

REDUCING THE RISK OF  
**CLIMATE-DRIVEN  
DISASTERS**

ROAD MAP FOR SCHOOLS

TBILISI  
2020



The road map has been developed by the LEPL Environmental Information and Education Centre (EIEC) under the Ministry of Environmental Protection and Agriculture of Georgia (MEPA) with the support of UNDP.

The information comprised by the document reflects seven main hazards, containing particular risks for Georgia, caused by the climate change – floods, hail, drought, landslide, strong wind, avalanche and mudflows.

The road map has been prepared within the confines of the large scale initiative of the government of Georgia and UNDP, which aims at protecting the population against disasters, driven by the climate change, including the above mentioned hazards, and which take place within the basins of 11 rivers of Georgia - Enguri, Chorokhi-AcharaTskhali, Supsa, Natanebi, Khobi, Kintrishi, Mtkvari, Aragvi, Khrami-Ktsia, Alazani and Iori.

Resistance of the population of Georgia towards the climate hazards will be increased as a result of implementation of this seven year program. Climate disasters' impact of the infrastructure and on the living environment will be reduced and 1.7 million people will be better protected against inundation, flooding, drought and other natural calamities.

The seven year initiative „**Reducing the Risk of Climate-Driven Disasters in Georgia**” is being implemented under the financial support of HCH, SDS, governments of Sweden and Georgia.

The main goal of the presented resource is to increase the awareness among the school community and stake holders on the issues regarding reducing the risk of the climate change and related disasters.

The general knowledge and awareness regarding disasters, reflected by the project also implies civil responsibility. If required it provides for proper readiness and psychological resistance, needed for ensuring safety of an individual or others.

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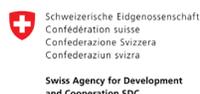
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# THE CLIMATE CHANGE AND GEORGIA

Presently globalization process is taking place throughout the world; and in the given reality global challenges have significant role and impact on development of particular countries, mostly having adverse implications. The climate change is exactly this kind of the global challenge, causing various natural calamities and even disasters, having negative impact on the countries and undermining stable social-economic lives of their populations.

Strictly speaking, obviously, the climate change, is a natural process, though in 95 % of cases it is caused by the human activities; as a conceptually new challenge, it was identified in the mid of the last century, when inadequate and irrelevant increase of global average annual temperatures were recorded. The impact of the climate change on the environment is reflected in melting the layers of glaciers and ice, increase of the world ocean level, floods, mudflows, landslides, avalanches, tsunamis, increase in the strength and frequency of various storms and tornados.

As a result of the climate change we witness the change in the nature and ecosystems, increased risks of human diseases. It is noteworthy, that intensity of the adverse outcomes of the global warming increases every year, which indicates to the vital importance of solving of the above problem.

It is obvious, that Georgia is not an exception here and our country is also experiencing painful impact of undesirable outcomes of the climate change.

Due to its specific and complex physical-geographic characteristics, Georgia can be considered to be a poly-climatic country. Therefore, climatic changes taking place in a small country, like Georgia, is felt more painfully compared with large countries with insignificant diversity of climatic types, or so called mono-climatic countries.

It is obvious, that economic-social well being of the population of Georgia largely depends on it climate fluctuations, if we consider the number of casualties and victims of floods, avalanches, landslides and other natural disasters, which is increasing on annual basis. Intensity and nature of geographic-biological processes, as well as human activities (food production, development of energy sector, transportation networks, construction etc.) is closely related to the climate change and therefore increases sensitivity and vulnerability of social-economic behavior and state of the population.

Based on the climate change there is a forecast that by year 2050 average increase of the temperature in Georgia will be 0.9-1.9 Celsius, and by 2100 it may reach 5.5 Celsius. Frequency and number of heat waves will also grow, sediments regime will change, desertification process will become more intensive, causing scarcity of land resources, sea level will increase, various natural calamities will become more frequent, number and scale of disasters will grow.

Based on the data of the National Agency of Georgia, it can be said that frequency and geography of various natural disasters has significantly grown in Georgia during the recent years.

In 1995-2009 aggregated economic and human losses of all kinds of natural disasters implied: economic loss exceeding 1.3. billion USD, almost 700 000 affected persons, and most regrettably – 1000 victims.

Another important message is reflected in Georgia's Second National Communication under the United Nations Framework Convention on climate change, which implies that frequency and duration of droughts will significantly grow in Eastern Georgia, being a significant precondition for increase in the demand on water resources. Concurrently there is anticipation for decrease of water resources of the rivers in Eastern Georgia, particularly in so called transit rivers, such as Mtkvari, Alazani and Khrami. E.g. in Mtkvari, water level reduction in Mtkvari is 26-35 %. It should be noted that by 2100 need for artificial irrigation of agricultural lands will significantly grow in Eastern Georgia.

We may talk a lot about past facts and future forecasts, as well as relevant prospects, but here we will only tackle singular examples, which we consider are sufficient that you fully understand the scale of the problem and realize the functional contribution and the role each of you may play in solving the above.

Therefore it is absolutely essential that tangible or intangible activities adapted to the given certainty of climate change are implemented in all possible ways.

Education and awareness are so called intangible or intellectual assets, which may be considered to be the most important resource at the first stage of problem resolution.

This belief is supported by Tbilisi Declaration record based on UNDP Environmental Program definition:

Increase of awareness and knowledge on the environment and environmental challenges;

Development of skills required for environmental problem resolution;

Formation of a citizen informed on environmental problems for the purpose of implementing high commitment activities.

It is absolutely obvious that education is needed; education, given its specific character and nature, is based on the principle of on going process of teaching/learning. Family is the very first step of this on going process, later being substituted by preschool institution.

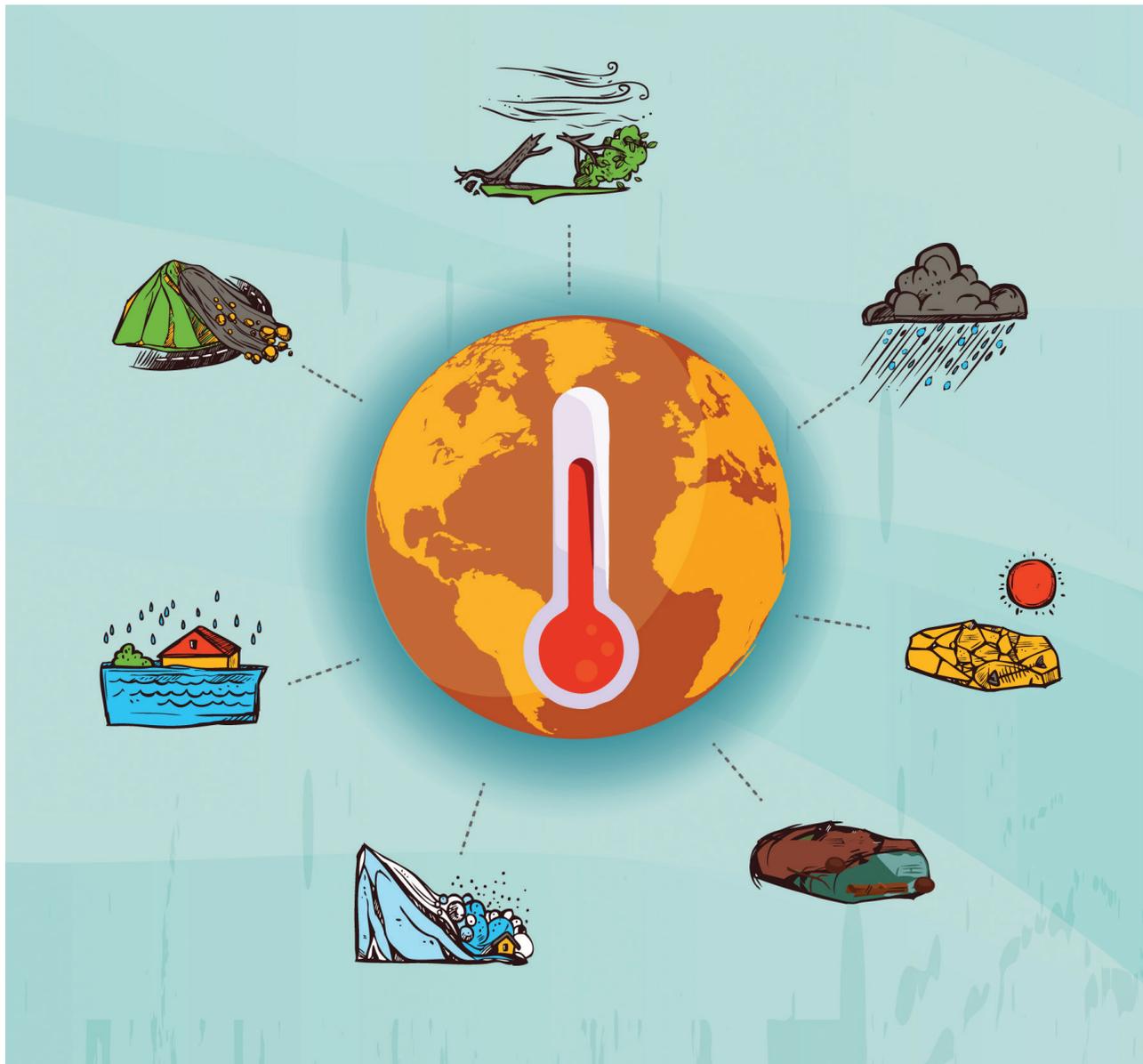
Therefore, we decided to suggest for the staff of the schools an information brochure on the issues related to reduction of risks of climate driven disasters.

The primary objective of the present publication is to provide the necessary information, so that the decision makers at the schools obtain the minimum knowledge and develop skills for ensuring safety of their charges.



Vakhushti, the great geographer and historian, was the first to provide comprehensive description and assessment of the climate of Georgia. It is very important that Vakhushti Bagrationi 300 years ago presented characteristics of Georgian nature with all its components, including climate. In that period it was not feasible to carry out instrumental monitoring over the climate. The monitoring processes were not implemented even in Europe; But in Georgia they started since 1844. Though he did not have technical equipment needed for monitoring the climate, he still managed to provide extremely accurate characteristics of the climate of Georgia. The description was based on sensor method, in other words, personal senses and perceptions.

Vakhushti Bagrationi, living in Russia, managed to carry out comprehensive characterization of the climate of Georgia back in 1742 on the basis of factual data and personal observations, provided in his work - "Geography of Georgia". Terms, applied by Vakhushti while describing the climate of Georgia, are rather interesting: "Unbelievable", "kind", "beautiful", "wonderful", "hot", "breezy", "merry", "cool", "rainy", "snowy". He was the first one to provide holistic characteristics of diverse climate of Georgia, which later became the basis for the regional climatology of the country and ensured its scientific development to present day. Anthropogenic irrational activities, carried out in relation to the environmental, which are the warrant of material wellbeing, on the other hand cause substantial and most regrettably undesirable changes in the environment, supporting development of negative processes. These processes on their own, with domino effect destroy social-economic systems. It should be noted that the global climate change is the main and the most important reason for increased frequency of natural disasters. Climate change, which usually takes decades or even longer periods.



Reduction of the risk of disasters on one hand implies their proper management, which on its own depends on knowledge of the issues of primary importance.

Here we present the list of the components which in aggregate will ensure safe environment at your institutions.

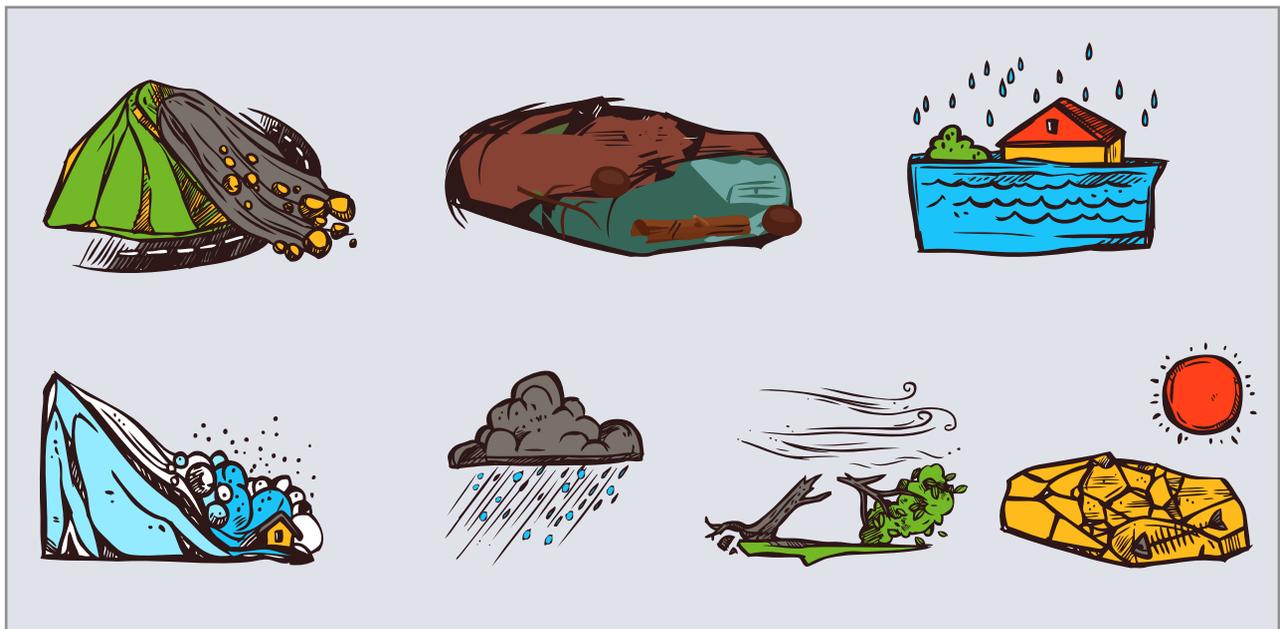
### Components:

- 1.** General knowledge on natural events and rules of behavioral actions on your part
- 2.** Vocal alarm signal
- 3.** Evacuation plan and relevant exit/movement ways

4. Safe space after evacuation

5. Permanent talks with colleagues on these issues,  
If possible, practical simulation evacuation, or at least tabletop games

## TYPES OF DISASTERS



Disasters may cause significant losses to humans and the environment. According to the origin, there are various types of extreme natural events:

**Geophysical natural events** - earthquake, tsunami, volcanic eruption, landslide, mud flows, mass movement, avalanche, subsidence;

**Hydrological natural events** - floods, landswell, land slide processes caused by excessive sediments;

**Meteorological natural events** - strong winds and rainfall, tropical storm, extreme temperatures, hail and fog;

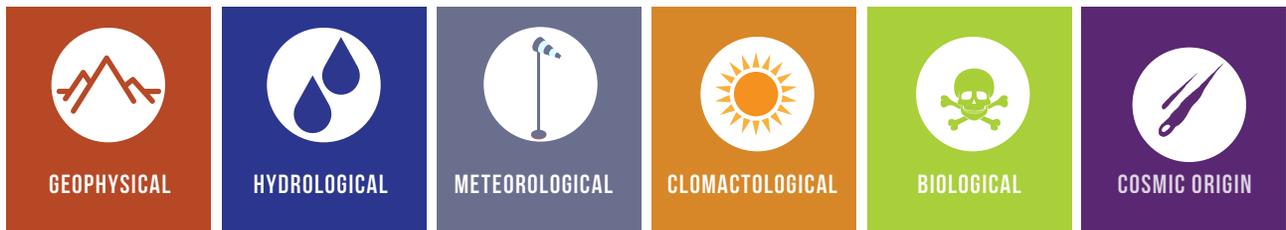
**Climatological natural events** - droughts, desertification, forest fires, glacier lake outburst;

**Biological natural events** - epidemic/pandemic, mass animal destruction (e.g. as a result of forest fires), insect born infections etc.

**Disasters of cosmic origin** - cosmic weather, large size meteorites etc.

Natural events may differ in accordance with their intensity, frequency, duration, areas, speed, scale of development and alternation within the time.

# CLASSIFICATION OF DISASTERS<sup>1</sup>



## WHAT IS THE DIFFERENCE BETWEEN “NATURAL EVENT” AND “DISASTER”



Natural events, such as earthquake, storm, flood etc., are associated with disasters. Though it should be mentioned that natural events are considered as disasters, when they are characterized with large scale negative outcomes for humans.

We will give an example for clear demonstration of the above: an earthquake, which is a natural event, is not considered a disaster regardless of its intensity, in case it took place in an uninhabited place and therefore had no adverse impact on humans and infrastructure. To be more precise, a disaster implies significant undermining/ destruction of functioning of a community or a society, causing large humanitarian, material economic and ecological losses, and exceeding capacity of affected community or society to overcome the outcomes of the event with its own sources.

Natural events are processes collateral to the development of the Earth, though as a result of intense anthropogenic interference, and in view of the climate change their scale, frequency and destruction power is significantly increased.

1. Annual Disaster Statistical Review 2015, p.7 Centre for Research on the Epidemiology of Disasters (CRED), Institute of Health and Society (IRSS), Université catholique de Louvain – Brussels, Belgium

E.g. presently hydro meteorological natural events, such as tropical storms, tornados, floods and droughts happen much more frequently. According to the data of one of the high credibility international organizations (World Watch Institute) average annual indicator of natural disasters was 300 in 1980-ies, it became 480 in 1990-ies, and reached 620 in the last decade.

