rivers overflow their banks and flood wetlands, which is called floodwaters.

When the water level in a flooded area reaches 1 meter and the water flow velocity exceeds 1 m/s, people are in danger. Rising water to a height of 3 meters is already causing the demolition of houses. During floods, the water flow velocity reaches 5 m/s. The flow velocity near the headwaters of the rivers is much higher. After the water level drops, the water in the swamps leaves everything it has brought.

The prediction of floods is based on the statistical processing of materials in catchments or large areas. Annual, ten-year and hundred-year floods are reported. Forecasts take into account the amount of precipitation, snowmelt, vegetation, morphological and geological factors. There is also an empirical prediction when using formulas to calculate maximum water levels and water consumption[1].

There are immediate and preventive measures against floods. The second of these is carried out by state-owned organizations, as it provides for the planning of settlements, compliance with land use rules, long-term measures. For example - forest planting on

1. All important factors are used in the formula of hydrogeologist Rostomov: Qm = 16.67 CBSARR where Qm is the maximum flow of water; C- water flow coefficient; B- coefficient of distribution of atmospheric precipitation; S-basin shape coefficient; A- basin area; R- Precipitation; R-duration of precipitation.

the slopes, arrangement of dams 3-10 meters high, regulation of the riverbed, its expansion and/or deepening, arrangement of canals through which the water of the wells is removed. Arrangement of reservoirs and dams. The system of such buildings practically eliminates the danger of flooding.

In the past, heavy floods on the rivers of Georgia have not been uncommon, but there is little information about them in historical sources. The reason for this is that humans did not have access to low-lying areas along the river that were flooded during severe floods and flash floods. Only those floods that ended in catastrophic consequences where described.

According to the information preserved in the collection of old Georgian historical works "Life of Kartli", the flood that fell on the river Tskhenistskali in 735 killed thousands of Murvan Kru's warriors camped on its shore to spend the night. According to another record preserved in the same collection, in the fourteenth century, a torrential downpour flooded the Ksani River, the boundary of the Largvis Church, and the bell tower. Information about other catastrophic floods in "Kartlis Tskhovreba" has not been preserved.

Photo N1 River Tskhenistskali

Photo N2 River Ksani

According to the natural floods, the rivers of the southern slope of the Caucasus are characterized by summer floods, the rivers of Meskheti and Likha ridges are characterized by spring-summer floods, the rivers of the Kolkheti lowland are flooded all year round, the lowlands of eastern Georgia and the highlands of southern Georgia have spring-summer floods.

Floods are typical for almost all rivers in Georgia. The following rivers of Georgia are especially dangerous and at high risk: Enguri, Rioni, Chorokhi, Kvirila, Liakhvi, Aragvi, the left bank of the Alazani, as well as the areas around the Mtkvari. Water flows rapidly in their bed. Water also rises rapidly as they originate in high mountains where it rains and snows frequently, while snow melts rapidly from the heat of spring.

Prior to 1995, the average recurrence of intense floods was observed once in 5-6 years. In 1995-2013, this figure increased almost 2 times (once in 2-3 years).

The floods have severely damaged people's agricultural activities and infrastructure, as well as causing human casualties, destruction, road closures, traffic disruptions, power transmission towers and gas pipelines, and more.

In the XX century there were strong floods within the borders of the Tbilisi basin both on the Mtkvari and its tributaries. For example, the Mtkvari flood in April 1982, when it crossed dams in Tbilisi, flooded basements, the coast, crossed the Ortachala bridge, then killed several people. In the Tsavkisistskali gorge of the right tributary of the Mtkvari, torrential rains on June 22, 1903 and October 5, 1955 destroyed the central part of Abanotubani. All the baths were filled with rubble, there were human casualties.

It can also be mentioned that there was a strong flood on the river Gldaniskhevi on June 22, 2010. The flood destroyed the bridge and killed several people.

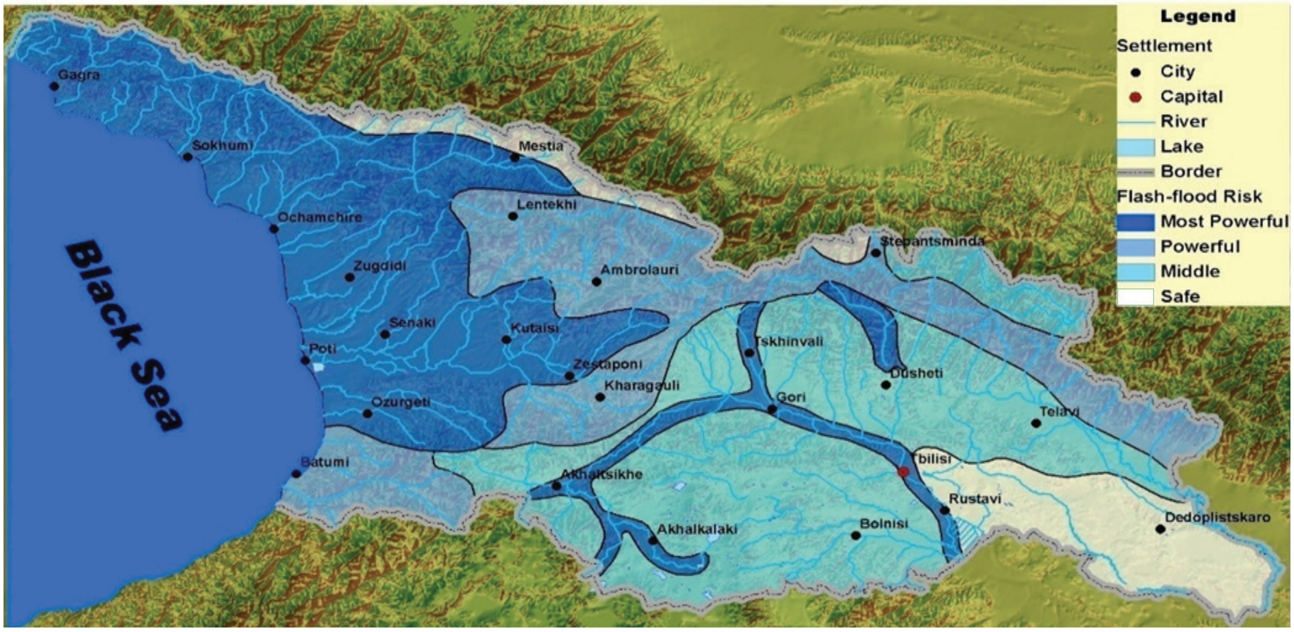
As it is known, the natural environment of cities is experiencing technogenic load as a result of urbanization. For example, in the difficult geological environment in Tbilisi, the development of negative natural-man-made processes began and brought its geo-ecological state to a crisis state. The onset of adverse geological events and geo-ecological complications on the territory of Tbilisi reached a critical point after the 2002 earthquake.

The coincidence of the mentioned factors, as well as the heavy rainfall in the Vere River basin on June 13-14, 2015 (according to the Tbilisi Meteorological Station, 49 mm of rainfall was observed in 3-4 hours) led to the loss of human life (19 people were killed), damage and destruction of city infrastructure facilities (Tskneti-Betania, Tskneti-Akhaldaba and Kojori-Manglisi roads were damaged, as well as the road connecting Tamarashvili Street and Heroes' Square in Tbilisi, dwellings located on the lower reaches of the gorge, various infrastructure facilities, buildings, Tbilisi Zoo and the children's city "Mziuri").

Catastrophic floods on the Vere River have occurred many times in the past. First recorded on June 12, 1924 (the newspaper „Communist", June 14). As a result of torrential rains that started at 8 pm on June 12 and lasted for about 1 hour, the torrent that fell on the Vere River at the junction with Mtkvari pulled in the workers camped overnight in the river and drowned them. It is noteworthy that at this time no strong flooding was observed on other tributaries of the Mtkvari River within the borders of the Tbilisi basin. The strongest floods on the Vere River also occurred in 1962, causing extensive damage to the Tbilisi Zoo and on July 5, 1982.

Map N1

Distribution of flood risks on Georgian rivers



Source: National Environment Agency

Sea Floods

When the sea floods the coast or coastal areas, there is talk of a sea flood. The astronomical rotation and reversal of the seas is related to the movement of the moon and the sun. When their attraction coincides, then there is a tide, what is called a tidal wave. Such events are not a catastrophe, all seaside settlements are built with the tide in mind. Sea tides increase more under the influence of winds, the winds generate waves on the sea surface. When the wind blows from the sea to the land, the sea waves rise and flood the coastal areas. If a hurricane or cyclone falls, the height of the sea waves will increase even more.

Sea tide is considered stormy when the normal sea level rises by less than 1 meter. Storm rotation can occur during normal astronomical reversal, as well as even when there is neither a low nor a high tide. Storm tides arise from winds and have nothing to do with astronomical tides. Storms and tsunamis are considered catastrophic events.

Storm tides take the lives of many people. According to UNESCO, 1 million people have died as a result of storm high tides in the historical period. The absolute height of many seaside areas is negligible, and in some places is lower than sea level. For example the Netherlands, the northern part of Germany, much of Southeast Asia, the Atlantic coast of the Americas, the eastern shores of the Caspian Sea. Marine floods and storms on the Black Sea coast of Georgia occur in Adjara, Poti and Samegrelo.

LANDSLIDE

A landslide is the movement of mountain layers down a slope of mountain rock masses under the influence of gravity. It arises as a result of slope washing, damping, earthquakes. Landslides can move slowly (tens of centimeters per year), its danger is manifested in the fact that it can gradually move to rapid movement, which can lead to further catastrophe. Medium speed landslides (one meter per day) are the majority of typical landslides. Fast landslides (tens of kilometers per hour) can lead to a catastrophic loss for hundreds of people, as people are unable to escape.

Landslides can consist of cliffside rocks, soil layers, a mixture of clay, stones, and ice. A landslide of snow mass is called an avalanche, and a landslide of fallen stones is called a collapse. According to the movement, landslides are classified into 3 types:

1. Dropped;	2. Protected;	3. Spilt.

The soil at the foot of the slope traps the entire slope mass, removing the soil from this root causes soil instability and landslide. Many landslides are caused by human activity: paving roads, building houses on slopes, building reservoirs and dams, laying pipelines and cables, constructing drainage and other engineering structures related to the movement of large amounts of soil, and when large masses of land are added to or removed from the base of the slope. In such a case, the need for rapid demolition of this slope increases. When a dam is built between the slopes, the slopes on the sides of the valley collapse, causing the land to be flooded with water. The reservoir and the lake also violate the regime of precipitation, water absorption and discharge.

Landslides can destroy homes and endanger populated areas, agriculture, communications, tunnels, reservoirs, overgrow valleys, create temporary lakes, contribute to floods and cause other damage.

More than 52 thousand landslide bodies have been mapped in Georgia, the total area of which exceeds 1.5 million hectares. Up to 70% of fixed landslides are developed in urbanized areas, agricultural lands and engineering facilities. Up to 2,000 settlements in our country with a population of more than 200,000 are located in the area of immediate danger of landslides. Landslide processes have put 25% of large reservoir shores and up to 30% of highways at high risk of accidents. Even in the background of landslide-gravitational activity, the damage to the country's economy is estimated at several hundred million dollars, including to the agricultural sector - in the range of 45-50 million dollars.

Landslide-gravitational events in Georgia are manifested in all landscape-morphological zones of the country. The main factors that contribute to the emergence and activation of these processes are: deep segregation of relief and the predominance of strongly sloping surfaces; Complex geological structure and the spread of rocks with low physical properties in large areas of the active energy metabolism zone of the geological environment; High tectonic cracking and seismic activity; Spatial-zonal changes of climatic conditions and contrasting of meteorological elements.

Recently, the activation of these processes is highly dependent on human training activities; This is clearly evidenced by the operative findings of the State Department of Geology on landslides and other agricultural facilities destroyed and severely damaged by landslides in 1981-1998.

Photo N5 Landslide in Racha

Photo N6 Landslide in the village of Nabeghlavi, Chokhatauri municipality

Almost all types and types of landslides known in engineering geodynamics are developed on the territory of Georgia - starting with the simplest, the impact of which does not exceed the aeration zone, ending with landslide bodies with a depth of tens of meters and several climbing planes. The area of individual landslides also varies in a large range - from one hectare to hundreds of hectares (Somitso landslide - 550 ha, Zazhkvi landslide - 1500 ha, Sioni - 600 ha, Esher - 1000 ha, etc.) and volumes - from several thousand m^3 to tens and hundreds of millions of m^3 (Eg: Adjara - Varjanuli landslide, 30 million m^3, Danisparauli landslide - 90 million m^3; Oni district - Chordi landslide, 150 million m^3, Zazhkvi landslide - 200 million m^3; Kvareli district - Chelti, Duruji, Avaniskhevi landslides - 150- 450 million m^3, etc.).

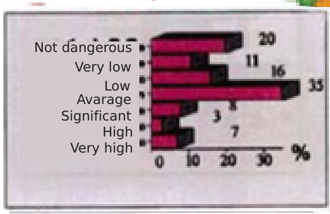
Map N2

Map of Georgian territories and regions according to the risk of landslide damage and dange

Conditional signs

Region sign	Regions according to landslide risk	Risk Category of hazards
	Very high	0.5-0.7
	High	0.7-0.5
	Significant	0.5-0.3
	Average	0.3-0.1
	Low	0.1-0.01
	Very low	<0.01
	Not dangerous	

Structure of tension by landslide processes in the territory of Georgia



Adjara, Guria, Imereti, Racha mountainous regions are distinguished by strong intensity of landslide processes and development of higher risk.

Intensive development of landslide processes is characterized by regions where the occurrence-activation of these events is associated with the regime distribution of atmospheric precipitation and the high sensitivity of the layers forming the slopes. This type of landslide is called climatogenic, or consistent.

A single cycle of landslide activation, quenching or temporary stabilization is defined as an average range of 3-8 years. Landslide activation has been reported 28 times in Georgia during the last 100 years. However, recently this pattern has been significantly violated and the activation of landslide processes are noted in a number of regions almost every year, above the normal background.

Mainly, rock-cut landslides are almost entirely related to regional and local tectonic disturbances, rainfall distribution areas, and coastal wash zones.

Coastal-based landslides occur in the washing zones of large rivers, the Black Sea, and reservoirs. Landslides are widespread in the valleys of the Rioni River, the Tskhenistskali River and the Kodori River, as well as in the Black Sea coastal zone of Abkhazia (Muser, Eshera-Akhalai Athoni districts). Landslides are accompanied not only by the destruction of fertile land, but also by the destruction of roads, oil and gas pipelines, and sometimes the demolition of houses, a classic example ("Rionhes" settlement).