Losses caused by natural disaster increase through the world for various reasons, namely:

- **Growth of number of weather associated extreme events related to the climate change;**
- **Growing pressure on natural resources and their excessive utilization;**
- **Unsustainable agricultural practices, increasing risks (e.g. unsustainable cattle breeding, or biofuel production on territories, previously occupied by forests);**
- **Growth of the population and unplanned urbanization process, producing increased demand on food, commodities and services).**

It should be mentioned that degraded environment further amplifies effects of natural events. So to say, natural calamity is a dangerous natural event, which has adverse impact on humans. This is an adverse effect what we call a natural disaster. In other words, natural calamity, causing damage to humans is called a natural disaster. Natural calamity, resulting in natural disaster, both are processes taking place in the nature, which have occurred, occur and will occur during the whole period of existence of the Earth.



# LANDSLIDE

**Landslide** is tearing away of soil or bed rocks under its weight and its swift movement in the direction of the slope gradient. Landslides occur when gravitational and other types of shear stresses within a slope exceed the cohesive strength of the materials that form the slope, which is caused by corrosion of the basis of the slope, or weakening of bed rocks shear stress as a result of soil depletion, seismic shocks or anthropological activities carried out without considering local geological conditions (explosion works etc.).

Volume of mass moved during the landslide may reach tens and hundreds of thousand cubic meters, and sometimes even more. Speed of the landslide may fluctuate between several meters per year - meters per second. Landslide may cause damage/destruction of residential or industrial buildings, engineering and road facilities, main pipelines and power transmission lines, as well as injuries or death of people.



There are 4 zones of landslide damages and possible development of landslide processes in Georgia:

- Zemo Imereti, Abkhazia mountain slopes, Racha and Inner Adjara belong to the highest categories of landslide prone territories;
- High intensity of landslide development is characteristic for slopes of the North exposition of Tsiv-Gombori range, As well as majority of hilly landscapes of Western Georgia and Meskheti.
- Northern slopes of Trialeti are also landslide prone territories;
- Landslides practically do not happen on Kolkheti lowlands, Alazani Valley and Shida Kartli plateau.

Natural calamities caused by landslides and mass movement are rather significant. Presently there are up to 50 000 landslide bodies registered in Georgia. There are about 2 000 settlements with the population of 200 000 inhabitants within the zones of the above hazards. Total area of landslide affected territories exceeds 1.5. million hectares. Statistical data collected during recent decades demonstrate that there are 15- 20 landslide events registered annually in Georgia.

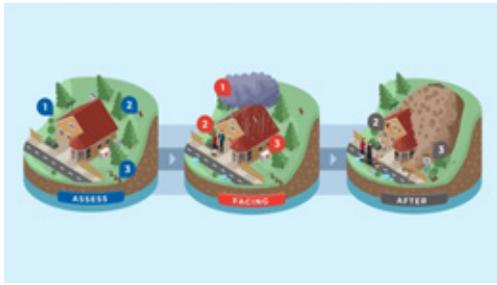


## Tsablana Tragedy

On April 19, 1989 mountain slope subsidence and landslide in the village Tsablana, Khulo district, Adjara, has caused death of 23 persons, including 3 children. Landslide processes were preceded by strong continuous rainfalls; tragic events took place at late night, when people were asleep and had very little capability to survive. The disaster which happened in 10 days after the tragedy of April 19, put the surviving part of the population in extremely hard situation. The authorities promptly evacuated the village community and placed them in Batumi and Mtsvane Kontskhi resorts. Approximately 800 000 cubic meter of inert mass moved down as a result of landslide processes. An artificial lake was created as a result of ponding of River Skhalta. In 2 years the river found its way down the gorge and returned to its old river bed.



## HOW TO GET READY FOR LANDSLIDES



- Obtain information on sites of possible landslide formation and their boundaries;
- Cattle grazing as well as growing crops, requiring hoeing and loosening shall be forbidden on territories affected by landslides;
- Ground water and runoff water resulted from rainfall shall be removed from landslide affected territories via drainage canals;
- Remember notification signals of the landslide hazard.



## SIGNS FOR STARTING OF LANDSLIDES

- Wedging of doors and windows of buildings;
- Appearance of cracks and clefts on the roads;

- Dripping of water on landslide prone slopes;

- If noticing landslide signs, notify the closest site of landslide response station, wait for the information from the above station and take relevant measures in accordance with the present rules.



## HOW TO ACT IN CASE OF LANDSLIDE

- When receiving the signal on the hazard of landslide, switch off gas and electric appliances, close water taps, and get ready for immediate evacuation in accordance with preliminary plan;

- Act in accordance with landslide response station information – on the speed of the landslide. In case the speed of landslide is low - several meters in month - act in accordance with your alternatives: move the constructions to the preliminary planned location, remove the furniture and luggage. In case the speed of the landslide exceeds 0,5 - 1,0 meters in 24 hours, the evacuation shall be started immediately, in accordance with the preliminary developed plan **in the direction perpendicular with the landslide movement**;

- You should take the documents, valuables, warm clothes and food products with you during the evacuation;

- Immediately move to safe place in accordance with the circumstances and administration instructions.



- Check the condition of walls and roofing in the buildings surviving the landslide, identify damage of power, gas and water supply networks; Help the rescuers to withdraw people from the debris and assist them.



## MEASURES AGAINST LANDSLIDES

- Afforestation;
- Arrangement of landslide preventive engineering constructions–piles, bearing constructions.



# AVALANCHE



**Avalanche** is a natural calamity with destructive power of geophysical origin. It usually occurs in mountainous places as a result of excessive snowfalls and temperature fluctuations. Avalanche is accompanied by noise and rumbling sound, carrying large flows of air.

There are two types of avalanche – dry and wet:

- **Dry avalanche** consists of powdery snow and during movement is accompanied by air wave, having destructive power.
- **Wet avalanche** is characterized with dense, cohesive snow and certain volume of water. The period when avalanche is anticipated is called avalanche season.

Period from January to March is considered the avalanche season in Georgia. This is when 71 % of avalanches occur. Power of avalanches mainly depend on the slope gradient. Majority of avalanches are formed on the slopes with 30° gradient. There are singular cases when avalanches occur on the slopes with 15-20° gradient. The avalanche is formed when snow cover exceeds one meter. There are also landscape characteristics, accelerating or hindering the avalanche formation.





Among the internal factors we should note composition of snow cover, its transformation features, and temperature regime. External factors comprise weather conditions, vegetation and soil cover, nature of relief formations, earthquake or other mechanical effects.

Avalanches are more common in Western Georgia, compared to Eastern part of the country, which is due to heavier sediments, as well as steeper slopes.

Each year avalanches cause significant damage to mountainous regions of Georgia and threaten human lives. Large part of transport communication network and settlements are within the avalanche prone zones. Frequently avalanches cause isolation of settlements (and sometimes municipalities) because of blocked roads.

Collection of relatively comprehensive and detailed information on avalanches in Georgia became feasible after regular traffic started to move on former Military Road in the XIX century. According to the statistical data number of avalanches in Georgia ranges between 3 and 8. Avalanches became especially intense on southern slopes of the Caucasus and mountainous Adjara. Namely, powerful avalanches occurred in years 1975–1976, 1986–1987 and 1996–1998.

Below are given a number of important avalanche events registered on the territory of Georgia:

**68 inhabitants** of village Ginati were killed in avalanche **on March 7, 1850;**

**112 inhabitants** of village Arashenda were killed in avalanche **on February 14, 1932;**

**27 inhabitants** of Mulakhi sakrebulo were killed in powerful avalanche **in 1987**, several buildings were destroyed. The volume of the avalanche was 1.5 million cubic meters, and depth was 80-100 cm <sup>2</sup>



## 1987 year avalanches in Svaneti

Unusually heavy snowfalls occurred in 1987, resulting in activation of avalanches, which covered 36 % of the territory of Georgia. Svaneti witnessed the hardest winter in the recent years. In January several villages were buried under 3—meter snow cover. Snow was so high that 10 meter deep avalanches occurred nearly in all gorges.

1987 year winter took 85 lives, approximately 2000 houses were buried under avalanches. Various buildings, motor ways, transmission lines, as well as Svaneti towers and old traditional dwellings – Machvibi – were destroyed. The roads were blocked, villages became isolated from the outer world, means of communication broke down. Ushguli and Mulakhi municipalities suffered the most; there were no undamaged buildings left here. Towers in Murkmeli and Jamushi were damaged and destroyed.

The loss exceeded 300 million USD. 16 000 persons were evacuated from the affected territory. Hundreds of local households became eco migrants as a result of the avalanche. Governments of Georgia allocated them in various regions. Majority settled in Kvemo Kartli. Some households settled in Village Udabno.

Since then, there have been no natural disasters of this scale in Svaneti, though this region of Georgia has been considered natural disaster hazardous zone for years.



### HOW TO ACT IN AVALANCHE PRONE ZONE

- Do not go to mountains in bad weather and snowfall;
- While being in mountains pay attention to change of the weather;
- If going to the mountains be aware of avalanche prone sites in the places of your trip or hike;
- Avoid avalanche prone sites. Avalanches are more frequent on the slopes with gradient of 300, and on slopes with no vegetation and forest cover, with gradient exceeding 200. During snowfalls avalanches occur on the slopes with more than 450-gradient;
- During avalanche season avoid slopes and foothills within 20°-gradient.

**Remember** - The most dangerous avalanche season is a spring day, when the snow cover is already high and it starts to melt, in the warmest period of the day, from sunrise to sunset. Avalanche season may last till summer months in high mountainous regions.



## HOW TO ACT IN CASE OF AVALANCHE

- Immediately leave dangerous place and run or walk fast to the safe location. Avoid the cliff ledge and do not stand behind young trees;



- In case we cannot avoid the avalanche, get rid of the luggage, lie horizontally or roll up, with your head in the avalanche movement direction;



- Try to hold your knees close to your abdominal with tightly clenched hands;

- In order to protect the mouth and nose, cover the face with gloves, scarf or collar. Try to stay on the surface of the avalanche, while trying to move to the side of the avalanche with swimming movements (avalanche movement speed is always lower at the side);

- Once the avalanche stops. Try to create the free space around your face and chest, to ease the breathing;



- If possible try to move towards the ground surface (you can find where ground surface is, according to the direction of falling of an object or saliva);

- Do not shout if caught in avalanche, snow completely blocks the sound, save your energy, oxygen and warmth;

- Try not to sleep;

- Remember, that they are looking for you and you are definitely going to be rescued. There have been cases when people caught in avalanche were saved after several days and even after two weeks.



## HOW TO ACT AFTER THE AVALANCHE

- If you find yourself outside the avalanche zone , use any means to notify the administration of the closest settlement about the disaster and start looking for the victims;

- Independently or with the support of rescuers check your body while getting out of the snow and provide aid to yourself if required;

- Notify your relatives and family about your state and location;

- While getting to the closest settlement, notify the administration about the avalanche;

- Apply to the local medical center or a doctor even in case you think you have no injuries. Later act according to instructions of a doctor or a chief of the rescue team.



# MUDFLOW



**Mudflow** ( sill flow) is rock–mud mass, moving down the river bed. It is a temporary flow/ mixture of water and large number of mountain rock fragments, clay particles, large stones and boulders, rapidly forming in small mountain river beds and ravines.

According to their composition mudflows may be stone/silt or water/ stony. Solid suspended particles (stony fragments or clay mass) may be result of:

- Exhaustion;
- Landslide-gravitation processes – erosion, accumulation, or their combination.

Factors provoking mudflows:

- Heavy rainfalls;
- Fast melting of snow or glaciers;
- Disruption of natural or artificial reservoirs etc.



Mudflow occurs rather rapidly and moves at high speed (4 m/s or more). Mudflow usually moves by spurts, from one obstruction to another. Sill flow moves at the speed of 10-12 km /hour and has destructive power.

Mudflow frequently occurs in form of waves, it may last from 10 minutes to several hours. Mudflow wave may reach 15 meters in height. Roaring and rumbling sound of mudflow can be heard at long distance. Mudflow is a disastrous event – people get killed, houses, engineering and road constructions are destroyed.

Each person, living in the mudflow prone zone, shall determine whether their dwelling is located in the possible route of mudflow. Residential houses should not typically be built in such places. In case the house already exist in such dangerous location, measures shall be taken for reinforcement of basement and walls, construction of earthwork, diversion channels, stabilization of slopes with plants or bearing walls, arranging additional protection for communication lines.



**Duruji River** first destroyed Kvareli in 1832 year. Next time the tragedy occurred in year 1904, when the river flooded the city and swept babies in their cots out of houses. In 1906 protective dams construction was carried out lead by Ilia Chavchavadze. They protected the city till 1949. Up to 40 disastrous mudflows were registered in Duruji basin during the recent 100 years, killing more than 200 persons. It has been stated that permanently renewed mudflow spot area in Duruji river is 20 sq. km. and volume of solid mass of mudflow is 500 million cubic meters. Experts believe that disastrous rock and mudflows are formed every 12-14 years in the upper part of Duruji river bed. These flows with large stone fragments move with the speed of 80-100 km/h and having 20 -25 m height front, thanks to the high density easily overcome and destroy any obstacles. In 1889 this kind of mudflow brought 140 ton boulder from the head of Duruji river down to Kvareli, which was an extraordinary fact and was entered The Red Book of Georgia. This “large stone” is one of the natural sights of Kvareli and is located in the North from Kvareli, on the territory of so called military barracks, at the left bank of Duruji River.

It is well known, that if not for mudflow discharge of Duruji River, there would be no wine “Kindzmarauli” in Georgia. The above colloid sediments are characterized by unique composition, which creates specific environment for the vineyards along the river. Based on soil characteristics of the above micro zone allow to use the vine variety “Saperavi” for producing wine “Kindzmarauli”.





## HOW TO PREPARE FOR MUDFLOW

Usually people are aware of mudflow prone territories. Study these places on your route prior to travelling to the mountains and avoid them after heavy rain-falls. Always remember that it is almost impossible to save a person trapped in the mudflow. You can only be saved from the mudflow by avoiding it;

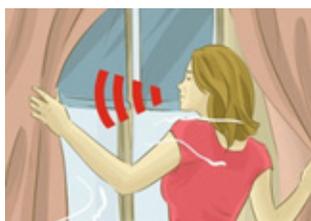


Prior to evacuation, switch off the power supply, close gas and water taps. Tightly close doors and windows and ventilation pipes.



## HOW TO ACT IN CASE OF MUDFLOW

In case of receiving warning/signal (siren, radio, telephone or any other preliminary agreed means) about approaching mud flow or in case you hear roaring sound, with bubbling water and crackling of stone fragments, resembling the noise of approaching high speed train, immediately move 50-100 meters up the slope from the valley and plain, or possible water runoff places;



At the same time you should remember that large boulders and stones may get erupted from the violent flow, inflicting danger to human lives;

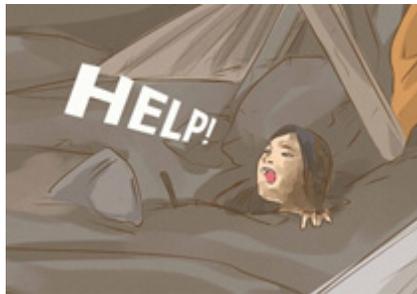


Try to evacuate to the safe location in accordance to the preliminary evacuation plan.



## ! HOW TO ACT AFTER MUDFLOW

- Provide aid to the victims and help rescuers, cleansing debris and blocking mass on the mudflow route and sites of main mudflow runoffs.



## ! PRELIMINARY MEASURES TO PREVENT MUDFLOW

- Mudflow prevention dams and retention structures are constructed in mudflow prone territories, diversion channels are arranged, mountain lake water levels are regulated or decreased, trees are planted in order to stabilize the ground on the slopes, observations are carried out, notification systems are established and evacuation plans are developed.
- 



# FLOOD



**Flood** is significant inundation of the territory as a result of increase of the water level in a river, lake, sea, caused by grown water flow, snow melting, heavy rainfalls or wind driven water, river obstruction or other events. Land may be inundated by river or sea, therefore there are river or sea floods. Floods pose danger to  $\frac{3}{4}$  of land of the Earth. Thousands of people die as a result of floods, economic losses resulted from it is larger than damages from other disasters. Namely: Destroyed settlements, drowned cattle, eroded and silted ground, various diseases and hunger.



Majority of rivers in Georgia are characterized by spring floods, exceeding one month in duration. Flood may also follow river blockage by landslide. It should be noted that there was high snow cover and strong frosts, during winter and temperature increased dramatically in spring, accompanied by heavy rainfalls, there is high probability of occurrence of floods.

**Fluvial floods** are characterized by relatively slow speed of development, they are caused by long lasting rainfalls or quick snow melting. This type of floods take place when river bed capacity is insufficient for accommodating runoff volume.

**Pluvial floods or flash floods** occur in Georgia is a result of abrupt increase of runoff, produced by heavy rains, intensive melting of snow and/ or glaciers; it may also happen as a result of dam failure, blockage of the gorge by a landslide etc.

**Tbilisi, Vere river flood. On June 13-14, 2015**, heavy rainfalls in Vere river basin (according to Tbilisi meteorological station, 49 mm sediments were recorded in 3-4 hours) have resulted in significant increase of water level, triggered and activated landslide-mud flow processes on Vere river and its tributaries, causing death of people (19 person were killed), damage and destruction of city infrastructure ( Tskneti-Betania, Tskneti-Akhaldaba and Kojori-Manglisi motorways, a highway, connecting Tamarashvili street and Heroes Circle, residential houses along the Vera river located at low elevation points, various infrastructural facilities, Tbilisi Zoo, children's park "Mziuri")

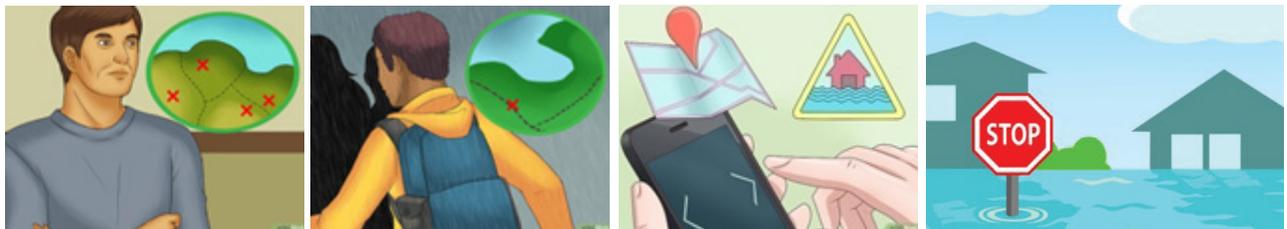


In the past there had been numerous cases of disastrous floods on Vere river. The first one was recorded on June 12, 1924 (Newspaper “Communist”, June 14, 1924). In the evening of June 12, at 8 p.m. as a result of heavy rainfall, which lasted approximately 1 hour, flood on Vere river washed sleeping farmers together with their carts and oxen down to Mtkvari river at the spot of Vere Mtkvari crossing and drowned them. Surprisingly, no strong flood have been recorded on other tributaries of Mtkvari within the confines of Tbilisi cave. Powerful floods on Vera river were also recorded in 1962 (strongly damaging Tbilisi Zoo ), as well as on July 5, 1982.

## FLOOD/INUNDATION PREVENTION MEASURES

In case your dwelling is frequently damaged by floods, study and remember

- possible boundaries of inundation. Also identify elevated areas in close proximity of your living, which rarely get flooded and remember their access roads;



- Inform your family members on evacuation rules as well as rules for acting in case of rapid flooding;

- Remember places for storing boats, rafts and construction materials needed for making them. Prepare a list of documents, medicines and objects you need to take with you during evacuation. In case of danger, pack warm clothes, food, water and medicines in your suitcase or backpack;



- Act rationally! In the periods when increase of the water level is not expected in the rivers, do not throw the waste into the rivers, canals and springs. In case you notice the waste in river and canal beds, notify the state agencies and utility companies;

- In the cities with increased surface runoff during the rainfall, do not put the waste in water pipes and do not close collection drains;



- If possible prepare sand bags in advance and place them at the entrance, to prevent water from getting in to the building;

- Do not close drainage pipes in summer.

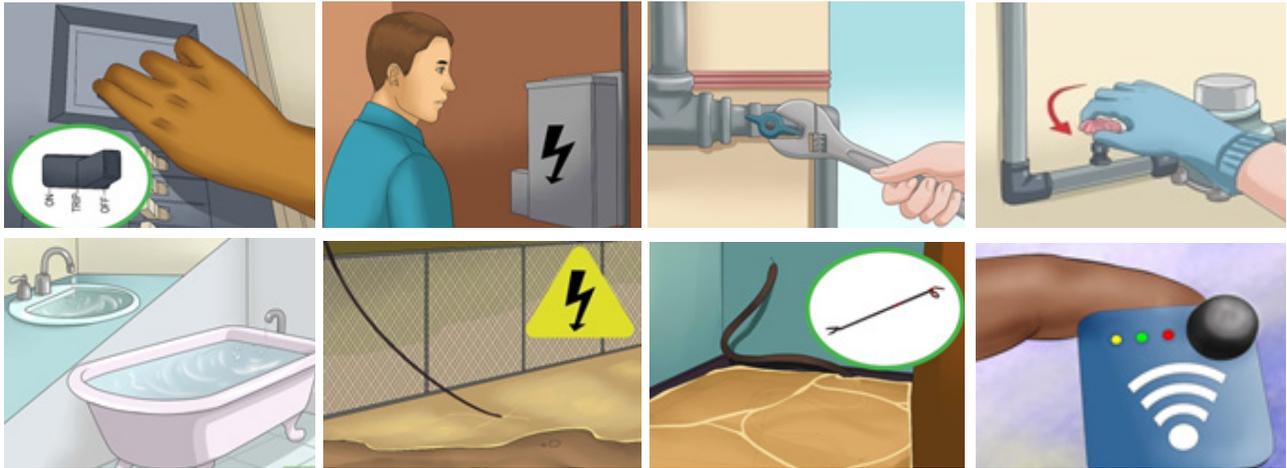


## HOW TO ACT DURING FLOODS

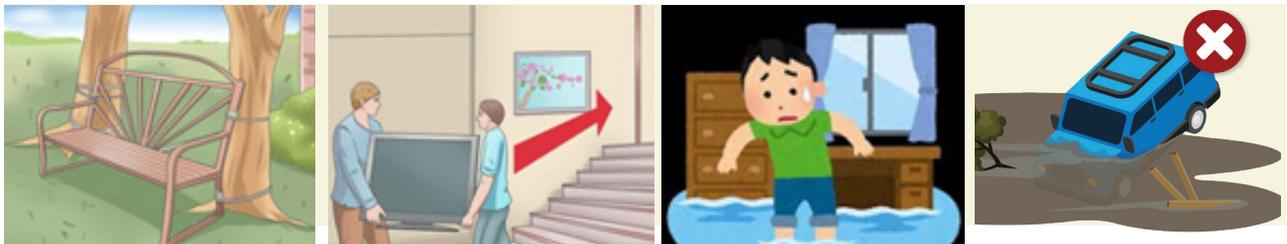
Upon receiving the signal on the danger of flood and evacuation immediately leave place of possible disastrous inundation and move towards safe location or elevated spot, taking documents, valuables, various objects and two days stock of food. Get registered in the evacuation center. Domestic animals are also subject to evacuation;



- While leaving the place of residence, switch off power, close gas, put out the fire in the stove, close all doors and windows.



- Fix all swimming objects located outside the building or put them in special facilities. If the time allows, take all valuable objects to upper floors or attic. Close doors, windows, and shutters, If time allows, nail up doors and windows with planks from outside;



- In case of unexpected disastrous flooding, in order to avoid outburst wave, promptly move to the elevated spot, climb the tree or get to upper floors of a stable building;

- In case you are in the water, do not get confused and stay calm if a wave is approaching you, dive deep, stay under the water for a while and then swim to the surface of the water;

- If you found yourself in the water get out to dry place swimming or with the help of swimming objects. Better get to embankment or dams. This will enable you to easier reach unflooded location;

- If you are in the water, try to get rid of heavy clothes and footwear and swim to unflooded place. Beware of objects swimming on the surface to avoid injuries;

- In case an organized evacuation is not carried out, get to upper floors of buildings, trees or other elevated objects prior to arrival of rescuers or decrease of the water level. Concurrently communicate continuous signals about the disaster: in daytime - waving a visible bright piece of cloth tied to a stick and at night - using a light signal or periodic vocal signals;

- After arrival of rescuers get to their swimming device carefully, without panic; Listen to rescuers' instructions and act according their requests. Do not exceed boat capacity, do not leave your seat during the trip, do not seat on the outer line. Act exactly in accordance with the crew instructions.



## HOW TO ACT AFTER THE FLOOD

- Prior to entering a building, check if there is a risk of its collapse or falling of any object, ventilate the building. Do not turn on electric lights, do not use electronic devices, until you are sure they are fully dry. Do not use open fire sources, do not use matches until the building is fully ventilated and until you are sure gas supply system is in order. Check the power cables, gas pipes, water supply system, sewage, and do not use them until you are absolutely sure they are in order. Do not eat food which might have been in contact with the water. Do not drink unboiled water from local water sources;



- For prevention of floods, it is desirable to plant trees around residential houses; do not litter river beds and drainage channels, so that water can move freely; In order to prevent buildings from being flooded, place sand bags around the buildings.

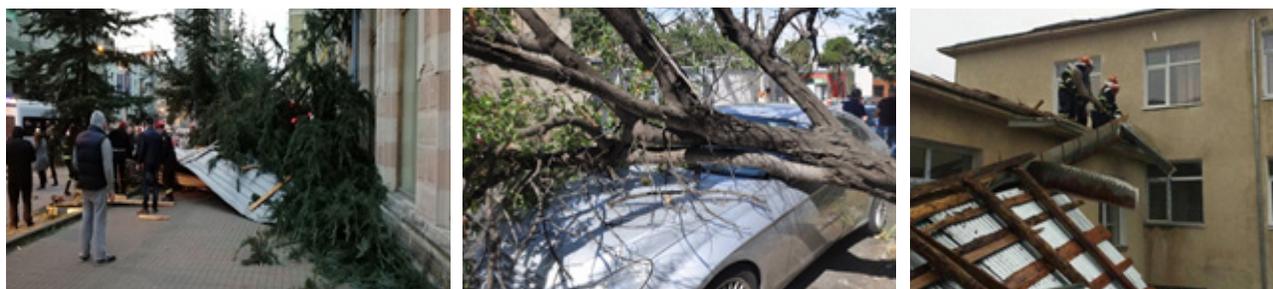
# STRONG WIND



**Wind** is movement of air masses. Larger the difference between temperatures and air pressures at various locations, stronger is a wind. Speed, direction and strength of a wind may be altered by a relief, vegetation cover and even constructions/buildings.

Hurricane, whirlwind or storm all have the same origin – wind. Wind force is estimated by Beaufort 12 point scale. Wind force is determined by its speed and capacity to impact objects located on ground surface. Hurricane is a state of emergency of meteorological nature, when speed of wind reaches 120km/h, and at the surface of the ground - 200 km/h. Hurricane is a very strong wind, which destroys everything on its path and causes significant losses to settlements. Storm is a variety of a hurricane. Whirlwind is spiral movement of large masses of air. It is formed in thunder cloud, later extending like a black giant sleeve or trunk, close to the surface of land or sea. The upper part of the whirlwind is broader, passing into the clouds and disappearing/scattering there. While approaching the surface of land or sea, its base swells out and resembles a funnel, turned upside down. Diameter of the funnel may be several tens of meters on the sea, and may reach 300 meters, even 1000 meters on the land. Height of the whirlwind may be 800 – 1500 meters. Because of low pressure inside the funnel and high speed, whirlwind sucks up sand, water and takes them to long distances. Main signs of a whirlwind are - increasing wind speed, drastic drop of air pressure, heavy rains and storm surge, heavy snowfall.

According to the statistical analysis carried out in Georgia during the recent years, there are approximately 5-8 cases of strong winds recorded in the country.



## HOW TO ACT AFTER THE STRONG WIND

### In case you are in the building:

- Do not stay close to the window, move to the safe location; inner walls, built-in closets, bathroom, pantry, under the table etc.;
- Close the doors, windows, shutter, put out the fire in the stove, switch off the power, close water taps natural gas;

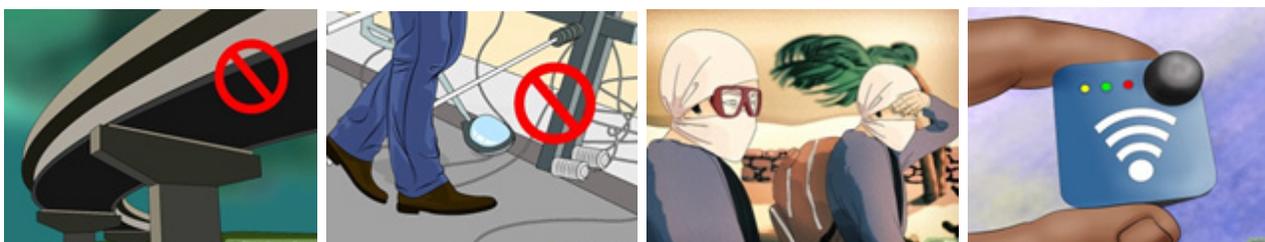


- At night use lanterns, lamps, candles; turn on the radio to obtain the information;

- If possible get to the cellar, deep shelter, bunker etc.



#### In case you are in the streets:



- Do not stop close to constructions, bridges, overpass, power transmission lines, towers, trees, river, lake or industrial facilities;

- Use plywood, cardboard, or plastic boxes, planks or other available materials and means in order to protect yourself from flying fragments and glass pieces, thrown by wind;

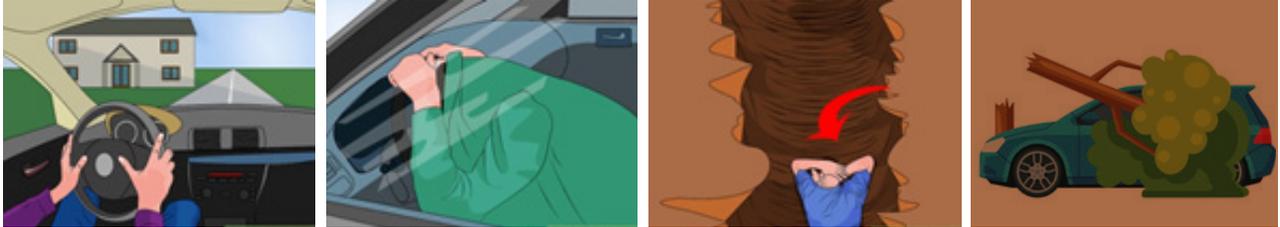
- Try to immediately hide in the cellar;

- Do not enter a damaged building, since it may collapse affected by the next blow of the wind;

- In case of dust whirl, cover your face with bandage, handkerchief or piece of cloth, protect your eyes with glasses;

- In case of receiving a signal about approaching tornado, immediately get into the cellar of the house or bunker, hide under the bed or other large sturdy pieces of furniture.

**If you are in the car:**



- Immediately leave the car, move to the open place and seek shelter in road side ditch, pit or narrow ravine. Lying on the ground increases the area of contact and cohesion;

- At the same time, cover yourself with clothes or tree branches.

**In case strong winds are characteristic for your place of residence:**

- In order to avoid damages it is advisable to fix roofs and advertisement signs;

- Clean the tress from dry and damaged branches;

- In order to reduce wind impact, it is good to plant trees and arrange windbreaks.



# HAIL



Hail is type of meteorological sediments, consisting of spheral shape ice pieces of fragments of various sizes, from 5-5mm, to 130 mm in rare cases. Hail is mainly characteristic to warm periods of an year, when temperature at the surface of the ground exceeds 200C. Hail may last 6-15 minutes.

Hail is one of the undesirable meteorological occurrences, having adverse impact on agriculture. Hail may cause significant damage to plants and domestic animals. Losses may be dramatic. Remember: you should avoid storm clouds in warm season.

Hail prone areas on the territory of Georgia: It is known, that hail particularly frequently occurs on hilly and plateau terrains, and is rare on plains and wide river gorges.

Hail days are frequent on Javakheti mountainous territories, southern slopes of Meskhети and Trialeti ranges, northern exposition slopes of Kakheti range. Vine growing districts of Kakheti region are the ones incurring the largest losses.



## Extreme natural events in Kakheti

As a result of heavy rainfalls a flood in a ravine inundated several houses in village Akhasheni of Gurjaani district, railway line was blocked; Rescue teams and facilities were mobilized; vineyards in village Velistsikhe and Zegaani were flooded and Vazisubani vineyards were affected by hail. Hail significantly damaged (60-80 % damage) vineyards grown on 100 ha territory in Village Nafareuli of Telavi municipality. Hail affected Telavi municipality villages – Akura, Vanta, Kurdgelauri and Kondoli. A strong wind dug out 4 trees on the territory of Napareuli and blocked a road. There were also two trees blocking the motorway towards Lapankuri. As a result of the works carried out by the rescue team the traffic on the blocked road was restored in short time. Kvareli municipality incurred significant damage. Perennial crops, vineyards, maize corn fields, water melon and melon orchards were devastated in Kvareli, Shilda, Gavaza, Kuchatani, Sanavardo and Sabue. The extreme natural events in Kvareli affected 1800 ha in total. Strong wind ripped off roofs of 15 houses in the villages Sanavardo and Gavaza. Storm dug out wall nut trees in the village Gavaza and blocked the road connecting the village to the rest of the municipality. Works started in several minutes after the occurrence and soon the road was cleaned. Special commissions were created in all three municipalities, which are still estimating the losses incurred. The works are being carried out to eliminate the consequences of the storm.



### HOW TO REDUCE HAIL - CAUSED DAMAGE AND NEED FOR PREVENTIVE MEASURES

- Avoid stormy clouds in warm season.



### SAFETY MEASURES DURING THE HAIL

- If you are in the building during the hail, get away from the windows, so that you are not injured in case glass is broken;
- Stay at home till the hail ends;

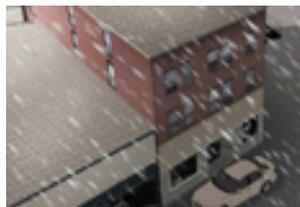
- Hail is frequently accompanied by thunderstorm and heavy rain, therefore try to avoid using electronic appliances;



- If you are in the street when the hail starts, immediately try to find a shelter. In case there is no shelter, cover your head with hands, bag or clothes. Avoid lowland, they may soon get covered by water or hail;

- If you are in nature, seek a shelter. If it is an open space, lie down and stay on the ground, do not forget to cover the face and the head;

- If you are in the car during the hail, stop the car and wait for the hail to end. Try to find a building or a covered facility, e.g. ridge, garage etc. Avoid the place,
- covered by hailstones, where the car may lose the control. Close the windows and sit with your back toward the windows, to avoid injuries in case the window glass breaks.