Large volumes of landslide-gravitational events (from 8-50 million m^3 to 150-450 million m^3) often lead to catastrophic consequences. Dozens of such catastrophes are known in the recent history of nature development of Georgia, including 1891 and 1996.

The villages of Azanta (Gulrifshi district) and the village of Kvedi (Oni district) are buried under 180 and 150 million m³ rock formations. Landslide-induced disasters (except for Tsablani and Khakhieti) in the last 20 years were observed in 1899 in the village of Ghvedi, as a result of which the Tskhenistskali River valley was blocked by a 50 m high dam in the Rioni River valley in Kldisubani 1977 (30 million m³), (19 million m³), in the Kelasuri river basin in 1978, (8 million m³), Laskadur in 1975 (20 million m³) and many more.

Considering the scale and intensity of the development of landslide-gravitational processes, we have divided the territory of Georgia into 7 conditional regions:

1. The Black Sea coast of Abkhazia, the areas with tertiary precipitation of Upper Imereti and Racha-Lechkhumi with landslide processes with a particularly **high coefficient of damage (0.7 - 0.9)** and a very high potential for landslide risk;

2. Adjara, Guria foothills, the middle of the Psou River basin, the Okribi and Gombori ridges with a **high landslide damage ratio (0.5 - 0.7)** and a high risk of process development;

3. **Significantly damaged by landslides (coefficient 0.3-0.5)** and with great opportunities for development of processes: northern slopes of Trialeti ridge, upstream of Mtkvari river in Akhaltsikhe depression, Potskhovi gorge, hilly zone north of Kolkheti, Iagluja ridge and Southern slope foothills (between the river Ior and the river Aragvi);

4. **The average landslide damage (coefficient 01, - 0,3)** and the probability of noticeable development of the processes include the part of the high and medium mountainous landscape of the southern slope of the Caucasus, built of Jurassic clays and Cretaceous-Paleocene flysch, the upper zone of Trialeti ridge (part of Mtkvari river To the Tbilisi Meridian), the northern and western foothills of the Kartli Depression and the foothills of the Gombori Range;

5. With **low landslide damage coefficient (0.01 - 0.1)** and significant risk of rockfall formation. Includes the distribution zones of volcanic and carbonate formations of the southern slope fold system of the Caucasus, the hilly part of the Iori zone, the high terraces of the Mtkvari River, the Khrami and Loki massifs and the surrounding areas;

6. **With very low landslide damage coefficient (0.01)** and great limitation of their possible development, significant distribution and development of rockfalls, include the zone formed by the crystalline formation of Kavaksion, Javakheti volcanic mountains, Khrami, Loki and Kelasuri massifs, Algeti, Ktsia rivers downstream;

7. Landslides are practically not found in the Kolkheti lowlands, Shida Kartli and Gardabani plains.

Tsablana Tragedy

On April 19, 1989, in the village of Tsablana in the Khulo district of Adjara, a mountain slope collapsed and a landslide killed 23 people, including 3 small children. Landslides were preceded by heavy rains, and tragic events took place late at night when the population was asleep and had the least chance of survival. The disaster, which erupted 10 days after the April 19 tragedy, plunged the population surviving the natural disaster into a very dire situation. The current authorities immediately evacuated the villagers and placed them in holiday homes in Batumi and Mtsvane Kontskhi. During the landslide processes, about 800,000 cubic meters of inert mass slid and an artificial lake was created as a result of the flooding of the Skhalta River. Two years later, the river again cut through the valley and returned to the old riverbed.

MUDFLOWS

Mudflow is a complex geological-geomorphological and hydrometeorological phenomenon. High-concentration groundwater flow in a river or tributary bed, which is manifested by strong landscape divisions, strong slopes and bedrock, intensive development of denudation and erosion processes, intense snowmelt, strong flooding of natural or man-made dams..

Large volumes of debris generated by intense physical depletion in flood-prone areas will turn into mud, sediment, and watercourses under conditions of water saturation and liquefaction, which are distinguished from conventional floods by higher flow rates, higher velocities, high flow rates, and high runoff volumes. Such streams have destructive power, which endangers populated areas, destroys or severely damages various buildings, industrial or agricultural facilities, various communications, causing human casualties.

By the end of the XX century, there were 2750 mudflow-transformable river basins in Georgia. 2 million hectares of the entire territory of the country were found in the mudflow danger zone; Mudflow processes threaten railways (300 km) and highways (1500 km); The action of these flows periodically disables irrigation facilities, agricultural lands. It poses a great danger to cities and towns - Tbilisi, Telavi, Kvareli, Lagodekhi, Sagarejo, Borjomi, Lentekhi, Oni, Tsageri, Mestia, Akhaltsikhe, Adigeni, Mtskheta and hundreds of rural settlements.

Annual mudflow damage to the country is estimated at an average of $ 100-120 million. In the case of their extreme manifestations, which are observed at intervals of 1-3, 3-5 and 8-11 years, the loss is estimated at hundreds of millions of dollars; For example: in 1977, mudflows in Telaviskhevi and the upper Tskhenistskali basin alone caused $ 130 million in damage; In 1982-1998, in mountainous Adjara - exceeded 500 million dollars. In total, the damage to the country during the period of extreme development of mudflows in Georgia in 1987-1991 exceeds one billion dollars.

Picture N7 Flood on Rikoti Pass

The chronicle of the consequences of catastrophic mudflows is fragmentarily preserved, although the available information also gives an idea of how dangerous this natural disaster is for the country and how much preparedness is needed to manage this event.

During the last two centuries, up to 800 extreme manifestations of the mudflow nature of Georgia have been observed in the river basins; Of these, catastrophic results have been reported in 42 cases; Hundreds of people were killed.

For example, in 1776, 1832, and 1909 in the valley of the river Tergi, earthquakes of a glacial nature transported through the lowlands of the valley tore apart settlements and claimed the lives of several hundred people.

A classic example of a mudslide in Georgia is the Duruji River, which joins the Alazani near the town of Kvareli and constantly poses a great threat to the town. Over the last 100 years, mudflows in the Duruji River valley have killed more than 150 people and caused colossal damage to the population of the city of Kvareli.

More than 210 people have died in the Tskhenistskali and Rioni river basins since 1921, and mudflow transformations in the Adjaristskali river basin have killed up to 120 people between 1910 and 1998. In 1976, a sudden mudflow on the Gori-Tskhinvali road killed 8 people working on the road, and a catastrophic mudflow in the Joekwara River Valley tore through a significant part of Gagra, killing 15 people. In the valley of the river Aragvi from 1897 to the present, up to 140 catastrophic mudflows have been observed on the 10 km section of Pasanaur-Mleta. On June 2-3, 1987, a mudflow caused a mass of 1 million m^3 of gravel, blocked a 1 km long military road, divided 5 important villages and killed 4 people.

Photo N8 Flood in Abkhazia

Photo N9 Flood in Dariali gorge

The intensity of development of mudflows in space and frequency increases from northwest to southeast. This is due to the reduction of the precipitation coefficient, the increase in climate continence and aridization, the narrowing of the mountain-forest belt and the gradual reduction of vegetation, and, most importantly, the replacement of high-density layers with less sustainable layers.

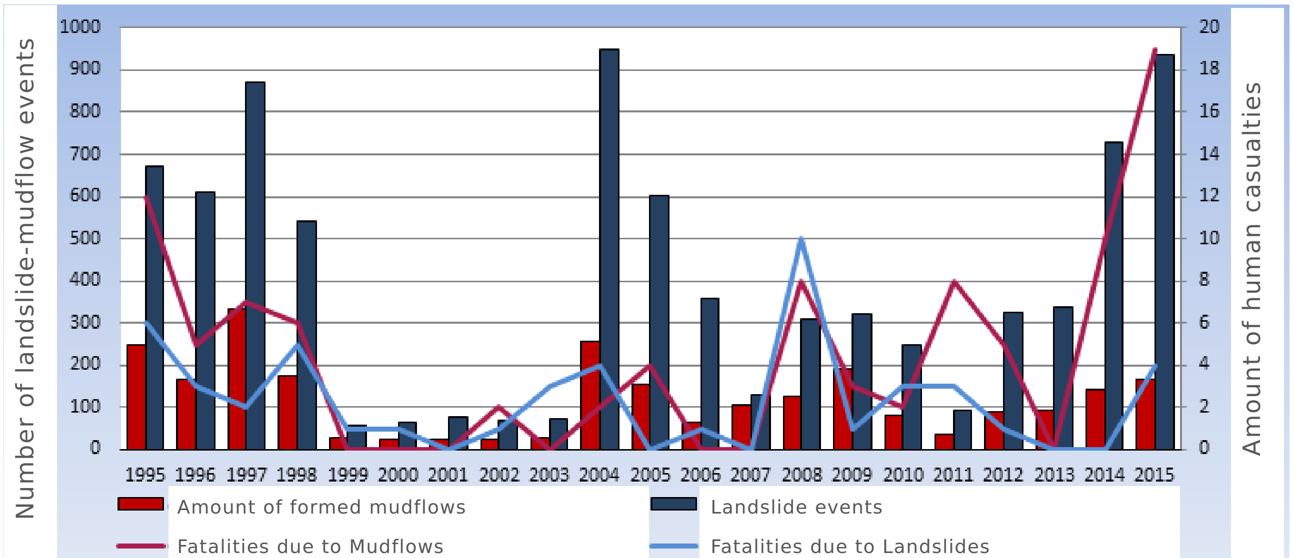
Mudflows caused by heavy rains (65-85%) are prevalent in Georgia and almost every one of them is accompanied by significant floods. As the intensity of precipitation increases, the probability of their occurrence also increases. It has been observed that in case of rainfall in the range of 80-120 mm per day, mudflows occur in all landscape-geomorphological zones; When the daily precipitation reaches 50-80 mm, torrential flows are recorded in geologically “sensitive” river basins, and during 30-50 mm of precipitation, the transformation of torrents takes place only in pre-prepared lightly sloping sediments. This type of mudflow is mostly typical for Tbilisi-bound hills as well.

Photo N10 Flood on the river Nenskra, Svaneti

During the earthquakes of Spitak in 1988, Racha-Imereti in 1991-1992, Pasanaur-Barisakho and the following years, such a large amount of gravitational material accumulated in the mountain river basins of the Georgian mudflows that in the next 10-15 years, we should expect mudflows every year, even with a slight increase from the average perennial norm of atmospheric precipitation, this is facilitated by the high technogenic load on the environment, which has become chronic.

Photo N11 Spitak earthquake

Diagram N1 Number of mudflow events and human casualties 1995-2015



According to the degree of damage by mudflow processes on the territory of Georgia, the risk of activation, the danger to the population and agricultural facilities, several areas are distinguished:

1. **Very high danger zone (damage coefficient 0.9),** includes a strip of loose conglomerates and clay layers of the middle and foothill tertiary area of eastern Georgia; Stone-mud streams form in almost all erosive ravines, recurring several times each year and sometimes even in season;

2. **The high-risk area (coefficient 0.6-0.8)** includes the area of distribution of the Caucasus Middle and Highland Jurassic slates and terrigenous-carbonate flysch, as well as mountainous Adjara, where mudflows with catastrophic consequences are repeated on average once every 3-5 years. The volume of extracted material can reach 7-10 million m^3;

3. The area of significant intensity of **mudflows (coefficient 0.5-0.6)**, includes the ridges of Trialeti and Meskheti, parts of the Kodir and Bzipi river basins built of Jurassic clays; High-risk mudflows recur on average once every 3-5 years. The volume of extracted material ranges from several thousand m^3 to 1 million. Up to m^3;

4. Areas at significant risk of **mudflows (ratio 0.3-0.6)** include the upper Iori and Alazani basins, Algeti and Tbilisi, rivers: Rioni, Tskhenistskali, Enguri and Kodori basins, Kvirila river headwaters, Ghali , Okumi and Gumist basins. Significant mudflows occur on average once every 3–10 years, and small-volume streams may develop annually;

5. Areas of moderate risk of **mudflows (ratio 0.1-0.3)**, include Dziruli, Khrami and Loki massifs, Guria and Imereti foothills, Joekwara, Sandrifshi, Psou and Tamish basins; Repeatability of mudflows on average once every 3-7 years. The single volume of the extracted material varies from a few hundred to 5-10 thousand m^3.

6. Areas of weak development of **mudflows (coefficient 0.01-0.1)**, include the hilly zone of the Greater and Lesser Caucasus foothills. Parts of Arabik, Askha and Racha ridges built of carbonate rocks, Okriba and Javakheti volcanic mountains. The single discharge of mudflows mainly vary from 0.2 - 2 thousand to 5 - 15 thousand m^3;

7. The area of limited **mudflow distribution (coefficient> 0.01)** includes the part of the Iori upstream and the lower reaches of the Mtkvari River within Georgia.

River Duruji

The river Duruji destroyed Kvareli for the first time in 1832. The next tragedy unfolded in 1904 when a river swept through the city and carried out children with cradles from their homes. In 1906, under the leadership of Ilia Chavchavadze, protective dams were built, which protected the city until 1949.

There have been about 40 catastrophic mudflows in the Duruji River basin in the last 100 years, which have claimed the lives of more than 200 people. It is estimated that the area of constantly renewable floodplain in the Duruji River basin is 20 km^2, where the volume of floodplain solid mass reaches 500 million m^3. Specialists estimate that catastrophic mudflows occur in the upper reaches of the Duruji River at 12-14 year intervals. These streams full of large rock formations, moving at speeds of 80-100 km / h and 20-25 m high front, easily overcome and break down any obstacle due to their high mass.