## HOW TO ACT AFTER THE HAIL

- If there is an injured person close to you, call an emergency; indicate the size of hailstones;

- If power transmission lines are damaged, it is dangerous to approach them, since there is risk you might get electric shock; In case of fire, avoid fire source and call an emergency and rescue team (112).

# DROUGHTS

Drought is long lasting and significant lack of sediments, frequently during high air temperature and low humidity. Drought may also be caused by changes in the soil and environment degradation, resulted by inappropriate human activities.

Intense heat is characterized by increase of surrounding air average temperature by 10°C or more during several days. It is dangerous to get hyperthermia – increase of the body temperature over 37.1°C or disorders in thermoregulation, when body temperature reaches 38°C. Such critical condition appears as a result of long and intense hyperthermia, caused by sunstroke and resulting in heart functioning problems. Symptoms of hyperthermia: red skin, dry mucosa, strong thirst. Fainting, loss of heartbeat and breathing may also occur.

Crops are damaged as a result of drought and agricultural sector incurs significant losses; food prices grow, in worst cases, drought causes famine, diseases and migration.



Drought is actually noted on the whole territory of Georgia. This natural occurrence is particularly severe in Shida and Kvemo Kartli, Kakheti and Zemo Imereti regions. In the past strong droughts occurred once every 15-20 years, but presently they have 6-7 years or even more intense cycles.

In Georgia, similarly to all The Caucasus, drought years are rather frequent, which are associated to the global warming of the climate by majority of scientists. During recent years 1976, 1992, 1996, 1998-2000, 2006, 2010 may be considered drought years. 2000 summer drought was particularly severe, even causing ecological catastrophe in lowlands of Eastern Georgia. According to Tbilisi airport station data, there was strong wind during 19 days, resulting in drying of the arable layer of the soil. Losses were estimated as hundreds of million GEL. We should also mention here drought of 2010, when air temperature exceeded annual average by several (5-6°C) degrees.



## PREVENTIVE MEASURES TO BE TAKEN PRIOR TO THE DROUGHT

- Prepare some kind of glassware/containers and fill them with water in advance if needed;
- Prepare appropriate clothing for hot conditions, electronic devices (air-conditioning, cooling fans);
- If you are in the countryside, arrange barns, pergolas, wells, fix shutters on the windows. Try to obtain autonomous power generating source, in order to provide energy for electronic devices;
- Be careful not to waste water;
- You should know and be able to teach others how to act in case of hyperthermia.



## MEASURES TO BE TAKEN DURING THE DROUGHT

- Avoid exposure to high temperature;
- Wear permeable light colored clothing (preferably cotton) and a hat. Remember, burnt skin cannot secrete sweat and cannot cool down;

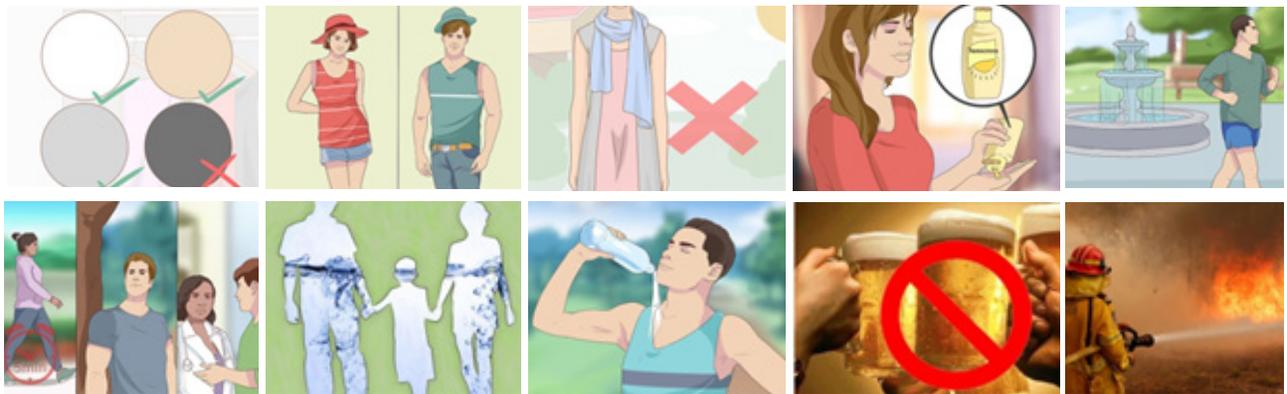
- Walk without haste and try to keep in the shade;

- In case you develop hyperthermia, immediately move to the shade, cool place, drought, or take a shower;

- Drink plenty of water slowly. Try to cool down your body in order to avoid sun-stroke;

- In the period of drought do not drink beer and other alcoholic drinks; it will make the general condition of the body worse;

- Remember, probability of fires increase during droughts.



## RULES HOW TO ACT AFTER THE DROUGHT

- If anyone faints as a result of a sunstroke, resuscitation measures (cardiac massage and artificial breathing) shall be taken;

- Contact local governmental bodies for obtaining information on the natural disaster and providing assistance to the population.



# EARTHQUAKE



**Earthquake** is an underground shock or shaking of crust of the earth, caused by movement of tectonic plates in the earth's crust or upper mantle, resulting in sudden release of energy. This energy causes destruction of various strength and scale.

The territory that might be damaged by an earthquake, depends on the depth of the focus of the earthquake; deeper the earthquake hypocenter, larger the territory of coverage and less the destruction power at the epicenter; and vice versa, upper the focus, or hypocenter, less the area of coverage and more destruction at the epicenter.

According to origin, an earthquake can be tectonic, volcanic, caused by gravitation processes or anthropogenic/tectogenic, human activities (mines, strong explosions while digging tunnels).

In means of destructive power, possible casualties and collateral tangible losses, the earthquake is the most significant occurrence in Georgia compared to other natural calamities.



# EARTHQUAKES IN GEORGIA WITH THE MOST SIGNIFICANT CATASTROPHIC IMPACTS:

Picture N1 - the earthquakes ending with the largest damage and casualties.

<p>Sukhumi (Dioskuria) 8.0 earthquakes in years 50 and 400 AD.</p>	<p>May 22, 1088 Tmogvi 8.0 earthquake in Samtskhe-Javakheti and April 14, 1277 Atskuri 9.0 earthquake.</p>	<p>February 20, 1920, Gori 8.0 earthquake, killing persons.</p>	<p>April 29, 1991 Racha-Imereti – Shida Kartli, 9.0 earthquake; 200 persons were killed.</p>
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- February 20, 1920, Gori 8.0 earthquake, **114 persons died**;
- May 7, 1940, Tabatskura earthquake, 8.0 in the epicenter. It caused severe damage, and **approximately 40 persons died**;
- April 29, 1991 Racha-Imereti – Shida Kartli, 9.0 earthquake; as a result of it, 46 000 residential houses were destroyed, **200 persons died** and hundreds were injured. About 100 000 of citizens of Georgia lost their dwellings. Losses caused by the earthquake totalled 10 bln USD. 4.0-5.0 shocks were also felt in Tbilisi.



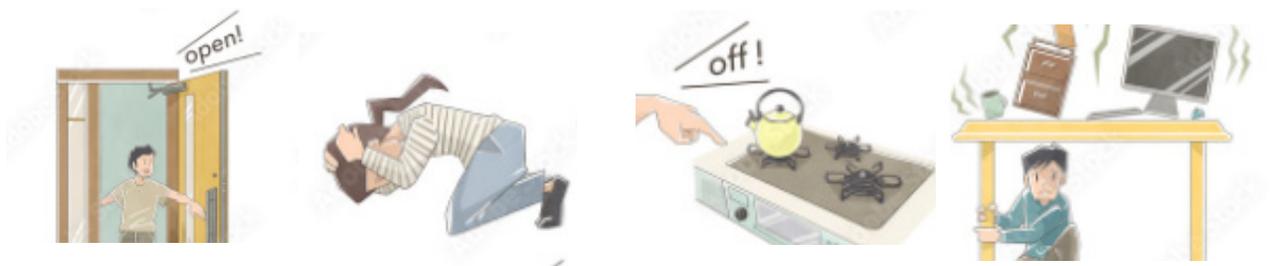
- April 25, 2002 - 7.0 earthquake in Tbilisi killed **5 persons**, 12 00 buildings were damaged, particularly in the old parts – Chugureti, Sololaki, Nadzaladevi, Mtatsminda districts. Direct losses were estimated as 300 000 USD, though actual damage was even more.

According to the statistical data of years 2005-2012, earthquakes with over 3.0 magnitude occur in Georgia 15-18 times on average annually.



## WHAT SHOULD WE KNOW AND HOW TO ACT PRIOR TO THE EARTHQUAKE

- Think about the building evacuation route in advance so that you can leave the building within 15-20 seconds prior to the aftershock;



- Right down and keep telephone numbers of the ambulance, the fire station and the police;

- Prepare in advance and keep water and food supplies for 2-3 days (4-6 liters of water per person, canned food etc.), drugs, documents, valuables, warm clothes, not to waste time, looking for them while leaving the house;

- Always keep a pocket light and a radio close to the bed.

- Remember: an elevator and a staircase, large glass openings in inner and outer walls, corner rooms are the most dangerous places during the earthquake.

- Define the most safe and favorable location in the flat, in the office, close to your workplace, where you can wait till the end of shocks;

- Do not arrange shelves over the sleeping place, above the entrance door, a gas stove, a sink or a toilet;

- Fix bookcases, shelves and other heavy furniture to the walls and secure them, so that they do not turn over and cause injuries;

- Do not arrange sleeping places close to large windows or glass partitions. Remember: in case of the deformation of the building, glasses are the first thing to break, causing significant damage to humans;

- Secure the chandelier, do not use glass lamp shades.

- Do not block entrance to the flat, the corridor and the staircase, do not put lots of things in exit ways, so that you can leave promptly and rescuers can move freely.;

- Keep hazardous substances (chemicals, igniting liquids) in safe, well isolated places;

- Everyone should know where power switches, gas pipe and water taps are, so that electricity is turned out and gas and water valves are closed;

- Learn the first aid rules, keep first aid kit;

- In case of evacuation, try to agree in advance where you and your family members would meet. Pay attention to construction norms and standards, meet the quality requirements. Do not forget you live in seismologically active zone.



## HOW TO ACT DURING THE EARTHQUAKE

- As soon as you feel the shocks and feel a building is shaking, see a chandelier is swinging, objects are falling, hear load roaring and sound of broken glass, remember that you only have 15-20 seconds till the complete collapse of the building;

While leaving the building, use a staircase (unless you live in a high block of flats); it is dangerous to use an elevator. Never leave the building, unless you are sure, you can get away from the building at a safe distance. Debris and fragments, falling from the building also pose a significant danger. Sometimes it is better to seek a shelter where you had been during the earthquake and wait for it to end;

- If you are not able to leave the building, stand at the safe place – at the corner of the inner walls, at the openings of bearing walls, try to hide under a bed, desk or a dining table, which can protect you from heavy objects and fragments, falling as a result of shaking and swaying;



Do not stand close to the window, glass furniture, partitions, as well as under the chandeliers. If there are children next to you, hug them in a way to cover them.

- Do not get scared if a door is jammed and doors/windows frames are creaking – all this is expected to happen when a building is undergoing a deformation. Do not use candles, lighters, matches, since there might be gas leakage and there is a risk of fire;

- While being outside the building, avoid hanging balconies, cornices and balustrade. Do not touch damaged cables;

- If you are in the car, stay calm, stop the vehicle away from high buildings, transmission lines and bridges, open the door and do not get out until the shocks end;



- Keep calm and do not panic, do not get confused, do not scream;

- After the shocks end, immediately leave the building. Take with you documents, domestic medical kit, necessary clothes, lock the door;

- In case you are in the high building, do not come out on the stair landing, do not enter the elevator, it may get stuck. Seek the nearby shelter;

- In case you are outside a building, try to get to the open space, move away from a building and transmission lines;

- Frequently the main shock of an earthquake is followed by the calm interval and then new, relatively weak shocks take place. Do not get surprised, if you feel a new shock, these are so called “aftershocks”. An earthquake may last for several days, sometimes even several months. “Aftershocks” may cause collapse of the buildings, which were damaged as a result of the mainshock.
- 



## HOW TO ACT AFTER THE EARTHQUAKE

- Provide first aid to the victims. Take part in getting people out of debris;



- Ensure safety of the children, the elderly and the diseased ones. Turn on the radios, listen to the information on the earthquake and measure to eliminate the consequences;

- Follow instructions and orders of local governmental bodies, emergency management service agencies. Check if there is fire threat. If you notice flame anywhere, put it out immediately;

- Be careful while going down the stairs, make sure it is safe;

- Check if there is gas leakage, in case you notice it, close the gas pipe. Leakage should be detected by odor, never use matches and a candle and never try to use any open source of fire. In case of damage of water pipes, close them and promptly notify the relevant services;
- 

- Do not drink water from wells unless they are tested by sanitary-epidemiological inspection services. Do not approach strongly damaged buildings and do not enter such buildings;
- 

- The very first hours after the earthquake are the most dangerous because of aftershocks; therefore do not enter the building. Do not spread rumors about possible repeated shocks. Only official data should be used;
- 

- Check to see if power lines are damaged, in case of damage, try to eliminate the problem or switch off the power in the flat;

- Carefully open the door of a wardrobe or a closet, so that heavy objects do not fall unexpectedly;

- Try to calm down the children and others around you, who have experienced a psychological trauma as a result of the earthquake. Put aside their fears and do not spread rumors;
- 

- You have to assist the police, fire-rescue teams and medical service providers in rescue operations. If required, you should try to provide first aid to the injured.

# ECONOMIC PERSPECTIVE OF DISASTERS CAUSED BY NATURAL HAZARDS

One of the most common expressions in the world, and obviously in Georgia as well, is “Socio - economic and political development of the country”. In fact, both the cause and the result of the existence and development of these three components is man, who is equally involved in forming society and the economy as well as politics. However, the qualitative and quantitative nature of all these components depends on vital data conditions, such as the physical-geographical characteristics of the country.

One of the goals of anthropogenic impact on the natural environment is to achieve goals that are fitted to people and relevant to their interests, for their own well-being; so, there are cause-and-effect relations between nature, man and socio-economic development, and in the circle of these connections, rational human action is necessary, on which the scale of negative consequences depends. With non-rational intervention, man might become a kind of factor, activating the risk of existing natural disasters and turning it into a catastrophe, which will inevitably lead to economic and social losses.

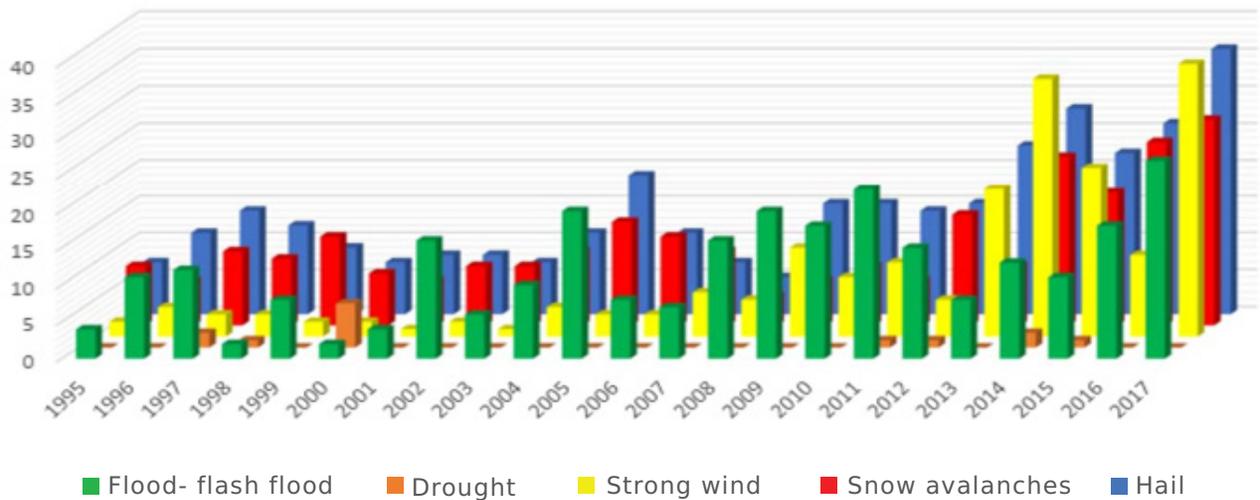


The peculiarity of the geographical location of the territory of Georgia and its complex relief contributes to the specific formation and development of general atmospheric processes.

Natural disasters have increased dramatically in Georgia over the last 20 years, and in various ecosystems (forests, water, soil, etc.) there is a tendency to increase the number of natural disasters related to climate change; landslides, floods, avalanches, river overflows have become more frequent; in some areas (Dedoplistskaro, Gardabani, Sagarejo) the process of desertification was more pronounced; some areas (e.g. Lagodekhi) have moved from a semi-humid climate zone to a humid zone. In many cases, anthropogenic factors play an important role in the development of extreme geological events, degradation of quality of land and forest degradation, and climate change contributes to the acceleration of processes.



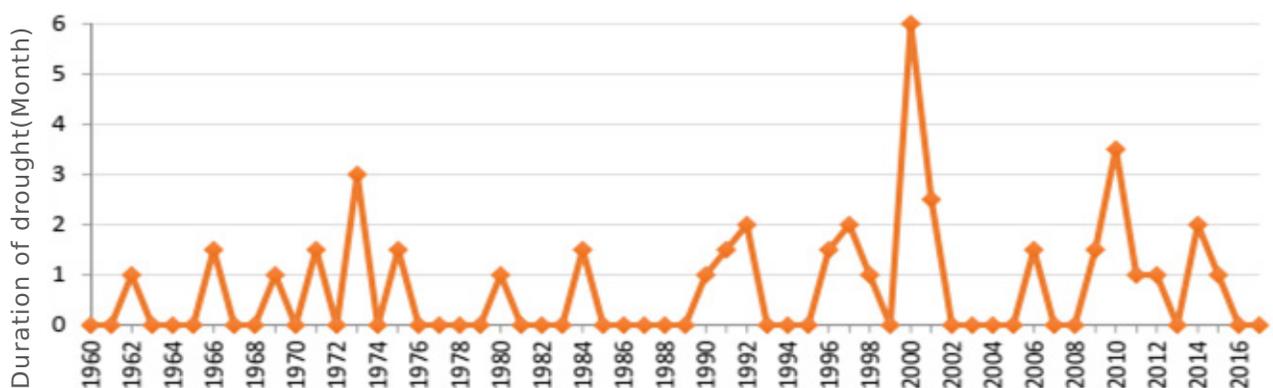
Graph N1 Dynamics of hydrometeorological events recorded on the territory of Georgia 1995-2017.



One of the most negative impacts of climate change is the increase in drought, the decrease of water resources, and land degradation. These factors may have a great impact on the economic life of the country in the future, as a large part of the population depends on agriculture. A clear example of this is the increase in the number of natural disasters such as floods, droughts, strong winds, snow avalanches and the tendency of dynamic increase in the number of hail days on the territory of Georgia (see Graph N1).

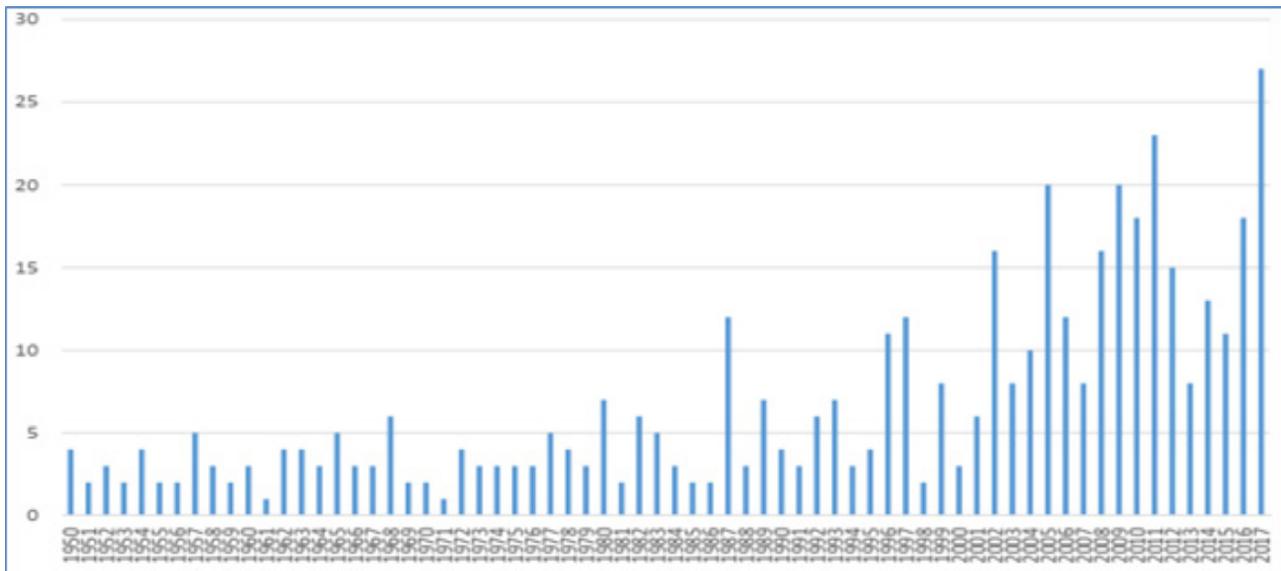
**Drought** is observed practically in the whole territory of the country. This event is especially intense in Shida and Kvemo Kartli, Kakheti, as well as Zemo Imereti regions. If in the early periods a strong drought was observed in the country once in 15-20 years, in recent years the frequency of this event has increased almost 3 times. During the period of 1985-2010, the change in the number of droughts in Kakheti region increased the most in Sagarejo (+14 cases) and then in Dedoplistskaro (+7 cases), while extreme droughts increased the most in Dedoplistskaro (+11 cases) and then in Kvareli and Telavi (+8 cases). Drought damage to agriculture in 1995-2017 alone reached GEL 445 million. It should be noted that no cases of drought were reported in the country in 2016-2017.

Graph N2 Dynamics of duration of drought periods on the territory of Georgia in 1960-2016



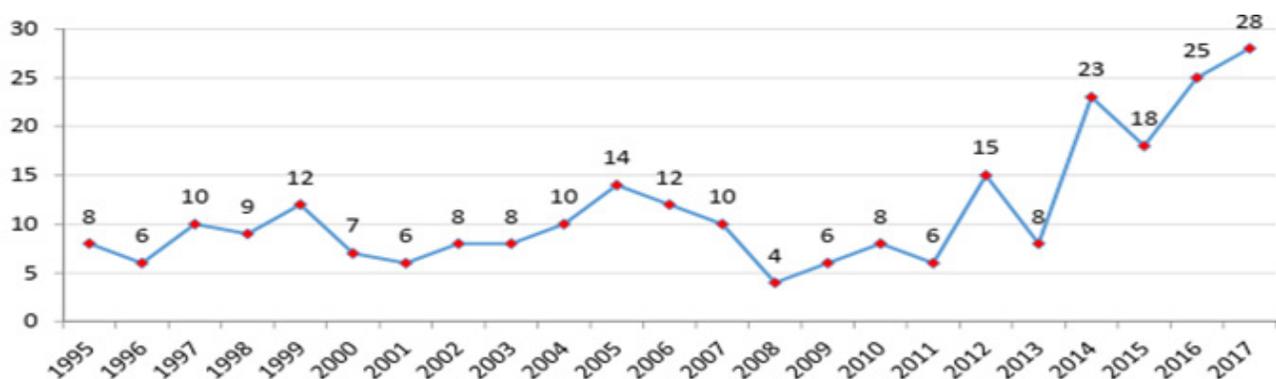
**Flooding/flash flood-** Analysis of multi-year data shows that floods and inundations are typical for almost all rivers in Georgia. Among them are especially of high risk: Imereti, Samegrelo, Guria, Mtskheta-Mtianeti river basins, as well as the territories adjacent to the river Mtkvari and left bank of the Alazani river. Before 1995 the average number of floods ranged from 3-5, in 1995-2006 from 4-20, and in 2007-2017 from 7-27. The damage caused by floods in the last 4 years has reached about 147 million GEL. During the floods 26 people died.

Graph N3 Dynamics of the number of floods recorded on the territory of Georgia 1950-2017



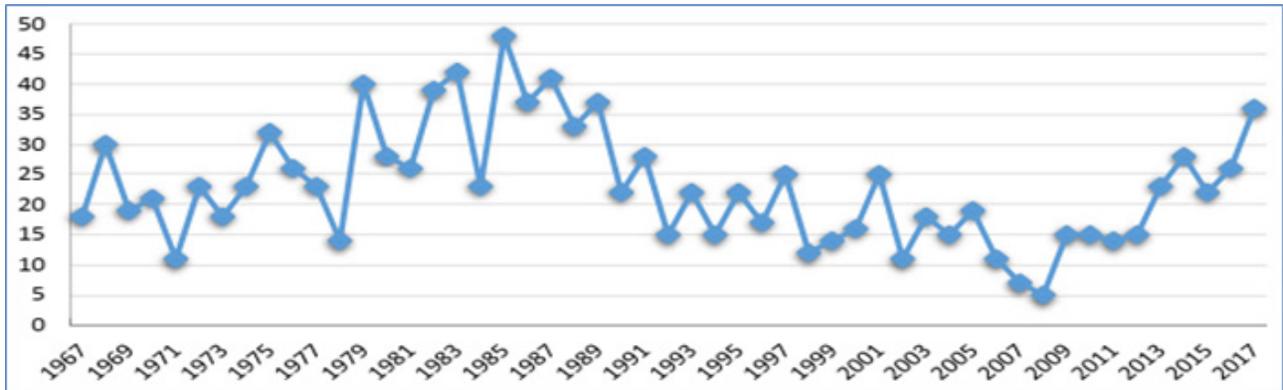
**Snow avalanches** In terms of snow avalanches, more than 50% of the mountainous territory of Georgia is located in the avalanche danger zone. This phenomenon is especially intense in the middle and highland zone. The western and central parts of the Caucasus and the Guria-Adjara mountains are at the highest risk of avalanches in the country. An increase in the frequency and intensity of avalanches has been observed since the 1970s. Their massive arrival was recorded in the cold periods of 1970-1971, 1975-1976, 1986-1987, 1991-1992, 1996-1997, 2004-2005. The population of Svaneti, mountainous Adjara, Tusheti, Kazbegi and Dusheti municipalities were especially affected by the snow avalanches. According to incomplete data, the loss exceeded \$ 750 million, 176 people died. During 1970-1987, up to 20,000 people were forced to relocate due to these above-mentioned avalanches. In 2007-2017 there were 151 cases of avalanches, 19 people died.

Graph. N4 Dynamics of the number of snow avalanches registered on the territory of Georgia in 1995-2017.



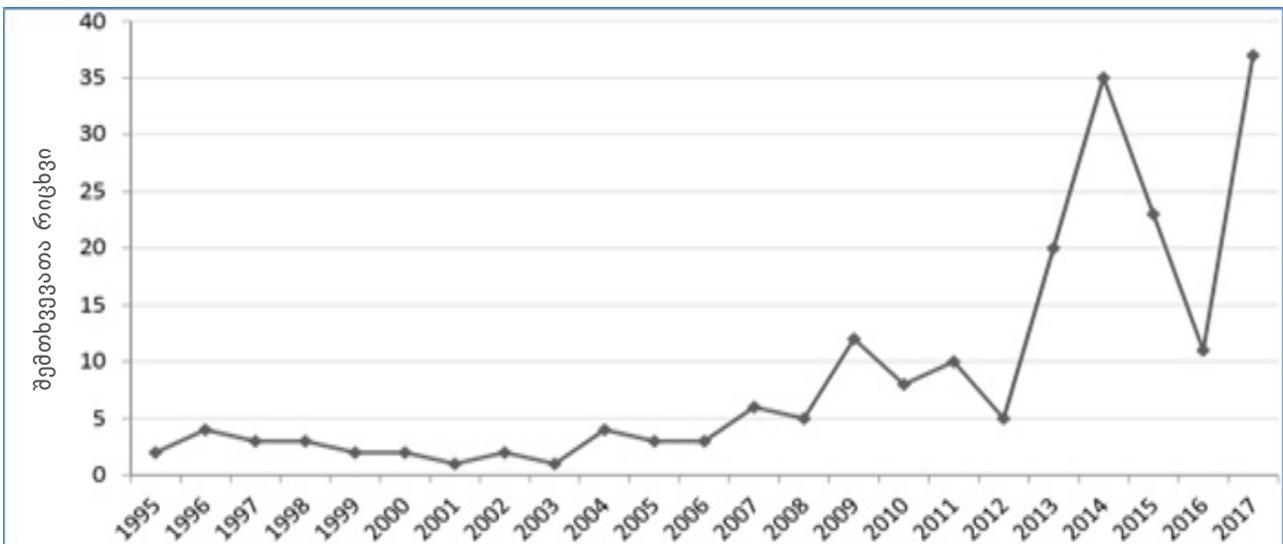
**Hail** is observed throughout the country. Its intensity and frequency are high in Eastern Georgia. The years of 1983, 1987, 1993 and 1997 were particularly intense in terms of hail. According to incomplete data, the damage caused by hail to the country in the last 15 years has exceeded 235 million GEL. There were 206 cases of hail in 2007-2017 and the damage caused by hail during this period amounted to about GEL 203 million. The growing dynamics of hail days have been observed since 2008. 2017 was 36 hail days, the highest rate since 1990.

Graph N5 Dynamics of the number of hail days registered on the territory of Georgia in 1967-2017.



The crestal zones of the Caucasus, Kolkheti lowland, Zemo Imereti, Shida Kartli, Tbilisi, Gare Kakheti and Samtskhe-Javakheti are distinguished by a particularly high rate of recurrence of **strong winds**. The number of strong winds recorded during the period 1995-2006 ranged from 1 to 4 per year, while in 2007-2017 the same figures were in the range of 6-37. According to incomplete data, the damage caused by strong winds during this period amounted to 262 million GEL. 14 people died.

Graph N6 Dynamics of the number of hail days registered on the territory of Georgia in 1967-2017



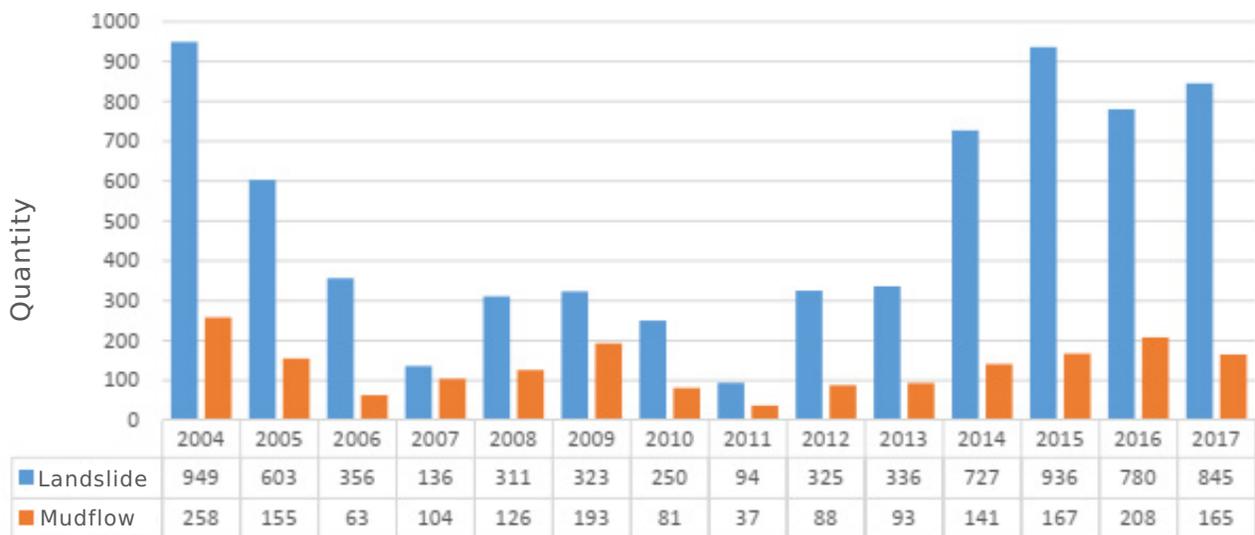
Thousands of settlements, lands, roads, oil and gas pipelines, high-voltage power transmission masts, hydro-technical reclamation facilities, mining and tourist complexes are periodically affected by the geological natural disaster in Georgia due to the scale of development and the risk of danger.

In Georgia there is expected reduction of agricultural lands due to natural disasters related to climate change, such as landslides, floods, mudflows, etc. An increase in their frequency may affect negatively on soil fertility. It should be noted that the activation of these natural phenomena can deepen the erosion processes of the land, which also has a negative impact on the productivity of the sector. The disaster zone covers almost all landscape-geographical areas - from the seaside to the alpine-nival zone, where the geo-ecological situation is complicated from "tense" to "crisis". According to the data of the National Environment Agency, in 2014-2017, the scales and quantitative indicators of landslide-gravity and activation of landslides increased significantly in the country.

The scale and cases of activation of **landslide-gravity and flood processes have significantly increased in the country. In particular, in 2010-2013 there were about 1000 landslides, and in 2014-2017 up to 3300.**

The number of cases of floods has increased from 300 to 680. As a result, the economic losses caused by landslides and floods have increased. According to available data, more than 4400 buildings were damaged, 33 people died.

Graph N7 Landslide and flood processes observed on the territory of Georgia in 2004-2017.