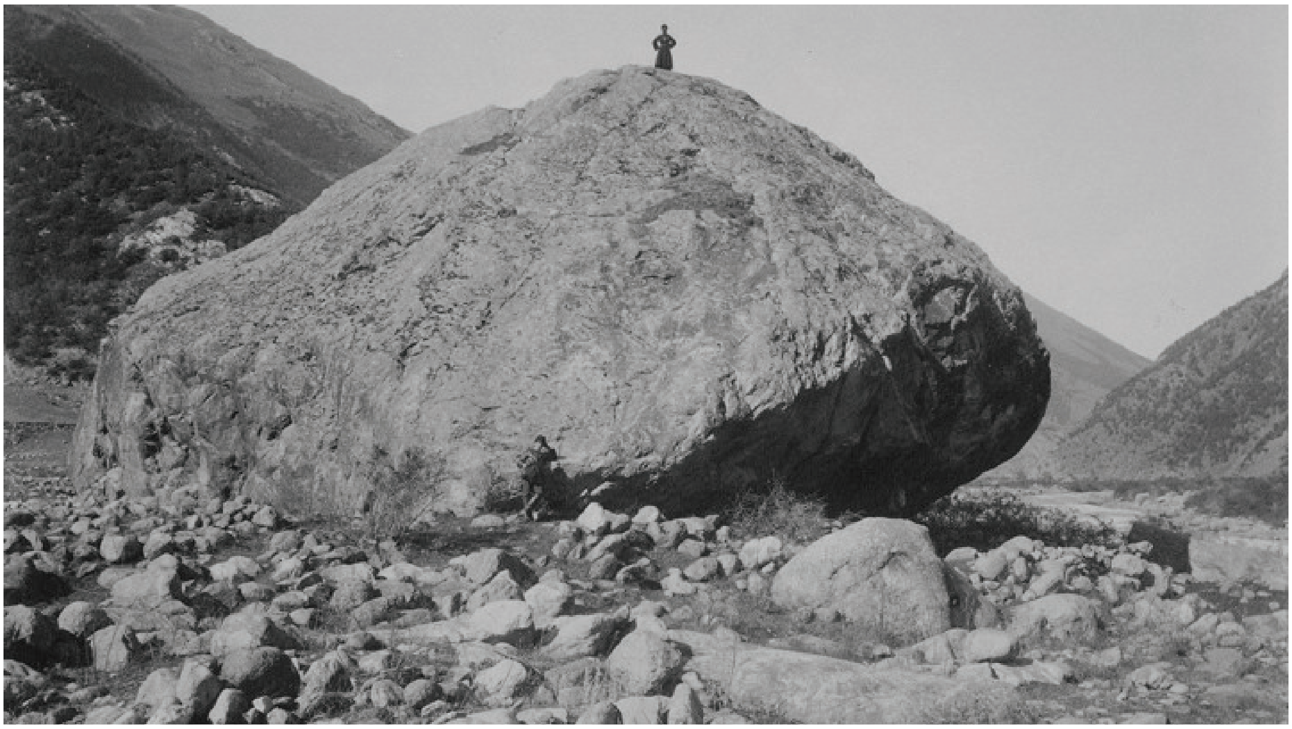
In 1889, a torrential downpour brought 140 tons of boulders from the headwaters of the Duruji River to Kvareli, which is considered a unique event and is recorded in the Red Book of Georgia. This "big stone" is today one of the natural sights of Kvareli, located north of Kvareli, in the area of the so-called barracks, on the left bank of the river Duruji.

It is known that if not for the mudflow discharge of the river Duruji, there would be no wine "Kindzmarauli" in Georgia. This colloidal sediment is characterized by such a unique composition that creates a specific environment for the vines grown near the river. The soil characteristics of the area of the mentioned micro-zone, according to the conducted researches, allow the Saperavi vine variety to be used for the production of wine "Kindzmarauli".

Photo N12 river Duruji

Photo N13 140 ton stone

Ermelov Stone



This natural wonder, also known as the “Traveler Stone”, was considered a strategic location in the Dariali Valley.

The next awakening of the Devdora Glacier on August 20, 1832, reminded us once again of its destructive power and scale.

A two-kilometer-long icy avalanche formed a 100-meter-high ridge of ice and stone boulders. Blockage flooded the river Tergi and stopped it for several hours. Later the water height reached 80-90 meters, broke the ice dam and took the path in the direction of the valley. The glacial flood, which caused great casualties, significantly damaged the city of Vladikavkaz, Georgia’s military road, settlements, there were also human casualties and traffic in the Dariali gorge was suspended for two years.

The huge stone depicted in the photo was found in the valley of the river Tergi, near Zemo Lars, as a result of the catastrophe of Devdorak in 1832. Giant granite boulder is 30 meters long, 17 meters wide and 15 meters high; Its volume is up to 7000 cubic meters, and its mass is about 16,000 tons.

The name of the stone is associated with the name of the famous Commander-in-Chief of the Russian Empire, General Alexei Ermolov, who commanded the Caucasus Military Corps to strengthen the positions of the Russian Empire.

This natural wonder, also known as the “Traveler Stone”, was considered a strategic location in the Dariali Valley. The granite monolith has no analogue in size in all of Europe[2].

2. https://nationalgeographic.ge/story/ermolovis-qva/

SNOW AVALANCHE

A snow avalanche is a mass of snow falling from the slopes, which is similar to a landslide. The fall of an avalanche is accompanied by the emergence of a pre-avalanche air wave, which brings more destruction and damage. An avalanche is formed by a mixture of snow crystals and air. A large-scale avalanche is a disaster, it can kill hundreds of people.

In terms of mechanics, an avalanche arises just like a landslide. The forces of snow grip exceed a certain limit and gravity causes the snow masses to move on the mountain slope. Snow changes its properties after falling, ie. undergoes metamorphosis. As the snow crystals increase, the pores of the snow mass decrease. Changing the crystallization from the snow surface to a certain depth can create a protective surface on which the snow layer floats. Violation of the snow layer in such places leads to the emergence of snow avalanches.

There are two types of snow avalanches: **dust avalanches and layered avalanches.** A dusty avalanche arises from a formless mixture of snow dust. Layered avalanches, like landslides, run along the break zone and float in layers. Layered avalanches are faster. The speed of an avalanche with a lot of air reaches 120-360 km/h, and the speed of an aggravated one is 50-70 km/h. The speed of the layered avalanche is 25-36 km/h.

Snow avalanches are classified as large, medium and small. Large avalanches destroy everything in their path - houses, trees, etc. Medium is dangerous only for humans, while small avalanches are practically no danger.

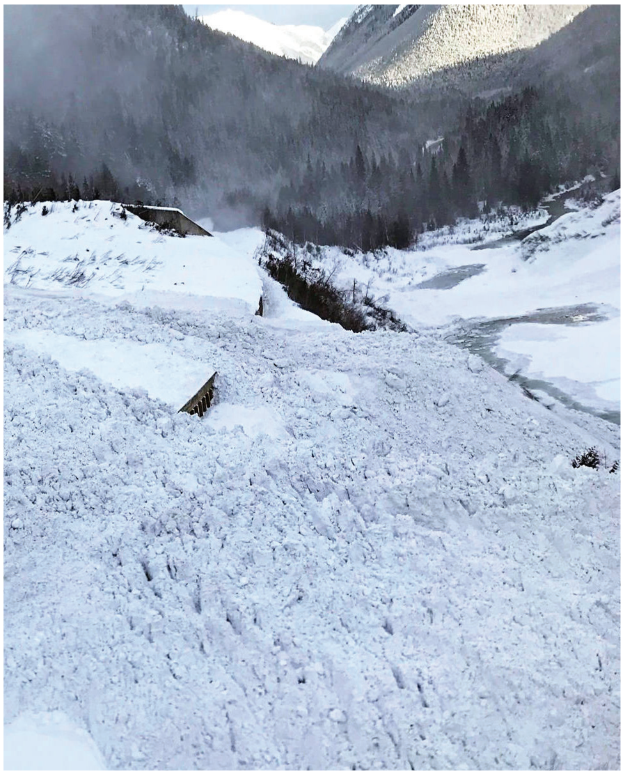
A large part of the territory of Georgia is occupied by high mountains, passes and steep slopes. That is why snow avalanches are frequent in winter. Especially the Jvari, Roki and Surami passages. It is true that road tunnels, snow avalanche retaining walls and other structures are built on these crossings, but due to their lack of infrastructure, traffic is stopped for a while during heavy snowfall until the roads are cleared of collapsed avalanches.

Road accidents are frequent in the valleys of the rivers Tergi, Aragvi and Dzirula. For example, in the winter of 1999, a bus traveling from the village of Kobi in the Kazbegi district to Vladikavkaz was hit by an avalanche, and the bus plunged into the Tergi River, killing 42 people. In January 2000, an avalanche fell in front of a bus heading to Tskhinvali from the Roki tunnel. The driver stopped the bus and went to get the tractor, but the returning driver was no longer met by the bus on the road as a new snow avalanche struck the bus on the road and crashed into a rock 80 meters deep, killing 28 passengers.

Preventive measures play a key role in protecting against both landslides and avalanches. Guessing avalanche-prone slopes is not difficult. The main importance is given to the study of previous avalanches as they collapse along the same route.

Wind direction and precipitation are important for predicting avalanches. When the amount of precipitation is 25 mm, it can be followed by an avalanche, and if the snow falls in the amount of 55 mm, then the avalanche is quite possible, but if the snow came in the amount of 100 mm, then the avalanche will inevitably fall in a short period of time. Avalanche expectations are also calculated according to the rate of snow melting.

Avalanches can be passive and active. Avoid avalanche-prone slopes or build dams during passive protection. In the case of active protection, avalanches are bombarded, causing small avalanches to collapse, preventing the accumulation of critical masses of snow.



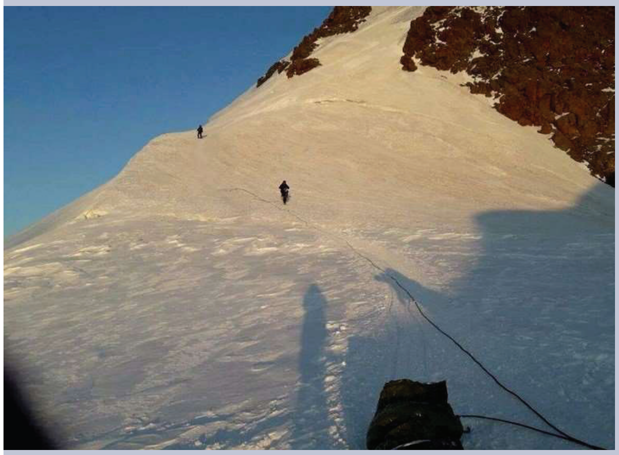
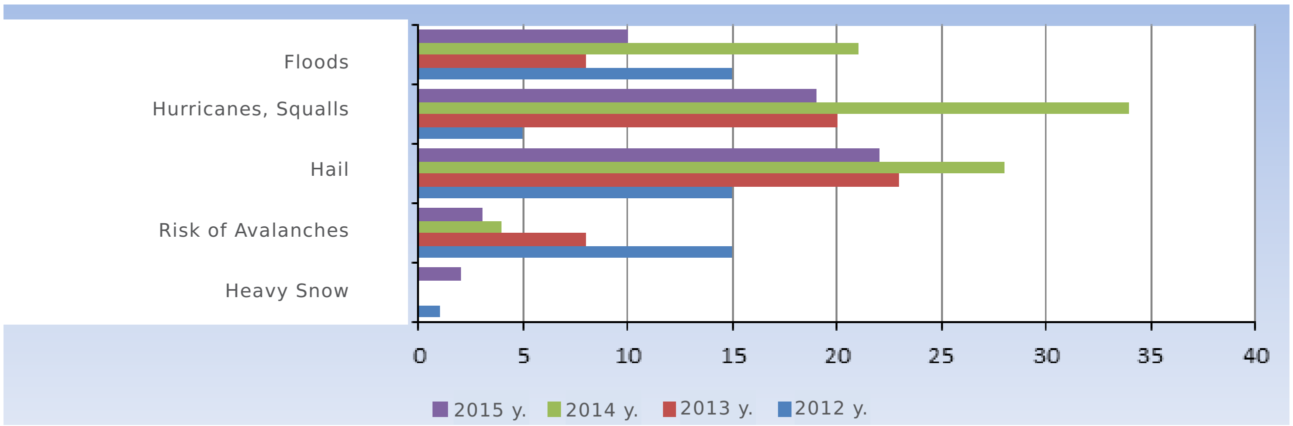


Photo N14 Avalanche on Tetnuldi

Picture N15 Avalanche in Keda

Snow avalanches are typical for the middle and high mountainous zones of Georgia and cause great material damage to the population of Svaneti, mountainous Adjara, Racha, Tusheti, Mtiuleti and engineering buildings, causing significant destruction, human casualties. More than 330 snowstorms that arrived in Svaneti in 1986-1988 alone claimed the lives of more than 100 people. The western and central parts of the Caucasus, mountainous Adjara, are distinguished by the highest avalanche danger coefficient (up to 75-80%). The formation and spread of snowstorms (including catastrophic) are mainly due to the large inclination of the landscape surface, separation, the peculiarities of the vegetation and meteorological elements. However, cases of avalanches are observed even in conditions of dense forest cover. This is evidenced by the snow-covered forests in the Nenskri, Nakri, Laskadura river basins destroyed in 1987 on 240-300 ha. The arrival of snow avalanches is facilitated by the artificial cutting of forest cover, which often ends in tragic consequences. A classic example of this is the tragedy of 1972 in the village of Ghurta (Khulo district), 1987 in the village of Mulakhi (Mestia district), where avalanches destroyed both villages and killed 77 people.

Diagram N2 Number of cases of natural hydrometeorological events 2012-2015



Source: National Environment Agency

During the massive arrival of catastrophic snowstorms, the monthly amount of atmospheric precipitation significantly exceeds the perennial norm and mainly coincides with the periods of invasion of Atlantic cyclones.

The special activity of snow avalanches on the territory of Georgia has been observed since 1070. Their massive arrival was recorded in 1072, 1975-1976, 1986-1987, 1992, 1996-1998; Specifically, in February 1992, 15 avalanches hit the Kobi-Kazbegi highway and traffic was suspended for 4 days. According to the State Service, 1996 Snowfall fell 40 times in Adjara district, 105 times in Svaneti and 149 times in Gudauri-Kobi section, as a result of which the road was closed for 42 days. In December of the same year, 21 people were killed in an avalanche that fell from the White Mountain (Georgian Military Road). 1997 Snowstorm fell 120 times on Gudauri-Kobi section, 5 people were killed, the road was closed for 40 days. In 1998 the avalanche hit the Gudauri-Kobi section 54 times and the traffic was stopped for 22 days.

Photo N16 Avalanche on Pshaveli-Abano-Omalo road Photo

Photo N17 Avalanche in Svaneti

In view of all the above, remote monitoring of research should be used in conjunction with traditional methods in order to reduce the economic damage caused to our country by these devastating natural events and to prevent human casualties, and to effectively manage their study and prediction. This is made possible by the Ivane Javakhishvili TSU Faculty of Geography and Geology, a remote sensing training-scientific center equipped with appropriate equipment and special programs.