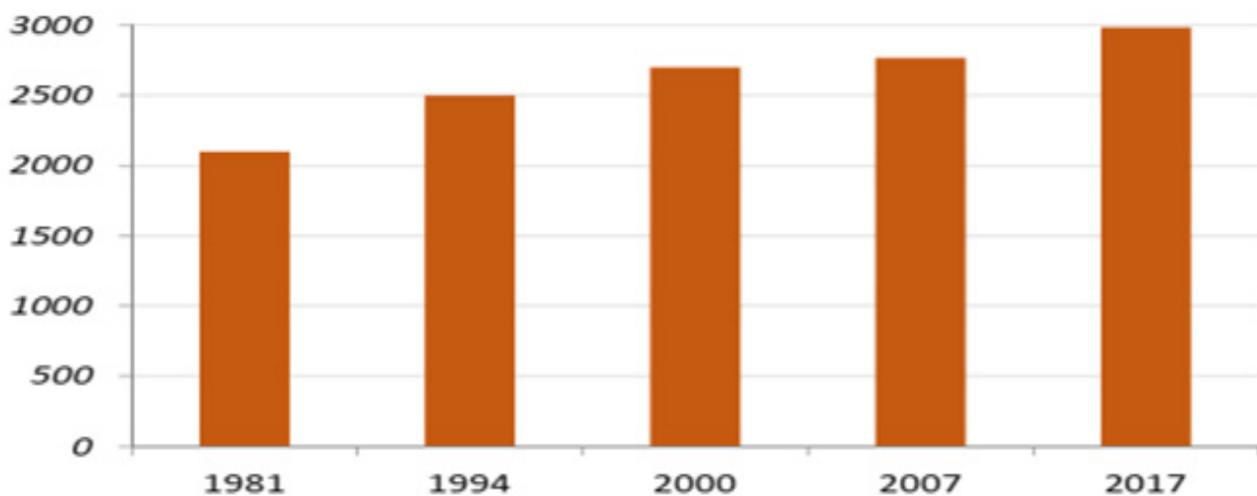
According to 2017 data, 18% (647 units) of Georgian settlements are at high hazard of geological processes. Particularly hard situation is created in the mountainous regions, where in conditions of extreme activation of the disaster, not infrequently, it is necessary to evacuate the population from their historically established dwellings and sometimes - to evacuate to another municipality.

In 2014-2017, out of 4,433 families assessed by the National Environment Agency, LEPL, 907 families with the status of eco-migrants were relocated to geologically sustainable places. Since the second half of the twentieth century, dozens of mountain villages have been emptied and lands deserted. The most alarming thing is that these events are often accompanied by human casualties. The geological disaster killed 141 people in 1995-2017 and caused an economic loss of approximately 1.7 billion GEL.

**Flood events** - Extremely high risk of life-threatening to the population of Georgia and the safe operation of engineering facilities are posed by flood events, which are distinguished by heterogeneity of development, the scale of damage to the territory, the frequency of recurrence and economic damage. Flood events are found in all climatic-morphological zones of the mountainous area of the country and in the conditions of the relevant geological structure - starting from the foothills, ending in the highlands-nival zone. All the settlements located in the floodplain zone of the river valleys and their surrounding area, as well as Tshiv-Gombori, Saguramo-Yalno ridges and the foothills of the Kakheti Caucasus and their infrastructure are at risk of floods.

Flood processes periodically damage roads, other types of road-irrigation facilities, agricultural lands, etc. Floods have been recorded in up to 3,000 waterways in Georgia. In 1995-2017, 94 people died in floods and economic losses reached 738 million GEL.

Graph N8 Number of flood events recorded in the territory of Georgia in different years



**Landslide events.** 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 the area of 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 resulted in 25% of large reservoir shores and up to 30% of highways being at high risk of occurrence.

Almost all kinds and types of landslides are developing on the territory of Georgia - starting with the simplest, ending with deep landslide bodies with a capacity of tens of meters and a few creeping landslides. Individual landslide areas also vary over a wide range:

From unit hectares to hundreds of hectares: Somitso landslide - 550 ha, Zazhkvi landslide - 1500 ha, Sioni - 600 ha, Esheri - 1000 ha, etc.

Volumes - from several thousand m<sup>3</sup> to tens and hundreds of millions m<sup>3</sup>. For example: in Adjara - Varjan landslide, 30 mln m<sup>3</sup>, Danisparauli landslide - 90 mln m<sup>3</sup>; Oni district - Chordi landslide, 150 mln m<sup>3</sup>, Zazhkvi landslide - 200 mln m<sup>3</sup>; Kvareli district - landslides of Chelti, Duruji, Avaniskhevi - 150-450 mln m<sup>3</sup> and others.

Landslide-gravity events are characterized by scale, deep layout, large volumes (from 8-50 million m<sup>3</sup> to 150-450 million m<sup>3</sup>) and often cause catastrophic consequences. Dozens of such disasters are known in the recent history of nature development in Georgia. Among them are:

The villages of Azanta (Gulrifshi region) and the village of Kvedi (Oni region) buried under rock avalanches of 180 and 150 million m<sup>3</sup> in 1891 and 1996;

Disasters caused by rock avalanches-Landslide - in the last 20 years, villages: In Tsalani and Khakhieti;

In 1899 as a result of the landslide in the village of Ghvedi, the gorge of the river Tskhenistskali was blocked by a 50 m high dam.

Similar events were observed: in the gorge of the river Rioni in 1977 in Kldisubani. (30 million m<sup>3</sup>) and the village of Chkvishi in 1991, (19 million m<sup>3</sup>), in the Kelasuri river basin in 1978, (8 million m<sup>3</sup>), Laskadur in 1975 (20 million m<sup>3</sup>) and many other places.

Even in the background of landslide-gravitational activity, the damage to the country's economy is in the hundreds of millions of dollars, including \$ 45-50 million in damage to agriculture.

In 2014-2017, several catastrophic natural disasters took place on the territory of Georgia, which, unfortunately, were accompanied by human casualties. Among them are the following events:

1.

**On May 17, 2014, a rocky avalanche type of landslide occurred on Mkinvartsveri.** The landslide brought with it the rock material along with the overlay glacial-snow mass, which turned into a mudslide and formed a 30 m high dam at the confluence of the river Amali-Devdorak and the river Tergi, which dammed the river Tergi. The volume of the torn mass was about 5 million m<sup>3</sup>, from which up to 2-3 million m<sup>3</sup> got into the floodplain-bed zone of the river Tergi. As a result of the event, 8 people died at the confluence of the Tergi;

2.

**On August 20, 2014** as a result of heavy rainfall in the Devdorak River gorge, excess material accumulated in the gorge during the event of May 17, 2014 was activated in the form of a **mudflow**, which caused the river to overflow, 2 workers working at the hydroelectric power plant under construction near the river Tergi died. The processes of May 17 and August 20 caused great material damage to the country on the whole, such as the Georgian military road, the north-south 700 and 1200 mm main gas pipelines, the high-voltage transmission lines, vehicles were damaged, the customs border checkpoint of Georgia was cut off from the outside world, the residence of the Patriarchate of Georgia was damaged and the great living problems were created to their service personnel;

3.

**On June 13-14, 2015 on the river Vere and its tributaries occurred flooding** and creation/activation of large-scale landslides and mudflow processes took place, which subsequently caused great damages to Tskneti-Betania, Tskneti-Akhaldaba and Kojori-Manglisi auto roads. In Tbilisi dwellings located at the lower height mark in the Vere River gorge, various infrastructure facilities, buildings and the Tbilisi Zoo were severely damaged and destroyed. According to the latest data, 20 people died and three people were missing;

4.

**On December 7, 2017, the creation -activation of the landslide-rock avalanche** took place near the town of Shorapani, which temporarily blocked Tbilisi-Senaki-Leselidze central motor way at 188 km and endangered a dwelling built in the ridge part of the slope above the road.

**Earthquakes.** Georgia is in the middle zone in terms of seismic activity, where small jerks are traditional, but Racha and Javakheti have been distinguished 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 earthquakes for which the seismic parameters of the earthquake focus can be determined is on average up to 1000 per year. At the same time, we must not ignore the worrying circumstance that in the near future in the Caucasus is expected a high probability of recurrence of strong earthquakes, which in terms of sustainable development of the region cannot be ignored, especially since the tall buildings in Tbilisi and other large cities were built without regard to real seismic safety, not to mention the abundance of depreciated houses in the cities.

Catastrophic danger is indicated by earthquakes in Spitak (Armenia) in 1988 and in Racha in 1991, which by magnitude (respectively  $M = 7$  and  $M = 7.2$ ), intensity (8 and 9 points), distribution area and socio-economic consequences are not analogous to the earthquakes registered in the Caucasus so far.

1991 Racha-Imereti and Shida Kartli earthquakes covered a significant area of the territory of Georgia 7800 km<sup>2</sup>, with more than 700 villages and urban settlements; the disaster destroyed and significantly damaged 46 thousand houses and up to 1000 public and agricultural buildings - structures, cultural monuments, left more than 100 thousand inhabitants homeless, the disaster severely damaged roads (more than 1,200 km), disrupted headworks, water mains and other communications facilities.

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

Table #1 Strong earthquakes in Georgia

N	Location	Earthquake intensity	Date
1.	Tmogvi	(in balls)	1088y.
2.	Mtskheta	9	1275y.
3.	Samtskhe	9	1283y.
4.	Alaverdi	7-8	1530y.
5.	Alaverdi	8-9	1742y.
6.	Akhalqalaqi	8-9	1899y.
7.	Kartli	8-9	1920y.
8.	Tabatskuri	8	1940y.
9.	Martvili	8	1957y.
10.	Guria	7-8	1959y.
11.	Madatapha	7-8	1959y.
12.	Chkhalta	9	1963y.
13.	Dmanisi	8	1978y.
14.	Paravani	7-8	1986y.
15.	Racha-Imereti	9	1991y.
16.	Pasanauri-Barisakho	7	1992y.

Thus, it can be said without exaggeration that it is necessary for all citizens of Georgia to acquire minimum knowledge and raise general awareness about natural disasters, as it is a kind of readiness phase to avoid risks and, consequently, to ensure the reduction of material and nonmaterial losses in the economic or social component.

# REDUCING THE RISK OF NATURAL DISASTERS FOR VARIOUS GROUPS, INCLUDING VULNERABLE GROUPS

Disaster affects everybody who are in the sphere of its action, although its impact on people is different; the outcomes are reflected differently on women and men, the elderly and the young, children and as well as vulnerable groups.

As mentioned above, natural disasters can lead to the death of people and destruction, including residential buildings, which causes quite a lot of harm to the population, people in general. But while natural disasters and their consequences are equally devastating, there are still differences depending on the preparations in the process of survival, the extent of involvement in prevention and so on.

As you know, the gender roles of women and men are different in society. From childhood, boys and girls acquire different skills and different qualities from each other. Consequently, already in adulthood, men and women usually play different roles, such as wife or husband, mother or father, child caregiver or family breadwinner, and so on. The existence of different roles, functions, and activities for women and men suggests that they behave differently during natural disasters.



## WHAT DOES GENDER MEAN?

Gender is an English word and means sex, but today it is used as a term that implies socially defined roles, norms, functions, perceptions, behaviors and expectations that exist related to men and women in a given society, culture. Gender defines the gender roles of women and men, their status in all spheres and levels of public life. Gender role implies the forms, norms and values of behavior imposed by society and culture on women and men.

How are gender roles acquired and what does it mean? Most of the features that are considered characteristic of women or men are created by culture. Many researchers believe that the acquisition of gender roles begins at birth. Parents treat their children - girls and boys - differently, giving them different toys and homework. Children receive encouragement and praise from their parents for engaging in sex-appropriate behaviors. Consequently, encouragement, praise, and approval contribute to the process of learning of behaviors. However, it must be said that parents are not the only ones who help their children to acquire gender roles.



Any other environment such as, for example, kindergarten, school, or a circle of peers and in general, the whole society, stipulates the acquisition of one's own gender role by a person.

Gender roles are significantly related to gender stereotypes. How are men and women different from each other? Is one of these sexes more aggressive, caring, stronger, or smarter than the other? Usually, how can these two sexes be compared to each other in terms of qualities such as courage, nimbleness, lightness, sensitivity or credulity? The notion of male and female personality traits and behavioral characteristics is called gender stereotypes.

Culture assigns certain characteristics to its representative woman or man, determines what a woman or a man should be and how she or he should behave, what they should know, what they can do, what type of rights they should enjoy in a particular society. This is due to the gender aspects of various events, in particular the management of natural disasters and their prevention.

Therefore, we can think that natural disaster events affect women and men differently, they react differently and play different roles in the process of survival or recovery. For example, the number of women injured in natural disasters exceeds the number of men. The reason for this may be that a man is physically stronger than a woman; or women cannot swim so well as men, which could be the cause of their death, for example, in case of flood. Family activities are mainly performed by women due to traditional roles. When climatic conditions change, or because of the catastrophe caused by this change, people are forced to leave their homes, move to temporary shelters, women are forced to do household chores in difficult conditions. In addition, during the evacuation, women prepare children, the elderly, and take care of collecting primary, essential items, or necessary documentation.

Also, when considering gender aspects, we should pay attention to the category of pregnant women who require a special approach in the process of management or recovery of natural disasters. Pregnant women face special difficulties during evacuation - they find it difficult to carry basic necessities themselves; they are even more anxious because they cannot help their own family members especially when they have small children; it is also difficult for them to get used to the temporary housing situation, which is often located in the field. Pregnant women who constantly need medical supervision can no longer receive these services, which can negatively affect their health status and their unborn children.

Recommendations to consider:

- 1.** The bag should be prepared in advance with primary items including necessary medicaments.
- 2.** On being placed in temporary accommodation you must notify about pregnancy.
- 3.** If necessary, inform the mobilized doctors on the spot about your health.
- 4.** Try to avoid polluted places and people who have health problems.
- 5.** To relieve stress, try to relax often and drink big quantity of water.

In case of disasters the number of victims is much higher with members of the vulnerable group.

## WHO ARE THE VULNERABLE GROUP MEMBERS AND WHAT SHOULD BE DONE TO REDUCE THE RISK FOR THEM?

In case of disasters vulnerable groups are considered to be: children, the elderly, pregnant women, people with disabilities - people with sensory problems (vision and hearing impairment), people with mental illness (memory impairment) and mobility problems, people addicted to various substances (drug addicts).

If possible, try to have information in advance about vulnerable people in your environment (class, neighborhood, community), in particular:

**1.** Visually impaired individuals or the blind;

**2.** Individuals with hearing impairment or the deaf;

**3.** Individuals who have difficulty speaking;

**4.** Individuals who difficulty move or move their limbs;

**5.** Individuals who have difficulty understanding, remembering and learning information;

**6.** Pregnant women;

**7.** The elderly;

**8.** Children.

It is important to know in advance the needs of these groups and their capabilities. Communication with members of a vulnerable group may require special effort. When dealing with them, try to address them personally and not their caregivers or guardians.

General recommendations to consider:

- When dealing with people with visual impairments, use a combination of visual and audio information, deliver audio messages to the blind.
- When dealing with hearing impaired people use non-verbal gestures, indicators, pictures, repeat what you say, if you suspect he could not hear, speak loudly, clearly and slowly. If he has a problem with one ear, stand on the side with which ear he hears better. When speaking, try to keep your face lit.
- When communicating with a person with intellectual disabilities, speak slowly and clearly, use visual aids, speak with simple sentences, use gestures.
- Remember that different means of early warning of risks are not equally effective for individuals with different disability categories.

Impairments	Effective signal
Movement, physical impairment	Audio signals (bell, drum, siren, megaphone). Visual signals (Posters, flags, leaflets, spotlight on / off)
Visual impairments	Posters in bright colors, audio signals, Visual signals, on/off of the spotlight
Hearing impairments	Visual signals, written documents, gestures, audio signals, body language, use of sign language
Intellectual impairment	Visual signals, audio signals

In order to reduce the risk of disaster consequences, teach vulnerable group members in advance how to act in the event of a natural disaster.



## EARTHQUAKE

They should stay where they are; If they are in a building, they should be arranged under a table. In the building they should stand away from cabinets, shelves, windows. If they are outside, they should stay away from buildings, electrical wiring, away from trees.



## FLOODS

Go to the most elevated place. Do not cross the water flow, even when it is not strong.



## LANDSLIDE

Move to a stable place as quickly as possible; if they realize that they cannot escape the landslide, they should sit down, take the shape of a ball and cover themselves with something.



## FIRE

Lay on the floor and in this way try to leave the room, if it is not possible to get out of the building close the doors and windows and cover the face and body with a wet cloth and lay on the floor.



## STORM

Shut the windows and doors, stand in the middle of the room, away from the windows.



## DROUGHT

Put on light-colored clothes and wear a hat outside, drink plenty of water, do not drink alcohol, including beer, avoid the sun and cool the body with a shower.

It should be taken into account that vulnerable groups often find it difficult to adequately assess the risk, part of the early warning signals, e.g., sirens are not informative for the deaf and persons with hearing impairment, they need more time to leave the building. When removing blind and partially sighted persons out of the building, if it is necessary to wait, ask them to stand against a wall and not interfere with others. On removing them out of the building, ask them to hold on your elbow.

Warn vulnerable group members to have their rescue bag prepared with primary necessities. Products and water should be sufficient for 3 to 7 days. The content of the bag should be renewed every 6 months. The bag should contain:

First aid items:

**1.** Medicaments (pain-relieving, related to stomach problems, cardiac drops);

**2.** Bandage, cotton, adhesive plaster, antiseptic, spiritus;

**3.** Scissors, pincer, clasp pin;

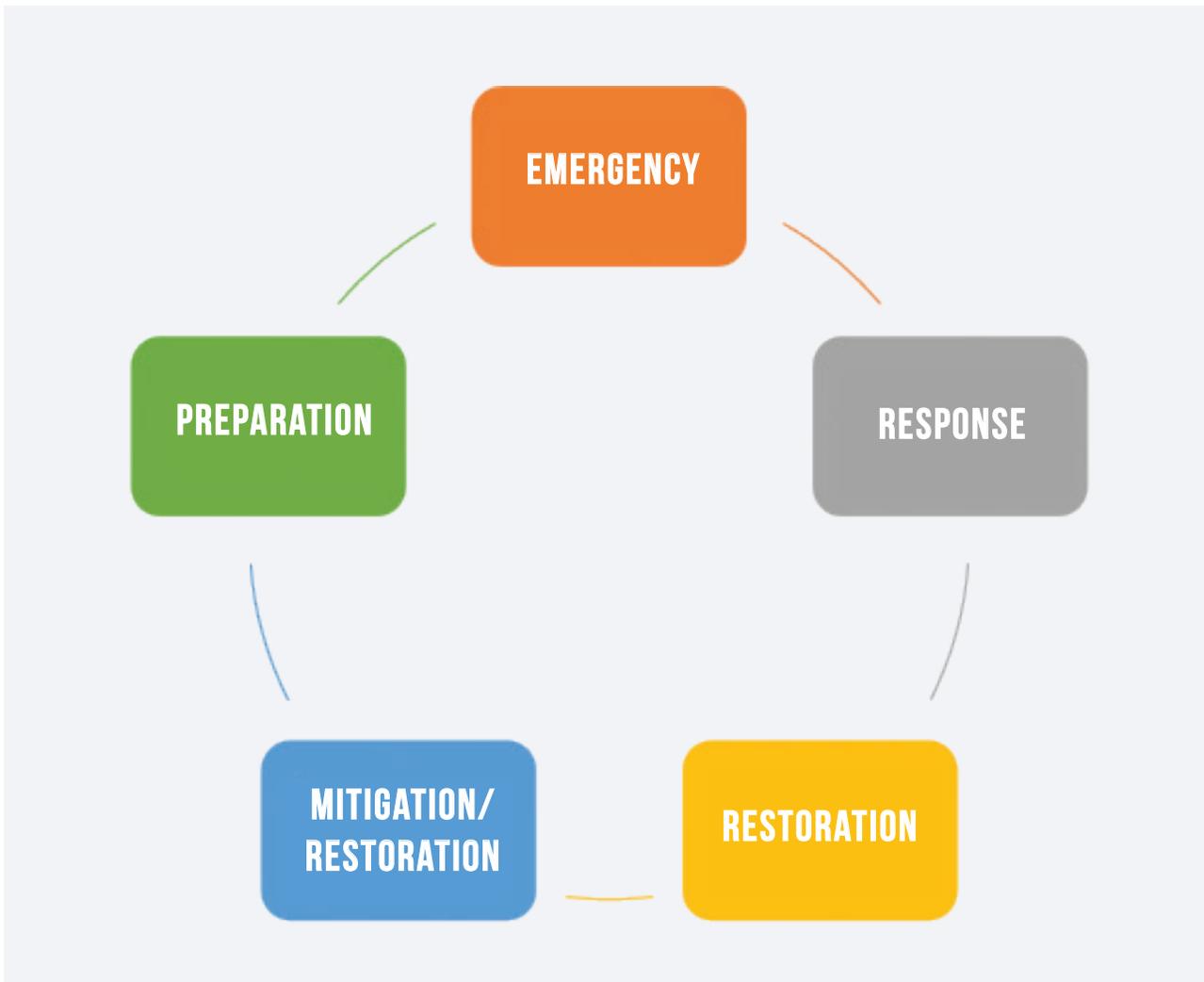
**4.** Water, tinned goods;

**5.** Mobile phone with torch and its charger;

**6.** Soap, dry and wet wipes;

**7.** Knife, tin opener, whistle, scotch tape.

# DISASTER MANAGEMENT PHASES AND KEY TERMS



## EMERGENCY RESPONSE

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

## RESTORATION

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

## MITIGATION

Mitigation (reduction) includes measures to reduce or limit the negative impacts of threats and related disasters. In many cases, it is not possible to completely avoid the negative consequences of threats, although by certain actions their scope and severity might be significantly reduced.

## PREVENTION

Prevention is the complete avoidance of threats and the negative consequences of disasters associated with them. The term “prevention” expresses the concept and intention, which means to avoid potential negative impact through preliminarily conducted measures.

## PREPARATION

Acquisition of knowledge and capacity building in matters of government structures, response and restoration by specialized organizations, communities and individuals to effectively anticipate, respond to and subsequently recover from expected, imminent, or already identified hazardous events or circumstances.

## EMERGENCY SITUATION

Significant disruption of the functioning of a community or society, which includes large-scale human, material, economic, or environmental losses and / or impacts that exceed the ability of the affected community or society to cope with its own resources.

## RISK

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

## HAZARD

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.

## DISASTER

The scope of a natural event in time and space that causes a significant disruption of the functioning of community or society, implies a large environmental losses, which exceeds the ability and capability of the affected community or society 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 from the harmful effects of the hazard. There are many aspects of vulnerability that are driven by material, social, economic and environmental factors.



# LESSON MODEL



## LANDSLIDE

Goal and objectives	Short contents
<p>Due to the internal regional specifics of Georgia, it is important for the pupils to know the basic information about the landslide. We need to teach them the appropriate behavioral skills in the event of a landslide.</p>	<p>A landslide is a collapse of a mass of earth and rapid downward movement in the direction of slope inclination. Landslides can be considered as both primary and secondary events, i.e. landslide provocation and development may be the result of an earthquake. Unlike an earthquake it is more or less possible to predict landslide development.</p>

### Recommendations:

We think that in order for the landslide simulation space to be meaningful and expressive, it would be desirable for it to replicate the real natural environment, such as the minimized model of a populated highland village.

### Consider the inclusive component

### Activities:

The teacher divides the pupils into two groups. One group is asked to play a situation where they have prior information about a landslide and are at home or in any building, while the other group is asked to perform the same task while on an open space / excursion. The first stage - pupils list the rules that must be followed; the second stage - they will play.

### The questions that a teacher can use to replicate knowledge

#### What to do in landslide hazardous areas?

- a) Plant a lot of trees and plants
- b. Lay the sand
- c. Cut down the trees

**What are the signs of a landslide?**

- a. Blocking of doors and windows, cracks and crevices on roads, water turbulence
- b. Rivers rising
- c. Thunderstorm

**Where should we go in case of a landslide?**

- a. To the mountains
- b. To the lowland area
- c. None of the answers are correct

**What should we do at home if we know a landslide will occur?**

- a. Hide in the basement
- b. Open the windows
- c. Turn off electricity, gas and water supply

**How should we move during a landslide evacuation?**

- a. By bicycle
- b. By car
- c. On foot

**In order to be prepared for any natural disaster, what should we put in our rescue bag?**

- a. Documents, warm clothes and shoes, non-perishable food (macaroni, beans), water, radio, torch and first aid kit
- b. Toys
- c. Only food



# FLOOD/FLASH FLOOD

Goal and objectives	Short contents
<p>As you know, Georgia is rich in rivers, their geographical coverage is large and that is why the behavior of rivers greatly affects the population. Thus, it is necessary for pupils to have minimal knowledge about the dangers of flood or flash flood and to be able to respond appropriately.</p>	<p>Floods are caused by rising river levels and its outflow from the riverbed due to excessive rainfall and rapid melting of snow. However, flooding is a more or less predictable process since it is related to seasonal events. As for the flash flood, it develops suddenly, which can also be accompanied by mud flow events (movement of stone-mud mass in the river bed).</p>

## Recommendations:

Obviously, the flood simulation space will not be very close to reality, however, it is desirable that the space be fully equipped with the necessary components that the student should use in real life (sacks full of gravity; rope, car ....)

## Consider the inclusive component

## Activities:

The teacher divides the pupils into three groups. The two groups are divided into two different prepared spaces (building and any type of vehicle: car, bus, etc.), and the third group is assigned the role of an observer. The instructor simulates a flood, or gives a signal and asks pupils to respond adequately and demonstrate appropriate behavioral skills.

The so-called the monitoring group / third group of pupils using the T diagram indicates the right and wrong actions of the pupils.

Assessing other peers on the part of pupils is also essential as they see what correlations exist between theory and practice.

Obviously, it is possible to change roles after completing the task. Often despite a well-learned theory, in practice pupils are confused and their behavior is not adequate.

**The questions that a teacher can use to replicate knowledge:**

**What should a house in a village stand on to be protected from floods?**

- a. On boulders
- b. On sacks full of fine sand
- c. On piles

**Where should we put the leaves and branches accumulated in the yard?**

- a. In a landfill site
- b. In the river
- c. In water ducts

**How to protect the house from flooding, which is located under a mountain slope and close to the river?**

- a. Make an artificial dam and plant trees in an elevated place
- b. Plant trees around the house
- c. Put sacks full of fine sand on the water ducts

**Where should we store items and food when heavy rains start?**

- a. In the cupboard
- b. Under the table or bed
- c. On top of a high cupboard

**What should we do when we are in a building / house during a flood?**

- a. Open the windows
- b. Close the doors and windows, switch off electricity and natural gas
- c. Wait for the rescuers

**Where should we shelter ourselves during a flood?**

- a. Elevated place, high floor, roof of the building
- b. Basement
- c. Windowless interior room

**What should we do in the event of a flood, if we are in a car?**

- a. Stay in the car and raise the window
- b. Get out of the car and go quickly to the elevated place
- c. Continue driving

**What should we do if the water is already up to the knee during the evacuation?**

- a. Swim
- b. Walk alone
- c. Rope with each other and so walk with the elders

**When can a match be used in a house after a flood is over?**

- a. After having the room aired
- b. In any case
- c. After having looked around the room

**When can electrical appliances be used after the flood is over?**

- a. When we make sure they are completely dry
- b. In any case
- c. In no case

**Which water can be drunk after the flood is over?**

- a. You must not drink water at all
- b. Tap water
- c. Bottled water

**Which kinds of food should we throw away after a flood?**

- a. Wet food
- b. Dry food
- c. None of the answers are correct

**In order to be prepared for any natural disaster, what should we put in our rescue bag?**

- a. Books
- b. Toys
- c. Documents, warm clothes and shoes, non-perishable food (macaroni, beans), water, radio, torch and first aid kit



## STRONG WIND / STORM

Goal and objectives	Short contents
<p>Provide correct information to students regarding disasters and about the results of strong winds.</p> <p>Assist them to recognize signs of strong winds and develop adequate response skills</p>	<p>Wind is the movement of air masses generated by uneven heating of the earth surface, and the greater the amplitude between atmospheric pressures, the stronger the wind.</p>

### Recommendations:

If it is not possible to arrange a simulation space related to the wind, then it is desirable to present in the room items that are dangerous in strong winds and should be avoided, for example, when you are at home, the window you do not have to stand at, when you are on the street, you should also avoid moving under the windows and under the balcony and the electrical power poles.

### Consider the inclusive component

### Activities:

At least one activity will be offered.  
The instructor divides the pupils into four groups and asks them to prepare an information poster.  
1-During a strong wind at home; 2- during a strong wind on the street; 3-during a strong wind in a populated area in the city, or in a car in an extended field; 4-during a strong wind in nature / excursion.

### The questions that a teacher can use to replicate knowledge:

#### What should we not approach after the end of the storm?

- a. Cars
- b. Broken power lines and skewed masts and trees
- c. Dogs

**What should we do, when a storm occurs and we are in a car?**

- (a) Stay in the car and raise the windows
- b. Get out of the car and run
- c. Stay in the car and lower the windows

**What should we do, when a storm occurs and we cannot shelter ourselves in a protected place?**

- a. Cling to the trees
- (b) Lay on the ground and clung to it with all our might and main
- c. Cling to the electric power poles

**Where does the wind speed increase?**

- a. In the forest
- (b) In narrow passages exits between buildings
- c. Between cars

**What should we do if a storm hits us on the street?**

- (a) Avoid walking under balconies and windows, as well as large trees
- b. Do not get into transport
- c. Do not cover yourself with a nearby building

**What should we do if a storm hits us in the building?**

- a. Leave the building
- b. Open the windows
- (c) Close the windows, doors and turn off electrical appliances. Get away from the windows, or enter the interior windowless room

**What should we do to reduce the negative effects of the storm?**

- (a) Check the strength of the door and window locks of the building often.
- b. Plant trees
- c. Remove all items attached to the outside of the building

**In order to be prepared for any natural disaster, what should we put in our rescue bag?**

- (a) Documents, warm clothes and shoes, non-perishable food (macaroni, beans), water, radio, torch and first aid kit
- b. Dishware
- c. Books



# EARTHQUAKE

## Goal and objectives

From the regional specifics of Georgia the main goal of the lesson is to transfer the necessary knowledge about earthquake and to acquire the skills necessary for vital, physical survival based on it.

## Short contents

An earthquake is a sudden oscillation/jerks of earth. It is a natural disaster caused by natural causes. Its strength and frequency determine the number of human casualties and generally the material and non-material damage. However, it is vital that people respond adequately and behave properly during and after an earthquake.

It should be noted that the earthquake, as the first catastrophe, can cause the so-called secondary disasters related to it: in the form of tsunami, landslide or avalanche. Earthquake "simulation space", it is desirable to provide for both elementary and elementary school pupils. So for example: if the items placed in the space used for defense during an earthquake should be age-appropriate, the inscriptions and hints should be understandable and clear;

## Recommendations:

It is desirable that the "simulation space" of the earthquake be provided for both elementary and basic and secondary school pupils. So, for example, if the items used for defense during an earthquake are placed in the space, they should be age-appropriate, the inscriptions and hints should be understandable and clear;

We think that earthquake simulation should not be played only on the example of the classroom, it is necessary to show it to pupils on the example of different geographical spaces or buildings.

## Consider the inclusive component

## Activities:

- The instructor asks the pupils to move and place the presented objects in the simulation room in such a way as to avoid the negative consequences during the earthquake as much as possible (mirror, bookshelf, picture, chandelier, etc. ...) For this assignment the pupils are given 10-15 minutes. Then the instructor will hold a small discussion with the pupils and discuss the assignment they have completed.
- By using the angle method, the instructor asks the pupils to choose a place to save themselves, or to move using the object that is the safest in the first minutes of an earthquake (building stairs, lift, retaining wall of the building, the room, table, balcony ...)

• The instructor offers the pupils a role play, discusses a specific case / outcome after the earthquake. In particular, the pupil is buried in the ruins:

- a) How does he behave, if he has a first aid kit;
- b) How does he behave if he does not have a first aid kit.

### The questions that a teacher can use to replicate knowledge:

#### Where to put the heavy items we have at home?

- a. Anywhere
- b. Below/down the height of the lowest family member
- c. On top of the closet

#### Where should we put the heavy items we have at home, what items should we check at home often to see how firmly it is attached or lying in its place?

- a. Shelves, chandeliers, home appliances
- b. Toys
- c. Books

#### Where not to hang a picture at home?

- a. On top of chair and bed
- b. In the dining-room
- c. In the children's room

#### Why should we replace obsolete door and closet locks?

- a. To protect against insects
- b. To avoid noise
- c. To prevent it from opening or closing during an earthquake

#### Where not to place the bed?

- a. Against the wall
- b. Under high furniture and wall shelves
- c. Against the TV

#### What should we do if we are at home / in the building during an earthquake?

- a. Creep under the table
- b. Get in the lift
- c. Run down the stairs

**What kind of shoes should we wear when we leave the house after the earthquake?**

- a. High-heel shoes
- b. Slippers
- c. Thick-soled and comfortable shoes

**What should we take with us when we leave home after an earthquake?**

- a. Computer
- b. Favorite toys
- c. Rescue bag

**In order to be prepared for any natural disaster, what should we put in our rescue bag?**

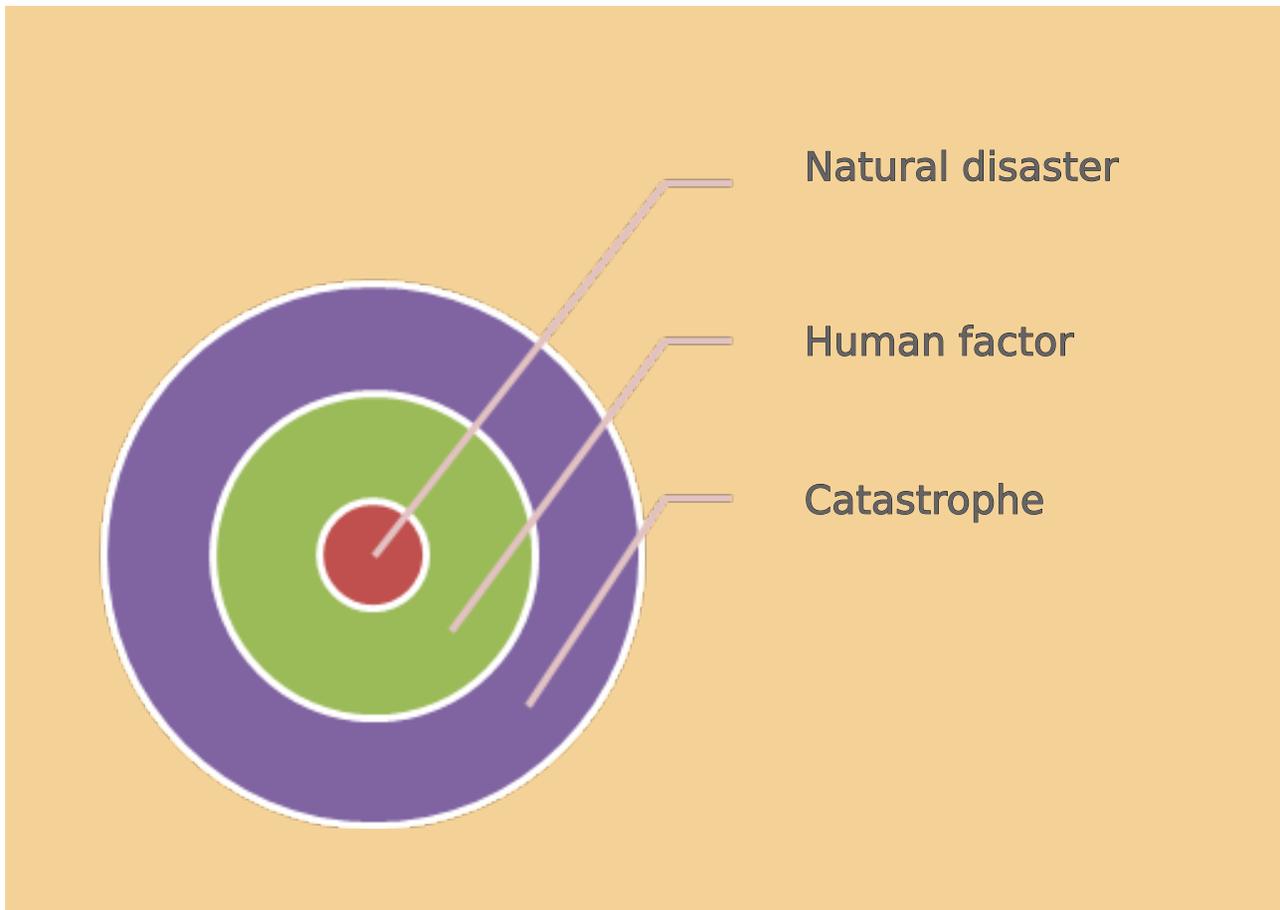
- a. Documents, warm clothes and shoes, non-perishable food (macaroni, beans), water, radio, torch and first aid kit
- b. Toys
- c. Books

Above are the model lesson plans. However, it is clear that during extracurricular activities in the eco-club it is possible to conduct various types of additional activities to explore the issue in more depth. Here are some of these activities:

It is interesting and useful for adults in a particular school to make a matrix connected with natural disasters in their own community and region that will be large format and illustrative. This matrix constantly will remind them of what risks and dangers there are and encourage them to take personally correct actions.