NUMBER OF CASES OF NATURAL HYDROMETEOROLOGICAL EVENTS 2012-2015, BY MONTHS

Table N1

Hydrometeorological event	Jan	Feb	March	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec	Total
2012													
Flood - Freshet	-	-	-	-	5	3	3	4	-	-	-	-	15
Flooding	-	-	-	-	-	1	1	1	-	2	-	-	5
Hurricane, squall	-	-	-	-	7	2	2	3	-	-	-	-	14
Heavy snow	1	-	-	-	5	3	3	4	-	-	-	-	1
Creating conditions for danger of an avalanche	5	4	5	-	-	-	-	-	-	-	-	1	15
2013													
Flood - Freshet	-	-	-	-	1	2	1	2	1	-	-	1	8
Flooding	-	-	3	1	1	3	2	1	2	1	3	3	20
Hurricane, squall	-	-	2	3	6	5	3	4	-	-	-	-	23
Heavy snow	-	-	-	-	-	-	-	-	-	-	-	-	-
Creating conditions for danger of an avalanche	1	2	2	1	-	-	-	-	-	-	-	2	8
2014													
Flood - Freshet	-	-	-	2	1	2	3	4	7	1	1	-	21
Flooding	-	3	2	1	3	8	2	2	6	5	2	-	34
Hurricane, squall	-	-	-	3	8	10	1	3	3	-	-	-	28
Heavy snow	-	-	-	-	-	-	-	-	-	-	-	-	-
Creating conditions for danger of an avalanche	3	-	1	-	-	-	-	-	-	-	-	-	4
2015													
Flood - Freshet	-	-	-	1	2	4	1	-	-	1	1	-	10
Flooding	2	1	-	-	-	-	-	-	-	-	4	2	9
Hurricane, squall	-	-	-	2	6	9	3	1	-	1	-	-	22
Heavy snow	2	-	-	-	-	-	-	-	-	-	-	-	2
Creating conditions for danger of an avalanche	3	-	-	-	-	-	-	-	-	-	-	-	3

Source: National Environment Agency

INTENSITY OF NATURAL DISASTERS (LANDSLIDES AND AVALANCHES), HUMAN CASUALTIES AND ENDANGERED FACILITIES IN 1995-2015

Table N2

Year	Landslide		Mudflow		Objects in the danger zone		
	reveal (Activated and newly generat-ed)	Human ca-sualties	The number of avalanch-es	Human ca-sualties	Damaged agricultural lands, ha	Number of weakened points	buildings
1995	670	6	250	12	179	274	105
1996	610	3	165	6	232	403	626
1997	871	2	335	7	337	458	227
1998	543	5	173	6	230	370	159
1999	56	1	27	-	138	157	314
2000	65	1	23	-	162	240	207
2001	75	-	26	-	128	191	127
2002	69	1	23	2	148	203	193
2003	71	3	28	-	107	90	207
2004	949	4	258	2	16 289	755	6 042
2005	603	-	155	4	7 590	473	3 682
2006	356	1	63	-	3 173	531	2 088
2007	136	-	104	-	1 389	269	707
2008	311	10	126	8	1 388	392	1 198
2009	323	1	193	3	8 232	521	2 696
2010	250	3	81	2	1 155	366	822
2011	94	3	37	8	652	181	463
2012	325	1	88	5	1 255	239	845
2013	336	-	93	-	1 413	739	1 269
2014	727	-	141	10	...	1 041	962
2015	936	4	167	19	...	931	1 014

Source: National Environment Agency

1987 Avalanches in Svaneti

The arrival of an unprecedented amount of snow in 1987 triggered avalanches, and avalanches from the mountains covered 36% of Georgia's territory. Svaneti has witnessed the worst winter in recent years. In January, several villages were covered with 3 to 5 meters of snow. The height of the snow was so great that in almost every valley snow avalanches were coming down from the slopes, the depth of which reached ten meters.

The winter disaster of 1987 claimed the lives of 85 people and left about 2,000 homes under avalanches. Buildings, highways and power lines, as well as Svaneti towers and old traditional dwellings - Machvibes - were destroyed. Roads were closed, communication with villages was cut off, all means of communication were out of order. Especially great damage was done to Ushguli and Mulakhi communities, where almost no house was left undamaged. Damaged and destroyed towers in Murkmeli and Jamushi.

The damage caused by the disaster exceeded $ 300 million. 16,000 people were evacuated from the risk zone. Hundreds of families of local residents became eco-migrants due to the avalanche, the Georgian government relocated them to different parts of the country. They settled mainly in Kvemo Kartli. One such settlement took place in the village of Udabno.

Since then, the disaster in Svaneti has not caused a tragedy of this magnitude, although this part of Georgia has remained a natural disaster zone for years.

STRONG WINDS 

Wind and their origin

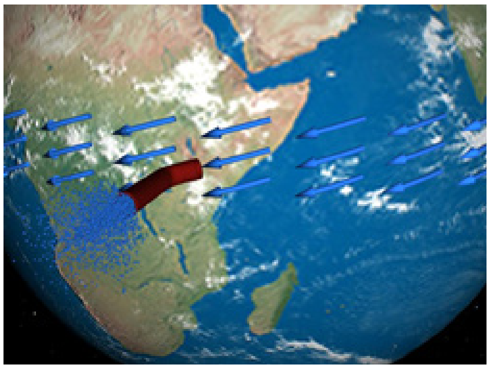
The air on the surface of the earth is in constant motion with more or less force, rarely calm. The movement of air masses is called wind. Winds are of variable strength; According to the Beaufort 12-point scale, the weakest is 1-point, while the strongest is 12-point wind. The speed of air movement depends on the strength of the wind. It can go from 1-2 m per second to 100-150 m. Light winds (1-3 points) reach 5 m/s, moderate winds (4-5 points) reach 5-10 m/s, and strong winds (6 or more points) blow at speeds of 10 m/s or more. The strongest wind is called a hurricane, which has a very high speed (30 m/s and more). The hurricane is destroying houses, mud trees, there have been cases of derailment of the train. Winds are monitored at meteorological stations by means of a blower. Wind force is also measured with an anemometer.

The origin of winds is related to the uneven distribution of atmospheric pressure on the Earth's surface. The wind blows from the place of high pressure to the place of low pressure. The larger the pressure difference, the stronger the wind. The unequal distribution of atmospheric pressures is influenced by the difference in air temperatures: it is known that warm air is lighter and has less pressure than cold. Therefore, the winds blow mostly from the area of cold air to warm. The weather is closely dependent on the nature and direction of the winds. Changing winds causes weather changes, so observing winds is important for the proper management of human agricultural activities.

According to the properties, two main types of winds are known: coastal and continental. Sea winds are associated with humid and changeable weather, while continental winds are associated with dry and clear weather. There are different types of winds: breezes, passages, monsoons, etc. As we know, the rate of heating and cooling of water and land is different. Accordingly, the pressure on them is unequal at the same time, which in turn causes coastal winds.

Breezes are coastal, periodic winds. The breezes change direction twice a day. During the day, when the sea is cooler and more pressure, and the land is warmer and the pressure is lower, it blows from the sea to the land - the breeze of the day; At night, on the contrary - from land to sea, night breeze. Breezes are also called diurnal coastal winds. It is characteristic of the shores of seas, lakes, reservoirs and large rivers.

Black Sea breezes go up to Zestafoni, i.e. 100-120 km inland. Sea breezes are mostly seen at noon and afternoon. Under its influence the air temperature on land falls.



Monsoons are periodic winds, caused by unequal warming of land and ocean as a result of pressure differences. In the summer it drifts from the ocean to the land, because at this time the pressure is low due to the heat above the land, and the sea has not managed to warm up and there is high pressure. In winter the opposite is true: the wind blows from land to ocean. The name "monsoon" originally came from the Arabic word "Mauses", which in their language means season, and the French called it monsoon. The monsoon distribution areas are characterized by the so-called monsoon climate, which is rainy and humid in summer and clear, sedimentary and cold in winter. Monsoon winds and monsoon climate are typical of India, Indochina, the northeastern coasts of Australia, the east coast of China, the southeastern part of Russia, Japan and other countries.

Trade winds are constant winds. They lie in the northern and southern hemispheres, from subtropical high pressure areas to the equator. Under the influence of the Earth's rotation, the trade winds tilt to the right in the northern hemisphere and flow to the southwest, in the southern hemisphere to the left and to the northwest.

The so-called **mountain-valley winds** are quite frequent in the mountainous parts. Like the breezes, it is a day-to-night wind: blowing from the bottom up (from the lowland to the mountain) during the day, and in reverse at night. Mountain-valley winds are the result of uneven heating and cooling of the slope and free atmosphere at the same altitude. During the day the mountain slope and its surrounding air layers are heated more than the air above the valley, so the barrier gradient is directed from the valley to the slope. At night, the opposite picture emerges. Like breezes, these winds are characterized by diurnal periodicity. Mountain wind speed increases with altitude and reaches a maximum of 200-250 m, then decreases. At a certain height the wind changes direction in the opposite direction.

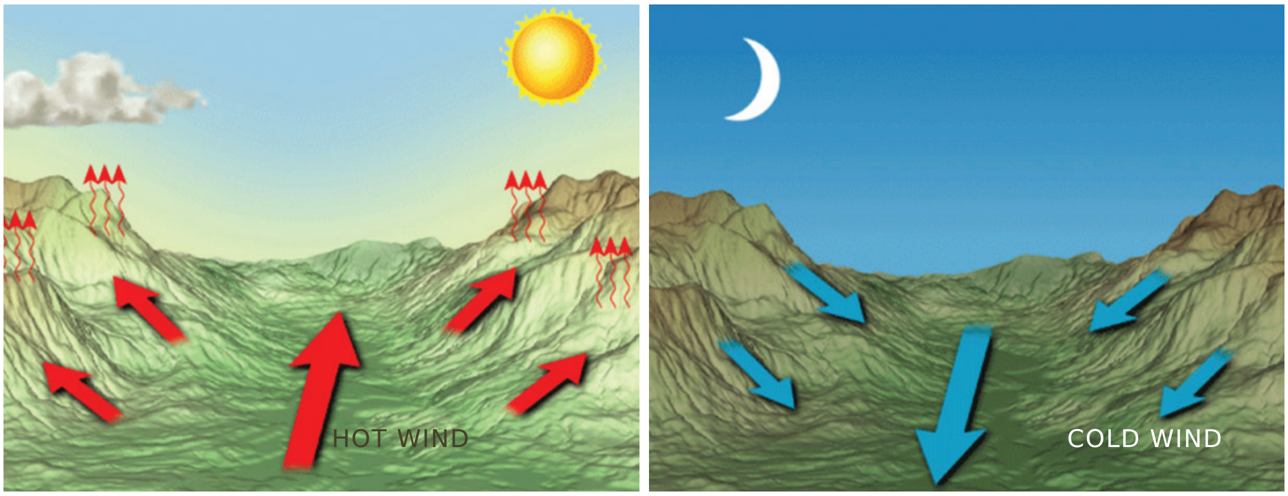


Figure N18 Direction of mountain-valley winds day and night

Mountain-valley winds are well developed in Georgia. Mountain-lowland circulation is observed in the high and middle mountain zone of the Caucasus. In the mountainous regions of western Georgia, mountain-valley winds are present all year round. However, in the warm period of the year, the wind of the valley is active even in the evening hours and its frequency is large enough. This is explained by the summer monsoon, the direction of which coincides with the direction of the winds and strengthens it.

In the mountainous regions of Eastern Georgia, mountain-valley winds operate mainly during the warm period of the year. The circulation of the mountain-gorge is somewhat weakened on the Javakheti plateau, which is due to the relatively flat terrain. Instead, strong mountain-valley circulation is observed in Kvemo Kartli lowlands and Kakheti lowlands. If the mountain is covered by a glacier, the barrier gradient is directed from the valley to the glacier during the day. Therefore, the wind in this case also flows from the Valley to the glacier, so the glacial wind arises.

Winds are of great importance for the creation of the features of the Earth's geographical membrane. Winds and related sea currents participate in the distribution of air temperature and humidity on Earth. Without winds and sea currents, the earth's natural zones would be much more dramatically different. The wind also cleans the air we breathe. The gases from car engines, the smoke from factories, the carbon dioxide (CO_2) that is released during the respiration of humans and many living organisms, strongly pollutes the air.

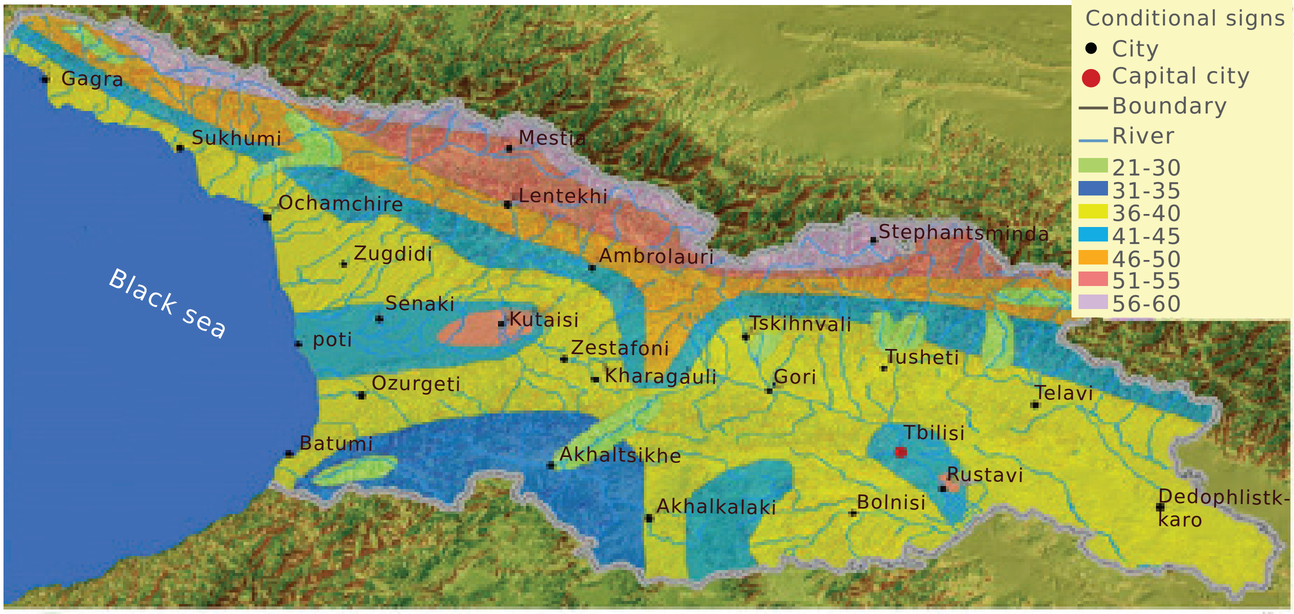
People have been using wind energy for a long time. Winds were and are used for sailing boats on the oceans and seas, winds were used for windmills, wind engines were used to drain swamps, to get electricity, in drought areas they were driven by pumps to supply water to fields. The wind power receiver is usually installed in places where the average wind speed during the year exceeds 4-5 m/s. According to this indicator, Mount Sabueti is noteworthy in Georgia (Likhi ridge, the total number of windy days here reaches 162 per year, in the future the use of wind energy is planned at this place) Areas of Poti, Surami, Kutaisi (63 windy days were registered), Inner Adjara, Northern slopes of Trialeti ridge, Khashuri (52 windy days/year) south-eastern part of Tbilisi, separate river valleys, etc. Georgia's electricity demand can be met in case of full use of wind energy.

The formation of the wind regime in Georgia is highly dependent on the seasonal distribution of pressures on the Eurasian continent, the Black and Caspian basins, and the difficult orographic conditions. It is the peculiarities of the layout of the landscape forms that determine the wind direction and speed on the territory of Georgia. The sub-meridian distribution of the Caucasus Range is a hindering factor that prevents the direct penetration of northerly winds and cold air masses into the territory of Georgia.

Photo N19 Wind turbines near Gori

Map N3

Georgian Regions by the maximum velocity of wind (I-VIII regions, wind velocity gradation m/s)



Source: National Environment Agency

According to the wind direction and strength, Georgia is divided into 3 main parts: West, East and South. Westerly winds prevail on the territory of our country, which is facilitated by the mountainous corridor of Georgia. Due to the placement of the landscape shapes, the direction of the prevailing winds may change in some cases, for example, the north-west wind prevails in Tbilisi.

Westerly winds are observed throughout Georgia, especially in the Black Sea coast, Shida and Kvemo Kartli, in the southern part of Kakheti. The wind regime in the Kolkheti lowlands resembles that of the monsoon; In particular, in summer the wind blows mostly from the sea to the land (west wind), and in winter vice versa, from the land to the sea (east wind).

Strong winds from the east in the territory of Georgia are observed in the Kolkheti lowland, on the river. In the lower part of Kvirila basin, in the central part of Shida Kartli plain. Strong winds from both directions are also observed in the temperate parts of the mountainous and high-mountainous regions of the country.

In southern Georgia, westerly and southwesterly winds prevail in winter, while in summer, on the contrary, east and southeast winds.

Among the local winds of Georgia, the warm and dry wind - Foehn wind is noteworthy, the direction of which is related to the location of the place. Foehn wind's mechanized origin is the result of air masses overcoming high mountains and ridges, or the descent of downward air from an anticyclone on a slope into the mountains. Foehn wind are frequent in western Georgia. In Kutaisi and Tskaltubo, 100-120 days are celebrated with Foehn wind. Its speed often exceeds 20 m/s, and its vertical power - reaches 1-2 km. According to Sh. Javakhishvili (1977), due to the action of Foehn wind, the air temperature in western Georgia may rise by 10-20^{0}C in a few hours, while the relative humidity may fall by 10-50%. Wind speeds are high and often reach 40 m/s. The air is clear during the fission and the visibility is good. In terms of medical climatology, it has a negative effect on the human body - causes unpleasant sensations, headaches, nausea, adversely affects health. The best time for the formation of Foehn winds in western Georgia is the cold period of the year, although rarely Foehn wind is also observed in the warm period. It should be noted that the perennial average air temperature in the Black Sea coast is the highest in Gagra, despite its location in the north, and is 15^{0}C, which, among other factors, is due to the frequency and duration of the Foehn wind map.

Gravity plays a big role in amplifying winds of mechanical origin. This refers to Bora - a cold stormy wind. Bora occurs mainly in winter, when an anticyclone is located on a cold continent, and a cyclone on top of a relatively warm ocean. In Georgia, bora is almost never developed, although stormy winds are not uncommon in the Kolkheti lowlands. For example, here a stormy wind took place on January 4-7, 1969. East wind speed in Poti increased from 16 to 28 m/s on January 4. On January 5, the wind speed during the day was 24-28 m/s. On January 6, the wind speed reached 34 m/s, and on January 7 it dropped to 16 m/s. This event caused significant material damage to the population and agriculture.

The average wind speed in Georgia varies within 4-5 m/s. The maximum wind speed on the territory of Georgia is recorded at the meteorological station in the vicinity of Mount Sabueti (Likhi ridge). Here, the average annual wind speed reaches 8.6 m/s, and the maximum wind speed is recorded near Mount Sabueti and is 9.2 m/s. Abkhazia, Kakheti and deep river valleys are distinguished by the minimum wind speed (for example, in the village of Shovi in Racha - 0.4 m/s, in the resort Abastumani - 0.6 m/s). The fact that the Likha ridge acts as a climate divider between western and eastern Georgia is confirmed by the wind regime, along with other meteorological elements.

Photo N20 Wind disaster in Ozurgeti

Photo N21 Strong wind in Kutaisi

Photo N22 Wind disaster in Gori

Photo N23 Strong wind in Gali, Abkhazia

The frequency of recurrence of windy natural disasters has doubled in the last 20 years and is repeated every 4-5 years. The frequency of strong (25-30 m/s) winds is high and ranges from 5-7 per year, while very strong (more than 30 m/s) winds in Kutaisi-Zestaponi section and Tbilisi suburbs 1-2 times a year, and in other regions of the country, on average it is repeated once in 5 years. The probability of very strong winds on the crossings and ridges of mountainous regions is more frequent and is observed several times a year.

Strong winds damage communications and power lines, causing sea turbulence, dust storms, snowstorms and uneven distribution of snow, followed by the formation of sediments, impoverishment from soil moisture, and more. Particularly unfavorable event in our conditions is the formation of snowstorm-induced debris on highways. This disrupts the mode of operation of transport, which causes significant damage to the country’s economy.

FIRE

According to the 2014 report of the World Health Organization (WHO), 267 thousand people died as a result of fires, millions of people were seriously injured, entire communities in different parts of the world were destroyed and there is no possibility of their recovery. The economic damage caused by the fires has exceeded tens of billions of dollars. The number of fires does not decrease every year, but, on the contrary, there is an increasing tendency. There are many types and classifications of fires, including the location of the fire, what caused the fire, and the cause of the fire.

Fire is an uncontrolled combustion process that causes material damage, damages human life and health, and threatens public and state interests. Depending on the location, there are fires: external (forest, field, vehicle fires) and internal fires (buildings, mines, man-made fires: pipelines, reservoirs, power plants, etc.). The cause of fire can be a natural or anthropogenic factor. By both natural and anthropogenic factors The fires, if not properly controlled and preventive measures are not taken, may be of a disastrous nature. Among the anthropogenic causes of fires are: proximity to settlements (negligence, land-

fills, etc.), the practice of “burning” agricultural land, proximity to industrial facilities, lack of fire protection zones, violation of forest use rules. Massive fires in Georgia could spread over several thousand hectares (during the 2008 Russia-Georgia war, fires covered up to 1,000 hectares, which was assessed as ecocide) and are likely to cause casualties as well as disruption of regional infrastructure, evacuation of local residents and long-term (for more than 5 years) environmental damage.

Natural (forest or field) fires in drought years are a very common natural disaster. It causes great damage to agriculture. If the fire fighting is not well organized in advance, it is possible that it will bring great trouble to the population living in its spread zone. The main cause of fires is irresponsible attitude towards incendiary and explosive substances. Fires can also be caused by lightning, faulty electrical wiring, self-burning of hay and dried plants, etc. In addition to forests, fires can occur in the fields, in the open, where there is dry grass or in a grain field (oats, wheat, etc.).

Field fires spread fairly quickly under favorable conditions. The fire front moves faster in the direction of the wind and much weaker - on the opposite side. During strong winds, the speed of the front of the fire reaches 25-30 km/h, and in mountainous areas (when spreading at the height of the fire) exceeds 50 km/h. Thus, fires are a very dangerous natural disaster because they involve highly damaging factors. Among them are the high temperatures, which can lead to human casualties. Everything in the fire area burns, large areas are covered with smoke, which adversely affects humans and animals (causing their poisoning, intoxication with carbon dioxide and other combustion products). Fires reduce the horizon of sight and negatively affect the psychological state of people. An important contributing factor to the spread of wildfires is the destruction of windbreaks (as a result of the practice of cutting and “burning”). Anthropogenic causes are compounded by natural factors (e.g., high temperature regime in summer 2014).

Forest fires are spontaneous, uncontrolled spreads of fire over a certain area of the forest. Forest fires are caused by two factors: human/anthropogenic or natural. Today, the main cause of forest fires is human activity, while natural fires (for example, fires caused by lightning, drought) account for only 7-8% of the total number of forest fires. The probability and speed of fire spread depends on the age of the forest cover; In young forests, where there is more greenery and young plants, fires do not arise easily and spread slowly, while in woods overgrown with aged trees, fires are easily expected. Thus, in nature, there is a kind of ecological equilibrium/balance, when fires are a factor of natural selection, and the old forest is replaced by young and healthy plants. Occasionally there is a deliberate fire in the forest, such as controlled fires, which aim to destroy flammable substances, wood waste, fight insects and forest pests, as well as deliberate forest fires to remove traces of illegal logging.

The most important forest fire hazards are fires in Samtskhe-Javakheti, Imereti, Kakheti, Shida Kartli and Adjara regions (areas belonging to I-III fire hazards). According to recent statistics, most cases of forest fires, especially in forest massifs near populated areas, are caused by anthropogenic impacts.

Table N3 Forest fires

	1995	2000	2005	2010	2012	2013	2014	2015
Number of fires, units	1	34	16	6	11	35	69	62
Fire forest area, hs	7	85	26	370	199	88	705	169
Damage caused to the forestry as a result of the fire, one thousand GEL	0.3	11.3	0.6	...	...	...	...	...

Source: LEPL National Forest Agency.

Note: The table includes the forest fund under the management of the National Forest Agency.

In the past, fires were a frequent occurrence in the forests of Georgia and spread over a large area. For example, a strong fire was reported in 1884 under the name “Gujarat”. It covered 30 thousand hectares of forest - from Bakuriani to the valley of the river Tana. The fire raged for several months. The population of Kartli and military units were mobilized for its localization.

Forest and field fires pose a particular threat to the soil. Overheating of the soil humus layer and consequently losses of organic matter and individual nutrients will eventually lead to changes in the physical and chemical characteristics of the soil and a decrease in its fertility. Damage to the soil depends on the intensity of the fire and its duration (the stronger and longer the fire, the higher the loss of organic matter from the soil). However, soil is a habitat for many micro and macro organisms, most of which die under high temperature conditions. As a result, soil fertility is reduced due to disruption of the circulation of natural substances. Fires are especially dangerous on slopes because, as a result of burning of vegetation, the risk of water soil erosion is significantly increased.

Photo N24 Fire in Tsaghveri forest

Photo N25 Forest fire in Tskaltubo municipality

Forest fire protection is of great ecological importance - the fire destroys the eruption, the emergence, the adolescent, burns the dead and the living cover. The physical-chemical, water-retaining and soil-protective properties of the soil are deteriorating, the danger of water and wind erosion is increasing. Forest fires can be prevented by taking timely preventive and fire-fighting measures, as well as by eliminating a number of organizational and technical problems. Forestry activities are diverse: sanitation of the forest, creation of a system of fire barriers and construction of various facilities, cleaning of the area from household waste, removal of mineralized strips, etc. In the fight against forest fires, it is very important to carry out forestry measures, organize fire protection, equip with appropriate technical means, and raise awareness among the population, enterprises and organizations. Forest protection in Georgia is provided by the Ministry of Environment and Natural Resources Protection of Georgia and its subordinate agency, the National Forest Agency, while forest fires are handled by the Emergency Management Agency under the Ministry of Internal Affairs of Georgia. World Firefighters’ Day is celebrated on May 4.

DROUGHT 

Drought is a complex phenomenon, in the formation of which simultaneously independent factors participate. The main meteorological conditions are lack of precipitation, high temperature and low relative humidity. This is a long period in spring-summer, when precipitation is below normal, at high air temperatures the moisture supply in the soil dries out and unfavorable conditions for plant growth and development are created, yields are reduced or completely destroyed. Against the background of global warming, the natural factors contributing to aridization are becoming more intense, as a result of which natural aridity will increase in Georgia.

Drought is a natural disaster caused by long-term cessation of atmospheric precipitation in high temperature (10^{0}C and above) and low humidity in this or that area during the warm season of the year. Drought is characterized by an average positive air temperature of 10^{0}C and higher for several days or weeks. Under such conditions, there is a danger of a person being overwhelmed, the thermoregulation of the human body is severely violated and its temperature reaches 39^{0}C degrees, in some cases even higher. Prolonged and strong overheating of the body can lead to sunburn or impaired heart function.

In Georgia, as well as in the whole Caucasus, drought years are quite frequent, which most researchers attribute to global warming. The drought years of the last decades can be considered as 1976, 1992, 1996, 1998-2000, 2006, 2010. The drought of the summer of 2000 was particularly intense, which even caused an ecological catastrophe in the lowland area of Eastern Georgia. According to the Tbilisi airport station, there was a strong wind for 19 days, which contributed to the strong drying of the topsoil. The damage reached several hundred million GEL. Also noteworthy is the summer drought of 2010, when air temperatures exceeded the perennial norm by several (5-6^{0}C) degrees.