<b>Catastrophes caused by natural hazards</b>	<b>Causing reasons</b>	<b>Geographical distribution</b>	<b>Active periods</b>
Avalanche	Unexpected / unpredictable warming, slope sharp inclination, deforestation, heavy snow and etc.	Caucasus high and medium mountains, or accordingly west and east Georgia, mountainous Adjara	January March
Mudflow			
Hail			
Drought			
It can be done in the same way with the rest of the cases			

After that, it is advisable for the adults to perform the following activity, which will further clarify the cause-and-effect relationships of the above information. Fill in another matrix by sharing the principle of a pie chart (a natural event that can be turned into a catastrophe by human impact and accumulated unreasonable or irrational steps).



Natural disaster	Human factor	Catastrophe
Torrential rain and intense rain	Pollution of riverbeds with waste, cutting down trees and etc.	Flood

# ACTIVITIES

## Flood

In spring and summer there is an increase in the amount of water in the river, which is associated with rainy weather, melting of snow and glaciers in the high mountains. Floods occur in almost the same period of year, and the population pays special attention and prepares as much as possible so that this natural phenomenon does not cause great damage to their yards and farms.

Basic features of flooding:

- An annual recurring natural disaster;
- The flood lasts from 2-3 days to several weeks;
- During floods, the average water flow rate in the river reaches 4 m /sec and more;
- During floods, the raised water flows out of the riverbed, and covers the surrounding territory. The floodplains are especially dangerous at this time and people avoid being in such places, doing agricultural activities and building houses.

### “Flooding”

Activity for city pupils

To perform the activity, you will need:

Medium-sized plastic bowl, 1-2 liters of water, house model, small toy men, toy cars, trees and animals, one cup of sand (for making hills), plasticine, etc.

Stage of implementation of the activity

Take a plastic basin and insert a model of a small house, toy figures of men, cars, trees, animals, etc. inside. Fill the bowl with water and watch what happens to the items inside. Fill in the table below (opinions expressed by pupils):

Flooding	Preventive measures are not foreseen	What preventive measures are needed
People	Are covered by the water.	They have to go upstairs, consider people who cannot move to the second floor, for example, disabled or blind persons. In such a case, you need to take special measures.
Cars	Are swept away from the yard by a stream of water.	The car must be parked on an elevated spot.
House	Fell down, the bottom floors are flooded.	Sacks filled with plasticine / sand should be arranged around it.
Animals		
Trees		

Continue the flood game according to the listed preventive measures. Make a plasticine dam around the house in a plastic basin, move the toy cars to a small hill of sand, place the toy figures of men on the top floor of the house and pour water again, wait for what will happen. Reflection.

**Reflexion.** Pupils should make conclusions and discuss the importance of pre-flood prevention measures. Draw or write a small essay about the flood.



Activity for pupils in the region

To perform the activity you will need:

A section of the school yard that joins a small canal, 2-3 shovels, empty polyethylene bags, bottles, empty candy wrappers, empty tin cans, a water pipe or a few bottles of water, plastic toys (such as washable toys) - cars, houses, dolls, etc.

#### Stage of implementation of the activity

- Pupils must arrange a small trench (preferably not straight, but twisted) (foil may also be used) that will join the water channel located outside the school;
- Fill the trench with the accumulated garbage (polyethylene bags, jars, etc.);
- Arrange toys along the trench;
- Fill the trench with water;
- Pupils will observe the movement of water along the trench: how it cannot pass and gets stuck in places, gets off the shores and it gets on the toys, garbage does not allow water to move freely, and so on.
- Pupils will draw conclusions about what preventive measures people should take to avoid flooding;
- Pupils clear the trench and fill it again with water;
- Pupils observe the developments and draw conclusions about what happened in the second case when the trench was free of garbage.

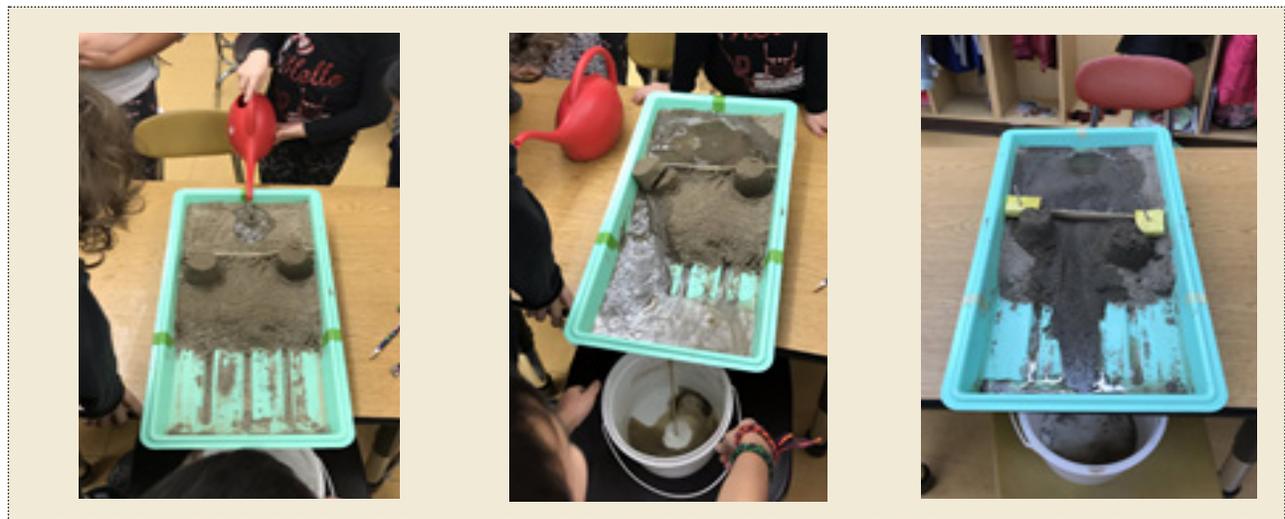
**Reflexion.** Pupils choose whether to draw or write a small essay about the flood. When writing an essay, consider people who cannot swim, or those who belong to vulnerable groups, and what would they do in that case?



## Mudslide

Mudslide is the same mudflow, rocky-muddy mass that moves in the river bed. Mudslides occur suddenly as a result of torrential rains and are usually characteristic of small mountain rivers. Most of the mudslide is composed not of water but of solid material - rock material generated as a result of depletion and erosion of rocks and mountain slopes. The speed of the mudflow can be 10 m /sec and more, and the wave height can even reach 15 meters. From the flood rivers in Georgia is distinguished the river Duruji in Kvareli municipality, which has more than once damaged the population of the city of Kvareli. There is still a 140-ton "big stone" in Kvareli, which was brought down by the river Duruji during the disaster in 1889.

"Protect our homes from mudflows"



To perform the activity, you will need:

The plastic bowl should preferably be rectangular in shape and large in size, 1-2 kg of sand, 2-3 liters of water, cardboard paper, a toy bucket and a sand shovel.

Stage of implementation of the activity

Put half of the sand into the bowl. With the help of a toy bucket children make sand houses (cylinders) in the sand, slowly pour water from one end of the bowl. Ask students to observe and answer the following questions: How did the water destroy the sand houses? What kind of waterflow is when it passes through the sand (turbid, muddy, etc.)?

Take cardboard paper and insert it into the sand in the form of a dam so that the flow of sandy water (mudslides) does less damage to the sand houses. Ask the children to repair the houses and repeat the experiment again. The children should draw conclusions by observing the processes.

**Reflexion.** The teacher asks the pupils to recall the name of the lesson topic. He writes the answer at the roots of the “tree of Reflexion”. Again, through questions, the teacher finds out the causes of the mudslide and writes the answers on the “tree branches”. Each pupil has to answer the following question independently for 5 minutes: “What are the consequences of a mudslide?” The pupils write the answers on sticky notes and stick them on the places of the leaves of the “Reflexion tree”.

## Landslide

Landslide is the breaking of soil or rock by the force of gravity and its rapid movement in the direction of the slope inclination. The development of the landslide is mainly related to - mountain slopes with large inclination, irrational deforestation, increase in underground water and ground water, high level of precipitations and etc. Land mass that moves during a landslide poses a threat to populated areas and agricultural lands.

“We measure the angle of inclination”



To perform the activity, you will need:

Angle protractor, smooth plastic board (imaginary mountain slope), small toy houses (made from plastic, paper, it is possible for children to make them themselves), 1-2 kg of sand.

Stage of implementation of the activity

The teacher arranges the toy houses on the table and using the plastic board slides the sand in the direction of the houses. With this model, children should be able to see the process of sliding of rocks from the mountain slope. The teacher changes the angle of inclination of the board, and the angle of inclination is measured by means of the angle protractor. The pupils observe when the sand falls faster - at a large or small degree of angle. The teacher fills in the table together with the pupils.

Inclination angle of the board/slope	Damage caused by landslide
200	The sand comes down slowly and does not harm the houses. (presumable answer)
250	
300	
450	
600	

**Reflexion.** Basing on the completed table, pupils draw the relevant conclusions:

- How to protect yourself and your own homes in landslide-prone areas;
- What possible measures should be taken in landslide-prone areas;
- How to protect vulnerable groups.



## Strong wind

Strong wind is the rapid and powerful movement of air masses. Generation of wind is related to the temperature difference between locations, which causes pressure difference and as a result wind is generated. The larger the difference is between pressures, the stronger the wind is. Wind is characterized by direction, speed and strength. There are many types of winds in the world - mistral (France), tramontana (Mediterranean), bora, meltemi (Adriatic), khamsin (East Coast), levant (Balearic Islands), sirocco (Sahara), Santa Ana Wind (California), katabatic wind (Antarctica, Greenland), and many others.

## Whirlwind in the bottle



To perform the activity, you will need:

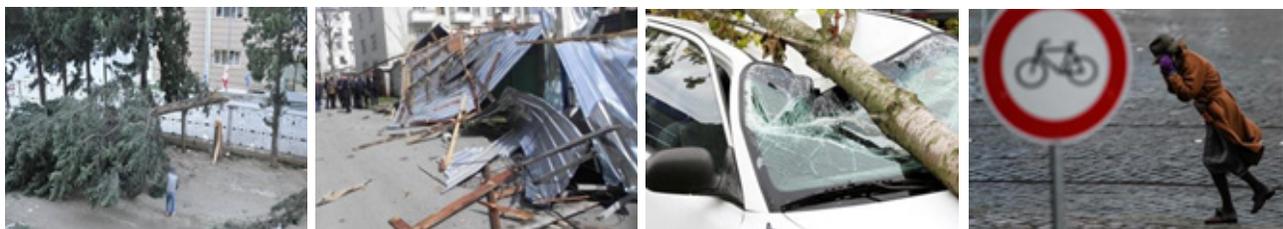
Two plastic bottles, make a hole in the middle of the bottle caps and stick with hot glue, water 1-1.5 liters, to give a different color to the water, you can use food dyes.

## Stage of implementation of the activity

Pour the colored water into one bottle, make a double cap, and make the second bottle as well. Stir the aqueous portion of the double bottle in a circular motion. The water starts to swirl. Turn the watery part of the bottle over, the water will be poured into the second bottle through the perforated lid. Ask the pupils to pay attention to the processes of formation, development and disappearance of the vortex.

With the help of this activity, pupils will get to know of the movement of the whirlwind.

**Reflexion.** Using photos and an experiment, ask the pupils to write a short essay or draw a picture with the following possible title: “Why do we not like windy weather” / “What kind of movement is the whirlwind, and why is it dangerous for the population, who needs special help in such a case?”



# Hail

Hail is atmospheric precipitation consisting of spherical particles, or fragments, of ice of various sizes (5-55 mm; rarely up to 130 mm). The hailstones have a layered structure - there are 1 mm thick transparent and semi-transparent layers. Hail is usually known during thunderstorms and torrential rain, mainly during the warmer months of the year (when the temperature is above 20°C). The hail comes from thunderclouds.

How ice is formed

To perform the activity, you will need:

A plastic mold for making ice cubes and a plate.

Stage of implementation of the activity

Ask the pupils to conduct the next test at home and present the results to the class.

The pupils should pour water into a plastic mold at home, put it in the freezer and complete the table below.

Describe in minutes	Results of observations
After 5 minutes	The water is still in a liquid aggregate state. (Probable answer)
After 10 minutes	
After 15 minutes	
After 20 minutes	
After 25 minutes	
After 30 minutes	
After 45 minutes	
After 1 hour	

The pupils must remove the frozen water cubes from the freezer and place them on a plate. Then they should observe and complete the following table.

Describe in minutes	Results of observations
After 5 minutes	The water is still in a solid state. (Probable answer)
After 10 minutes	
After 15 minutes	
After 20 minutes	
After 25 minutes	
After 30 minutes	
After 45 minutes	
After 1 hour	

**Reflexion.** The pupils should present the test results in class, compare the results, analyze and draw conclusions.



# Drought

Drought is a natural phenomenon, the formation of which is simultaneously influenced by the following factors: prolonged lack of precipitation, high temperature and low relative humidity. According to the time of the year there are distinguished types of drought - spring, summer and autumn droughts. Summer droughts are frequent in Eastern Georgia, which requires irrigation systems and melioration works.

## How drought affects plants



To perform the activity, you will need:

Two potted plants of the same species<sup>4</sup>.

## Stage of implementation of the activity

Water one pot plant regularly and leave the other without water. Pupils will observe the processes in class and fill in the table step by step. They should present the observation results in each column. Take photos of the plants at each stage, and present them as a collage at the end of the experiment.

Period	Pot plant, which is regularly watered	Pot plant, which is not watered
After 2 days		
After 4 days		
After 6 days		

4. Choose any flowering plant that cannot tolerate the lack of water. The maximum duration of the experiment is 2 weeks.

Period	Pot plant, which is regularly watered	Pot plant, which is not watered
After 8 days		
After 10 days		
After 12 days		
After 14 days		

**Reflexion.** Using the experiment and photos, ask students to draw or write a short essay - "The Impact of Drought on Living Organisms."



## Earthquake

An earthquake is a natural disaster with a sudden and devastating force, which is very difficult to predict. Earthquakes are characterized by earth shocks and oscillating movements of the earth surface. Scientists have studied the causes of earthquakes (as a result of the movement of tectonic plates), and people have begun to build such buildings in seismically active areas that can withstand earthquakes (earthquake-proof buildings) and will not collapse. As Georgia is located in a seismically active zone, and the reoccurrence of strong earthquakes is 5-10 years, the population and especially children should be prepared to face this natural disaster.

"Why does a ping-pong ball jump off the ground?"<sup>3</sup>

To perform the activity, you will need:

Medium size a stainless steel bowl, sand, water 1-2 liter, a brick, a spoon, a hammer (with wooden head), a ping-pong ball.



### Stage of implementation of the activity

Pour a little water in the bowl and add the sand, mix and place the brick on top, which will serve you as a model of the house (you can paint the windows, the door on it). Dip a ping-pong ball into the wet, damp sand near the house so that the sand completely covers it.

Hit the bowl with the hammer a few times. Soon you will see the water rise to the surface, the building began to swing and fall, and the ping-pong ball jumped on the sandy surface by itself.

**Explanation of the experiment.** Water in soils and rocks rises during earthquakes and poses a threat to the sustainability of buildings. The ping-pong ball is a model of underground communications (water supply, sewerage, etc.), as well as underground tanks (gasoline, gas) at petrol and gas filling stations. In this experiment, pupils will be able to see the dangers posed by earthquakes.



**Reflexion.** Pupils are free to create their own little models, draw the results of an experiment - "Why is an earthquake dangerous", or write a short essay - "What do I know about an earthquake". What do we need to consider in order to survive? Who might need more help and why?



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