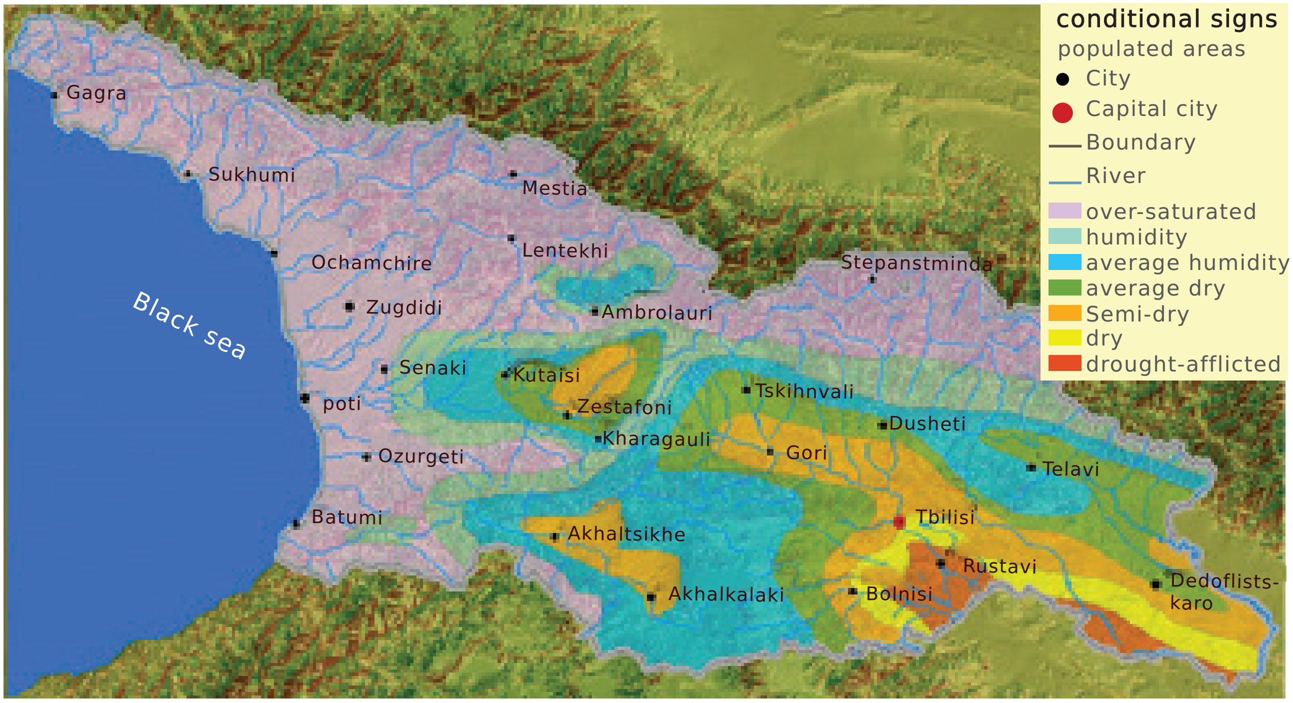
Photo N26 Drought in Kakheti

Figure N27 Drought in Dedoplistskaro municipality

Map N4

Map of drought regions of Georgia

Vegetation period (April-September)



Source: National Environment Agency

Drought is observed on the whole territory of Georgia, but in this respect Kakheti, Shida and Kvemo Kartli, as well as Zemo Imereti regions stand out. If in the early periods drought was observed once in 15-20 years, recently this event occurs once in 6-7 years. In 1995-2008, the damage to agriculture from this event amounted to 400 million GEL. Georgia is a contrasting region in terms of rainfall. The Caucasus, Guria, Adjara and Kolkheti lowlands receive more than 1000 mm of rainfall per year. Precipitation in other regions is less and amounts to 300-750 mm. That is why the problem of desertification, the main cause of which is drought, is relevant for Georgia. If the global warming process continues, the desertification process may affect the arid and semi-arid landscapes of the plains and foothills of eastern Georgia, as well as the sub-alpine and alpine zones of the highlands. If preventive measures are not taken in time, then the process may become irreversible, especially in Kvemo Kartli and Dedoplistskaro districts.

Photo N28 Drought in Ninotsminda, potato fields

Photo N29 Drought in Kakheti, sunflower fields

Desertification is one of the biggest problems facing humanity today, making a quarter of the world's land area unusable and endangering the lives, health and safety of some 250 million people in the area.

The issue of desertification was addressed at the Earth Summit in Rio in 1992, and on June 17, 1994, the UN Convention to Combat Desertification was adopted in Paris.

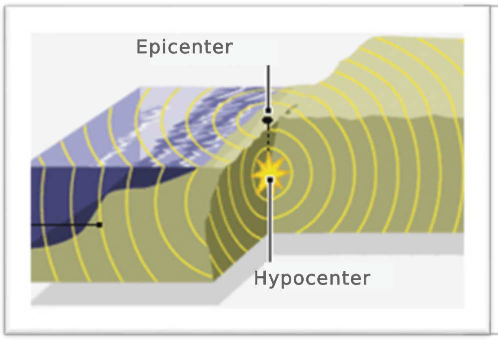
Four main regions where the effects of desertification are visible are: Africa, Asia, Latin America and the Caribbean, and the northern Mediterranean.

Usually, desertification occurs in densely populated areas due to intensive farming and grazing. As a result of desertification, biodiversity is reduced (lost) and soil fertility is reduced. Diverse natural ecosystems are replaced by a homogeneous (single dominant perennial species) ecosystem.

International Desertification Day has been celebrated since June 17, 1994. The main purpose of this day is to raise public awareness and inform about the expected consequences of desertification and possible preventive measures.

EARTHQUAKES

Earthquakes are earth tremors and sudden oscillations of the earth's surface that occur as a result of tectonic deformation, sudden faults, and landslides in the earth's crust or upper mantle, and are transmitted over long distances in the form of elastic seismic waves.

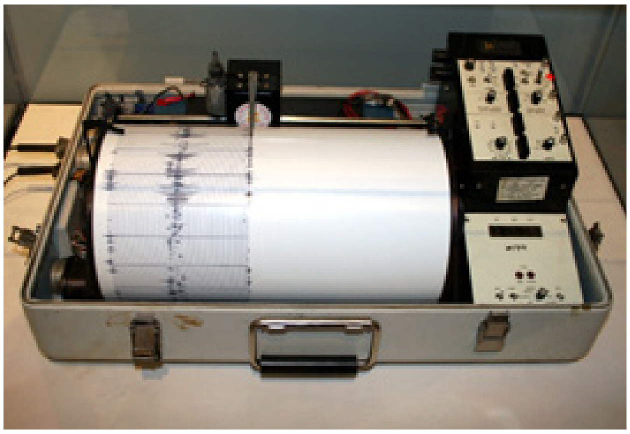


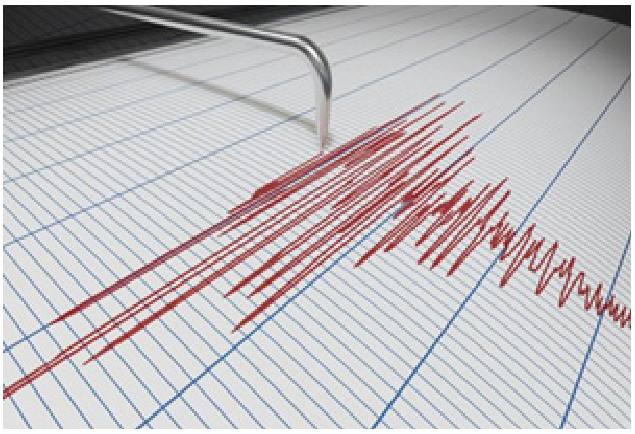
- **The hypocenter** of an earthquake is called the point in the Earth's crust where seismic waves propagate

- **The epicenter** of an earthquake is called the epicenter of the earthquake, the shortest distance that corresponds to the location on the Earth's surface.

More than 1 million earthquakes are recorded on Earth every year, which allows the improvement of seismic vibration recording devices (seismograph) and increase the number of observation areas. Technological advances have allowed scientists to observe the processes going on in the depths of our planet and to record more and more earthquakes from year to year. If at the beginning of the XX century there were up to 40 earthquakes of magnitude 7 and higher every ten years, in the same interval of time in the XXI century this figure increased tenfold and reached 400.

Seismic stations are arranged in many countries of the world, the instrument uses a seismograph to determine the place, time, force and direction of an earthquake. A seismograph records and registers all types of seismic waves, and with its help scientists calculate the magnitude of an earthquake.





Earthquake magnitude (M) - is a unit of energy released during an earthquake in the form of seismic waves. The magnitude scale was first introduced in 1935 by the American seismologist Charles Richter. Earthquake magnitude ranges from 1 to 9.5.

In contrast to the magnitude of an earthquake, or the unit of energy for seismic waves, they still calculate the intensity of an earthquake. Earthquake intensity is measured on a 12-point scale (Mercalli scale in the US, European macro seismic scale in Europe) or 7-point scale (Japan). Earthquake intensity scales are used to determine the effects of an earthquake on how people were affected by the earthquake, objects, buildings, natural objects, and so on. The intensity of an earthquake is determined after the earthquake, after a certain time interval, when information about the results has already been received.

MERCALLI SCALE OF EARTHQUAKE INTENSITY

1 POINT People will feel it only in particularly favorable circumstances.

2 POINT It will be felt by people in silence on the high floors of the building. Loosely hanging items will be loosen slightly.

3 POINT People on the upper floors of the building will feel quite clear. Parked vehicles shake slightly. Vibration similar to passing a truck will be felt.

4 POINT During the day it is easy to feel inside the building. Some people wake up at night. Dishes will be moved, windows and doors will be opened and closed. The parked cars vibrate noticeably.

5 POINT Will be felt by all people. Sometimes the glass cracks, cracks in the walls, unstable objects fall.

6 POINT People run outside. Heavy furniture moves, plaster falls, wiring is damaged, minor demolition occurs.

7 POINT Everybody runs away from home. Slightly demolished buildings are completely demolished, houses that are built well are moderately demolished, poorly built houses are demolished. Drivers in motion feel it too.

8 POINT Minor demolition occurs in seismically resistant buildings. Ordinary houses with wooden and brick walls are significantly damaged and partially demolished. Poorly built houses are completely demolished. The panels go beyond the frames. Chimneys and factory pipes, columns, monuments, walls fall. Heavy furniture flips. The water level in the wells changes. Dogs feel tremors.

9 POINT

Special construction buildings are significantly damaged. Framed well constructed buildings are tilted. Houses built of ordinary materials are very damaged and partially demolished. Houses are moving from their foundation. Cracks in the ground are well visible, underground piping is cut off.

10 POINT

Well-built wooden houses are falling down. Brick and frame houses are collapsing along with the foundation. The land cracks, the railway tracks bend. Landslides on slopes and river valleys.



11 POINT

Only seismically resistant buildings will survive the demolition. Bridges collapse, wide cracks form in the ground. Underground communications are completely out of order. There are strong landslides and avalanches. The rails on the railway bend too much.



12 POINT

Everything is completely falling apart. All parts of the buildings are demolished. The surface of the earth becomes wavy. The landscape collapses, objects fall above.


The lithosphere consists of several large plates and these lithosphere plates move towards each other. There are usually 6 large, continental-sized plates: Africa, America, Antarctica, Australia-India, Eurasia and the Pacific, and 14 relatively small subcontinental plates: Philippines, Caribbean, Arabian, and so on.

Earthquakes are caused by the interaction of plates. Areas of frequent earthquakes are known, as so-called seismic zones: the Pacific coast (Pacific zone) and the Alpine-Himalayan zone (includes: Southern Europe, the Caucasus, the mountainous regions of Asia Minor and Central Asia, the Himalayas).

The territory of Georgia, as an integral part of the seismogenic region of the Caucasus, belongs to the Mediterranean-Himalayan seismic zone and is the northern border zone of Anatolia and the Iranian highlands. The seismotectonic nature of the Caucasus is due to:

- The interaction of Arabian and Eurasian plates;
- The movement of the Arabian plate to the north is 3-4 cm per year,
- Horizontal movement of Crimea-Caucasus 1-2 cm,
- And Anatolian and Iranian microfilaments 3-5-7 cm/year.

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Earthquake epicenters in the Caucasus are located in the upper part of the Earth's crust, mainly in the granite layer. At the same time, if the depth of the Javakheti mountain ranges is mainly located at a depth of 5-10 km, it reaches 15-30 km within the Caucasus, and has transitional importance in the Belt region of Georgia.

The high activity of earthquakes is characterized by the volcanic mountains of Javakheti and the axial zone of the Caucasus southern slopes, the seismic potential of active structures of which is determined by the maximum possible energy potential of the earthquake Mmax = 7 and intensity 9 and above.

16 earthquakes of 7 and 9 magnitude have been registered on the territory of Georgia since the historical period.

Table N4 Strong earthquakes in Georgia

N	location	Intensity of earthquake	Date
1.	Tmogvi	8	1088
2.	Mtskheta	9	1275
3.	Samtskhe	9	1283
4.	Alaverdi	7-8	1530
5.	Alaverdi	8-9	1742
6.	Akhalkalaki	8-9	1899
7.	Kartli	8-9	1920
8.	Tabatskuri	8	1940
9.	Martvili	8	1957

N	location	Intensity of earthquake	Date
10.	Guria	7-8	1959
11.	Madatafa	7-8	1959
12.	Chkhalta	9	1963
13.	Dmanisi	8	1978
14.	Faravani	7-8	1986
15.	Racha-Imereti	9	1991
16.	Fasanauri-Barisakho	7	1992

Significant earthquakes on the territory of Georgia from the beginning of the XXI century to the present (2017):

April 25th, 2002 - Four people died as a result of the earthquake in Tbilisi. One of them died of a heart attack. The magnitude of the earthquake was 6 and the magnitude of the earthquake was M = 4.5. The epicenter was reported 21 kilometers south of Tbilisi. Residential houses were destroyed and damaged, mainly in the old districts of Tbilisi - Mtatsminda, Sololaki and Isani.

March 1st, 2003 - At 5 o'clock in the morning, a 3-magnitude earthquake was recorded in Tbilisi. The epicenter was in Ortachala. The tremors were not followed by demolition.

February 6th, 2006 - In the morning, at about 8:05, an earthquake shook Georgia. The epicenter was reported in Racha-Lechkhumi, with a magnitude of 5.1 on the Mercalli scale. The tremors were felt in Tbilisi as well. According to the available information, the earthquake in Racha-Lechkhumi region did not cause any damage or casualties.

September 8th, 2009 - The epicenter of the earthquake was in Oni district, the magnitude of the earthquake on the Richter scale was M = 6 units. More than 1000 houses were damaged in Racha. At least 400 families were left homeless. This is the number of families whose homes were either destroyed or so damaged that they could not be rebuilt.

In 2010, up to 15 earthquakes of magnitude 3 occurred in Georgia.

Earthquakes near Anaklia in the Black Sea in December 2012 reached a maximum of 5.9 magnitude.

On January 20, 2017, a 4.3 magnitude earthquake was recorded near Akhaltsikhe.

Georgia belongs to the middle zone in terms of seismicity, where small tremors are traditional, but Racha and Javakheti are characterized by relatively high intensity earthquakes in the last 20 years. The seismic activity of the territory of Georgia is also confirmed by the fact that the number of such earthquakes for which the seismic parameters of the earthquake center can be determined is on average up to 1000 per year. At the same time, we can not ignore the disturbing circumstance that in the near future, the Caucasus is expected to have a high probability of recurrence of strong earthquakes, which in terms of sustainable development of the region can not be ignored, especially since tall buildings in Tbilisi and other large cities have been built without taking seismic safety into consideration, not to mention the number of damaged houses in the cities.

Indicators of catastrophic danger are the earthquakes of Spitak (Armenia) in 1988 and Racha in 1991, which have no analogues in magnitude (respectively M = 7 and M = 7.2), intensity (8 and 9 points), distribution area and socio-economic consequences in the Caucasus.

In 1991, the Racha-Imereti and Shida Kartli earthquakes covered a significant area of Georgia, more than 7800 km^2 of villages and urban settlements; The disaster destroyed and significantly damaged 46 thousand houses and up to 1000 public and agricultural buildings, cultural monuments, left more than 100 thousand inhabitants homeless, significantly damaged roads (more than 1200 km), water intakes, water mains water pipes and other communication facilities.

The 1991-1992 earthquake caused up to 20,000 new landslides and rock outcrops, accumulated large amounts of flood-transforming solids in river valleys and ravines, caused numerous cracks in the earth’s surface, and more.

- Up to 1500 settlements were found in the zone of negative impact of these events, up to 332 thousand hectares of land became uninhabitable, up to 100 people died; The village of Khakhieti was buried under 70 million m^3 of rock, and the gorge of the river Kvirila near the village of Perevi was buried with a mixture of 50 million m^3;

- The village of Chordi (Oni district) was directly affected by the earthquakes, 2 houses were damaged, and the giant landslide provoked by it (volume about 150 million m^3) completely destroyed 70 households, as well as the villages of Beloti and Satskhenisi (Tskhinvali zone);

- Landslides of 170-200 million m^3 developed in the villages of Zhazkvi and Bajikhevi (Oni district).

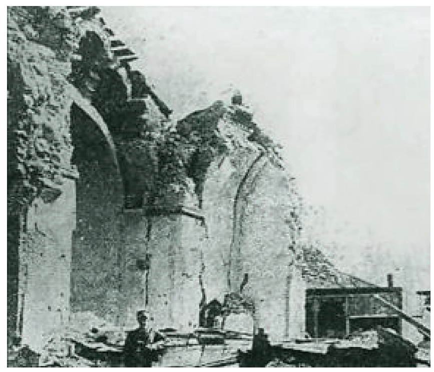
- Landslide blocked the gorge of the river Patsa (a tributary of the river Didi Liakhvi) and flooded 16-18 million m^3 of water with a 40 m high dam. Subsequent partial floodwaters flooded the banks of the Didi Liakhvi River, flooded villages on low terraces (Kurta, Kekhvi, Achabeti and a significant part of Tskhinvali) and triggered a landslide in the village of Khreiti, making residents relocate to safer places.

Activation of earthquake-induced landslide-gravity events was also observed outside the epicenter, almost throughout all of Georgia. Landslides of tens of millions in volume have developed in Adjara, Lechkhumi, Svaneti, Mtiuleti and others.

By expanding antiseismic construction in the future, it will be possible to avoid devastating consequences for earthquakes. But the second no less dangerous - the activation of landslide-gravitational events provoked by earthquakes, the fall of snow-glaciers, the formation of a solid composition of avalanche hotspots, karst-subduction collapses, etc., which often occur in areas significantly different from the epicenters of the earthquake and with different geotectonic regimes.

Gori earthquake of February 20, 1920

(EARTHQUAKES IN GEORGIA)



The city of Gori no longer exists! Not a single whole building is left, Gori Mazra is leveled with the ground. Lots of people were killed, the survivors were put in a helpless state due to lack of food, clothing and homelessness. Both new and century-old buildings and historical monuments have been demolished ... - The newspapers of February 1920 provided information about this content to the population of Georgia.

The first strong earthquake was registered in Gori Mazra at 02:55 on February 20, and the second one - at 14:45. The magnitude of the earthquake on the Richter scale (local magnitude) was 6.2 (for comparison, the magnitude of the 2002 Tbilisi earthquake was 4.6), while the magnitude on the Mercall scale was 8-9 at the epicenter. The strongest, 9-magnitude tremors were recorded in the village of Khidistavi, 3 kilometers from Gori. The magnitude of the earthquake in Gori was 8 points, as well as in most of the villages of Gori region. The tremors were felt throughout Georgia. Its capacity in Tbilisi was 6 points, and in Batumi and Poti - 5 points.

As it turns out, the night tremor did not cause much destruction in the city of Gori, but the repeated earthquake completely destroyed the already damaged houses. According to eyewitnesses, during the afternoon earthquake, the city was so dusty that noone could not see anything. Terrible noises were heard in the streets - the barking of dogs, the screams of people looking for their own family members or calling on relatives for help to escape from the rubble.

After the earthquake, a terrible picture appeared in front of those who arrived in Gori Mazra. In Mazra, and especially in the city of Gori, almost nothing survived except small huts. According to the statistics of the Statistical Commission, only 16 out of 1336 buildings described in Gori were not damaged, and 756 buildings were either completely destroyed or demolished. 405 buildings required major repairs and 156 minor repairs. The buildings of the city and the self-government, the post office, the gymnasium, the theological school, the churches, the barracks, the prison were destroyed. The famous fortress of Gori almost completely collapsed. The quake killed 18 people (including 7 children) in the city of Gori, and injured 267 people of varying severity. The situation was especially difficult in the village of Khidistavi and also in Okhera, where the epicenter of the earthquake was located. Both villages were completely destroyed by the night earthquake. The casualties were great too. According to the Statistical Commission, 30 people were killed in Khidistavi and 16 in Okhera (according to other data, the death poll in these two villages was 59), and 49 people were injured. 338 families were affected in these villages.

Almost completely destroyed: Ateni, Gorijvari, Skra, Khoveli, Sasireti, Does and other villages. 75 villages of the region received various degrees of damage. According to the Statistics Commission, **the earthquake in Mazra killed 129 people (according to other data killed up to 200), injured 661. The disaster affected 7118 families.**

The Democratic Republic of Georgia, which already had domestic and foreign problems at the time, was tested by nature. Akaki Chkhenkeli, who saw the ruined Shida Kartli with his own eyes, returned to Tbilisi and said directly at the meeting of the Constituent Assembly: - This was the last thing we needed!

Indeed, the losses were enormous. Homeless people could not spend the night in the open air during the cold days of February. With the demolition of houses, a large part of the rural population lost their livestock. On February 20, government officials arrived in Mazra to learn about the situation on the ground. On February 22, a special government committee was set up, chaired by Justice Minister Rajden Arsenidze. The government called on the people of the whole country to support the victims in this difficult situation. A Victim Assistance Bureau has been set up. At the same time, the newspaper “Republic of Georgia” published a rather original call to the “rich”: **“Rich person, earthquake makes everyone equal.” “Take away your wealth to help the victims.”**

On behalf of the government and the people of the country, it must be said that they have supported the victims of the disaster. The Georgian government immediately disbursed the initial 20-million loan, although the total cost of the first aid package rose to 60-80 million manat. The population sent: food, basic necessities, 10 thousand tents, firewood. Field hospitals were set up to provide first aid to the victims. Passenger, luggage and sanitary trains were running continuously on the railway. The injured were transported to Tbilisi by a sanitary train. It should be noted that in addition to the two devastating power shocks that occurred on February 20, the land was weak but still moving for several days, which had even more depressing effect on the already devastated population. It is the period that is connected with the joke spread among the people of Gori that they are characterized by walking in the middle of the road. Indeed, frightened residents avoided walking on the sidewalk to avoid anything falling from the rubble of the buildings.

There are accounts of pregnant women giving birth in the sanitary train from the shock received. The government rented flats for the homeless in Borjomi, Khashuri and Surami. In the latter were prepared apartments for 5 thousand people. Thousands of regular army and guard units, volunteer student sanitary units, doctors, engineers were sent to Mazra. The population actively responded to the call of the government, there was almost no looting in Gori, which is not uncommon in such a situation. Victims were provided with financial assistance throughout Georgia, from personal donations to members of the government and the founding assembly, to individuals and various private organizations.

Money collected in churches was sent to help the people of Gori, part of their salaries were paid by soldiers and guards of the regular army, erobs, representatives of the Tbilisi Prison Inspectorate, students, workers of various institutions. For example, 225 thousand manats were collected for first aid in Zestaponi, and the Tbilisi Clubs Council decided to send 100 thousand manats to the Gori Foundation, as well as 10 percent of the proceeds from the lottery, and once a week the entire net profit of the lottery. On February 28, the Writers' Union Council held a grand evening in the famous "Cimerion" cafe to help the people of Gori, which was attended by Georgian and Russian writers, actors of Georgian drama, "Tarto" and the State Theater. The Italian civilian mission sent 200,000 rubles to help the earthquake victims, as well as a field dispensary for 500 people and a team of doctors in Gori. The victims were assisted by the Armenian National Council, which allocated 50,000 rubles to the people of Gori and undertook to store 20 beds in the hospital for the injured. The March 10 issue of the American newspaper "The New York Times" published an article on the earthquake with the headline "Hundreds killed, thousands left homeless - the result of a severe earthquake in the Caucasus." The American East Aid Committee sent three wagons of old clothes to the victims.

The Gori earthquake of February 20, 1920 turned out to be such a devastating force for Georgia, but the disaster in the middle of Kartli united and brought together the entire population of Georgia.

Magazine "Historian", May 2012, # 5/17
(Author: Dimitri Silakadze)

DISASTER SOCIAL IMPACT AND VULNERABLE GROUPS

The impact of disasters on people is mainly severe and multifaceted, it includes both the economic as well as the social and psychological aspects.

People are vulnerable to disasters due to their geographical location, where they are. A disaster can be short-lived or long-term, single or multiple, of different types and scales. Disaster causes direct material damage such as death and damage to health, demolition, destruction or damage of dwellings and farms, dismantling or destruction of infrastructure, isolation of people, destruction of animals. The indirect consequences of disasters such as poverty, stress and anxiety are also great.

Social impact is defined by the consequences that changes the way people live, work, interact, have fun, and adjust to life.

The social effects of catastrophes are multifaceted, primarily related to the increase in poverty caused by the deterioration of the economic situation, the impact of which on people is as much social as economic. Poverty is much more than a lack of material resources, it limits a person's access to health services, education and entertainment, leads to social isolation, low self-esteem and feelings of inadequacy.

Disaster is often followed by the need to move, which leads to the disintegration of the community, the loss of established relationships, and the need to adapt to the new environment. Migration, both inside and outside the country, is a serious social consequence of disasters. External migration significantly changes the demographic picture in the country, as there is mainly an outflow of young, able-bodied people of reproductive age to another country.

Disaster has a significant impact on both psychophysical and mental health and behavior.
It can lead to digestive tract disorders, tics, disorientation, concentration problems, attention deficit. The impact on the psyche is reflected in feelings of fatigue, anxiety, depression, fear and grief.
Behavioral effects of catastrophe include insomnia, alcohol and drug use, changes in appetite, and ritualistic behavior.
A large part of the population affected by disasters needs psychological help. However the effects of a catastrophe on mental health are usually not lasting.
The outcome of a disaster, as mentioned above, is mainly due to location, although its impact is also determined by the vulnerability of people or groups of people and primarily by the amount of resources they have to deal with the disaster.

Vulnerability is defined as the characteristics and circumstances of a community, system or property that make them vulnerable to the harmful effects of a threat. There are many aspects of vulnerability that are driven by social, economic and environmental factors.

Vulnerability defines an individual or group, by their ability to predetermine, adapt or cope with the outcome of a disaster. Vulnerability reflects the different impacts of the event on different groups, taking into account the differences between people.

VULNERABLE GROUPS ARE CONSIDERED:

- Seniors
- Children
- Women, especially pregnant and nursing mothers
- Persons with disabilities
- National minorities

In case of disasters, foreign tourists and foreign nationals working in Georgia should also be considered as vulnerable groups.

The vulnerability of these groups is primarily due to their disaster preparedness and response to the small amount of resources at their disposal compared to other groups.

A differentiated approach to mitigating the negative consequences of disasters must be implemented at all stages of the disaster response cycle, prevention, preparedness, response and rehabilitation.

It is especially important to consider the capabilities of different groups in the disaster preparedness phase, to make access to warning information available to them.

This primarily means recieving the disaster alert.

The elderly often have impaired hearing and vision. This problem is even more acute in the case of people with disabilities. There are 118,651 such people in Georgia, which is 3% of the population. Disaster relief information should be provided through a channel accessible to these groups, preferably combining audio and visual information. Warning for national minorities, tourists and foreign workers should be provided in a language they understand.

People with disabilities and the elderly often have mobility problems. Because of this, it should be considered in advance who will need help and how to move them if necessary.

The response should take into account for the prevention of isolation of the vulnerable groups from the family and the community, the separation of children from their parents, the provision of more food and water for pregnant and nursing mothers, the provision of hygiene items for women, the greater need for the elderly.

Children suffer much more than adults as a result of natural disasters, and this impact is often long-lasting. This is due to less ability to escape, inability to identify themselves, difficulty in making critical decisions, dependency on care for adults, shelter, transportation, and protection.

Disasters affect children mainly in three areas: physical health, mental health, and access to education.

Disaster can lead to the death or injury of a child, the destruction of their home and the loss of material resources of the family, the death of parents or family members, the destruction of existing social networks. Disaster can lead to food shortages that negatively affect a child's physical health.

The effects of the catastrophe on the child's psyche are severe. It can lead to post-traumatic stress disorder, which can last longer than in adults, with fear, anxiety and depression. Most children do not need psychiatric treatment, but it is necessary to screen their psychological condition after the disaster and, if necessary, the intervention of a psychologist.

Disaster can lead to the demolition of buildings, including school buildings, which will hinder the education of children. In the event of separation after a disaster, it is essential that the children return to their families as soon as possible.

The vulnerability of the elderly to catastrophes is primarily due to their physical condition, therefore, as a result of the catastrophe, it's their physical health that is mainly damaged. The physical sensations of the elderly are usually weakened, they have mobility problems, chronic disease and often limited socio-economic status. They are less sensitive to disaster warning signals, trying not to leave their homes and thus protecting their property.

Older people are more likely than young people to suffer material loss due to their sentimental attitude towards things, and rehabilitation is more problematic for them.

At the same time, a number of studies indicate that the psychological impact of disasters is much less on the elderly than on the young. This is explained by the fact that older people are less emotionally responsive to disaster, have a more established adjustment style.

The rehabilitation process should take into account the specific needs of the elderly, the problem of their mobility, the provision of treatment for chronic diseases, medical care, dietary food. The time of isolation from their family and loved ones should be reduced as much as possible.

GENDER ASPECT

As already mentioned, natural disasters affect different groups of the population differently. Therefore, the mechanisms for responding to, avoiding and managing them are different. Society is divided into two large groups, women and men. The differences between them, which underlie gender needs and roles, determine the gender aspects of natural disaster management and prevention.

What are the gender aspects?

GENDER

As the term, it refers to the socially defined roles, perceptions, behaviors, and expectations that exist regarding men and women in a given society.

GENDER ROLES

Are the forms, norms and values of behavior imposed by society and culture for women and men.

The attitudes towards women and men underlie the different parenting styles used by them, giving boys a more dominant role in the family and society. Consequently, at the age of childhood, boys and girls acquire different skills and different qualities from each other, choosing different professions. All this leads to the fact that already in adulthood, men and women usually play different roles.

Gender roles are significantly related to gender stereotypes (perceptions of male and female personality traits and behavioral characteristics). Culture attributes certain characteristics to its representative woman or man, determines what a woman or a man should be and how he should behave, what he is obliged to do in the family and society.

Because of gender roles, natural disasters affect women and men differently because they respond differently to the event and need different types of help.

Gender equality, which is one of the most important priorities of our country, implies consideration of gender aspects in all spheres and levels of public life. Gender equality ensures the protection of women and men, the proper planning and fair management of the economy, recognizes different gender needs.

Different gender needs must be taken into account in the prevention, management, response or recovery from natural disasters. An approach that identifies gender needs, takes them into account, and implements appropriate activities or support is called gender mainstreaming.

As it is known, the number of women injured during natural disasters exceeds the number of men. The reason for this may be that a man is physically stronger than a woman; Or women are less prevalent at swimming than men, which can lead to their death during floods. During the evacuation, women prepare children, the elderly, and take care of collecting basic, essential items or documents.

Family activities are mainly performed by women due to their traditional roles. Because of disasters, people often have to leave their homes and move to temporary shelters with their families, where women have to do household chores in difficult conditions.

When considering gender aspects, we should pay attention to pregnant women who need a special approach to the course, management or recovery of disasters. They face special difficulties during evacuation - they find it difficult to carry basic necessities themselves; They are even more anxious because they are unable to help their family members. This issue is especially acute when they have young children; It is also more difficult for them to adjust to the conditions of temporary residence. Pregnant women who need medical supervision can no longer receive medical services, which can negatively affect the health status of them and their unborn children.

Therefore, it is important to prepare pregnant women through the training they need to receive and respond to the impending disaster.

THE DISABLED

Who are people with disabilities (the disabled)?

A person with a disability is a person with a variety of physical, mental, intellectual or sensory impairments that may prevent him or her from fully and effectively participating in public life on an equal footing with others.

People with disabilities belong to one of the most vulnerable categories of society. Consequently, their risks to life and safety during natural disasters are further increased. In such cases, they face various types of physical, social or mental problems and barriers, which pose a serious threat to their life and health.

THESE PROBLEMS AND BARRIERS ARE AS FOLLOWS:

- A person with a hearing or vision impairment may not be able to understand or read an early warning message, a person with an intellectual disability may not be able to respond adequately;
- People with disabilities need more time and help during evacuation;
- Improper equipment used during survival can make it even more difficult for people with disabilities;

- Primary asylum may not be convenient, adapted for a person with disabili ties, which in turn will further complicate their situation;
- Difficulty with moving and spatial orientation, need to travel long distances to be accommodated in a shelter.
- In case of urgent response, the rescuer may not be able to accurately iden tify the disability and consequently, the disabled person may not be able;
- Understand/perceive warning signals;
- Insufficient human resources to provide assistance;
- Inadequate first aid;
- Lack of social support.

It should be noted that the effects of disasters are not only negative. In less developed countries it can become a stimulus for development as it is often associated with the introduction and reconstruction of new technologies.

Natural disasters cannot be avoided, but through proper management it is possible to significantly reduce their negative consequences, saving significant lives, health and material resources.

IMPORTANT ASPECTS OF DISASTER MANAGEMENT, MANAGEMENT PHASES AND KEY TERMS

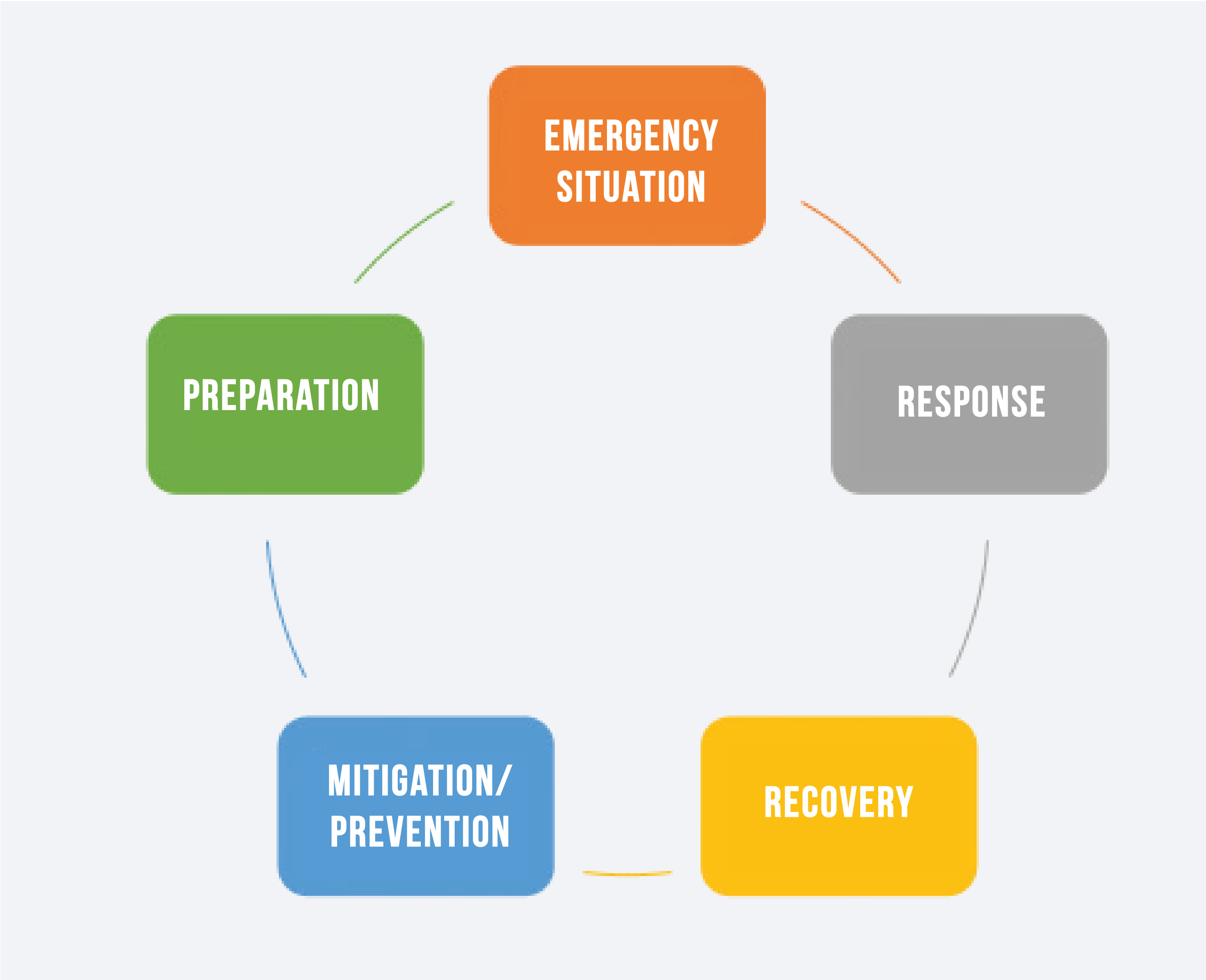
- Disaster management is a clearly defined complex data and is reflected in the harmonious combination of measures planned and implemented by government agencies aimed at preventing or reducing the social, economic and environmental damage caused by possible disasters, ensuring human safety, rapid response and effective remedial work.

- It is also very important to coordinate local governments and work in coordination with the community and the central government.

- In general, one of the most important determinants of good practice in the world in the face of disasters is the principle of coordination and teamwork.

- In disaster risk reduction, it is essential to constantly monitor human or natural risk factors and to take appropriate safeguards as far as possible.

- Clearly, in an emergency/disaster management process, it is also very important for proper action to have a proper understanding of the fundamental terms on which the respondents operate appropriately in time and space.



RESPONSE

In the event of a catastrophe or as soon as a catastrophe occurs, emergency assistance and state support will be provided to save people's lives, reduce harm to their health, ensure public safety, and meet the basic needs of the affected population.

RECOVERY

Restoration and improvement as needed of relief facilities, livelihoods and living conditions for the disaster-affected community, which also includes efforts to reduce disaster risk factors.

MITIGATION

Mitigation includes measures to reduce or limit the negative impacts and related threats. In many cases, it is not possible to completely avoid the negative consequences of threats, although through various actions their scale and severity can be significantly reduced.

PREVENTION

Prevention is the complete avoidance of threats and the negative consequences of related disasters. The term “prevention” expresses the concept and intention, which means to avoid potential negative impact through pre-measures.

PREPARATION

Acquisition of knowledge and capacity building by government agencies, organizations, communities and individuals specializing in response structures and recovery to effectively anticipate, respond to, and subsequently identify anticipated, imminent, or already identified hazardous events or circumstances.

EMERGENCY SITUATION

Significant disruption to the functioning of a community, involving large-scale human, material, economic or environmental losses and/or impact beyond the ability of the affected community or community to deal with its own resources.

RISK

A combination of the probability of an event and its negative consequences.

DANGER

Dangerous event, substance, human action or situation that can lead to death, bodily injury, disease or deterioration of health, property loss, loss of livelihood and disruption of services, disruption of socio-economic systems and damage to the environment.

CATASTROPHE

A natural disaster of a magnitude in time and space that causes significant disruption to the functioning of a community, involves large amounts of human, material, economic, or environmental losses that exceed the ability of the affected community to cope with its own resources.

VULNERABILITY

Vulnerability is defined as the characteristics and circumstances of a community, system or property that make them vulnerable to the harmful effects of a threat. There are many aspects of vulnerability that are driven by material, social, economic and environmental factors.

EVACUATION PLAN

The evacuation plan for the building is prepared by the local services of the Emergency Management Agency. The evacuation plan should include: stairwells, elevators and adjacent halls, rooms, utility rooms, corridors, balconies, outdoor stairs, as well as all doors on the stairwell, elevator adjacent hall and evacuation route. Storage room names should be written directly on the floor plan or they should be numbered and displayed in the right corner of the drawing; The door should be shown in the open position. If some of the exits are lined up during operation, then the door openings on the evacuation plan should be shown in the closed position. The place of storage of the key should be indicated by the following inscription - “Box with the key to the outer door”. If the building is equipped with an external fire ladder, then the evacuation plan should be marked “Exit to the fire ladder”. The main evacuation routes on the floor evacuation plan shall be marked with solid green lines and the additional evacuation route with green dots (dashed line). These lines should be twice as thick as the building drawing lines; The main evacuation routes should be directed to the stairwells with external exits, as well as to the stairs leading to the first floor. If two stairwells are equally important in terms of fire and smoke protection, then the main evacuation line should be directed to the nearest stairwell. Evacuation route lines should run out of each storeroom (room) and should end at the exit of a safe place or directly outside the building. Evacuation vectors should not intersect and should ensure that an equal number of persons are handled in a short period of time. The floor plan will be marked with special symbols to indicate the location of fire alarm buttons, telephones, fire hydrants, fire extinguishers. The symbols mentioned above must comply with international standards. The characters must be marked clearly. Character definitions must be provided under the evacuation plan in Georgian and English. The height of the text letters should be no less than 7 mm and the width - 5 mm. The graphic part of the evacuation plan should indicate the telephone numbers of the fire and rescue service, the head of the organization, the duty personnel and the security service and the application of special markings (symbols). The floor plan should not be overloaded with unnecessary details.

Identify the person responsible for sounding the alarm during emergencies; Identify the person responsible for opening the evacuation exits before evacuation and prepare the evacuation exits; Identify flow regulators (direction guides in the corridors) and supervisors with stairwells at the floor during emergencies; Identify the person responsible for assessing the safety of stairwells prior to evacuation.

When you hear the evacuation message, try to stay calm, do not panic; Leave the building according to the evacuation scheme. Before starting the evacuation, make sure that the evacuation routes are safe (whether the evacuation sequence of the load-bearing structures of the building is indicated). Before starting the evacuation process, the following should be done: Identify the person responsible for opening the evacuation exits before evacuation and prepare the evacuation exits; Identify flow regulators (direction guides in the corridors) and supervisors with stairwells at the floor during emergencies; Identify the person responsible for assessing the safety of stairwells prior to evacuation. Preliminary intelligence of the evacuation route should be carried out by an authorized competent person of the emergency group in accordance with the Emergency Management Plan. The building must be evacuated through at least two stairwells (recommended at the end of the corridor or in the middle of one of the corridors). It is not allowed to use the elevator during an emergency evacuation (if the building has one). After evacuation from the building, it is necessary to move to at least a distance equal to the height of the building and to gather in a pre-determined safe place.

In order to reduce the risk of disasters, it is essential for the state to have the relevant legal documents and also to participate and sign international agreements, framework programs or memoranda, which ensure the implementation of various types of security measures.

Law of Georgia on Civil Security (May 29, 2014);

Resolution # 508 of the Government of Georgia of September 24, 2015 "On Approval of the National Civil Security Plan";

Resolution # 371 of the Government of Georgia of July 23, 2015 "On Approval of the Regulation on the Implementation of State Fire and Civil Security Supervision in Georgia";

Resolution # 68 of the Government of Georgia of 21 March 2008 on the Approval of the Regulation on the Rules for Determining the Classification of Emergency Situations;

Resolution # 51 of the Government of Georgia of January 14, 2014 on the Approval of the Technical Regulation on Civil Engineering and Technical Measures;

Resolution # 153 of the Government of Georgia of June 4, 2010 "On Approval of the Charter of the Emergency Response Force";

Resolution # 154 of the Government of Georgia of June 4, 2010 "On Approval of the Instruction on the Rules for Submission of Security Declaration";

Resolution # 370 of the Government of Georgia of July 23, 2015 "On Approval of the Technical Regulation on Fire Safety Rules and Conditions";

Disaster Risk Reduction Framework Action Plan Sendai 2015-2030;

European Civil Security Forum Brussels 2015.

Different types of documents must take into account the geographical specifics of Georgia and, as far as possible, must be adapted to the nature of potential disasters in Georgia, as well as regional peculiarities. Obviously, in the global world, there is a unified approach and solution to disaster reduction, although individual approaches significantly determine disaster preparedness and the implementation of appropriate mitigation or prevention measures.

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