

AVALANCHE HAZARDS IN THE MOUNTAINOUS REGIONS OF GEORGIA

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Summary: 56% of the Georgian territory is avalanche hazard, and 1882 avalanches poses serious risks to the settlements and infrastructure of the mountainous regions. The article presents the map indicating all avalanche-hazard and potentially hazard settlements. Based on the degree of the danger, article suggests grouping the settlements into 4 categories and provides methodology for determining the level of disaster risk. In addition, the article offers the mitigation measures and relevant recommendations.

Key Words: avalanche hazard, Georgia, mountainous regions

Introduction

One of the natural disasters, snow avalanche, is widespread and every year, in winter or early spring, it significantly damages the mountainous regions of Georgia, causing destruction, damage, endangering human life, impeding traffic. The foundation of avalanche-populated areas, roads and various communications was based on long-standing (more than 40 years research. Of particular importance was the field material obtained after the massive arrival of the catastrophic avalanches of February 1971, January 1976 and January 1987, as avalanches came from almost all avalanche collectors during the extreme winters of those years. We also used data from the archives of the Hydrometeorological Department, literary sources, newspaper publications of various years, reports on the arrival of avalanches in the annual volumes of the "Caucasus Calendar" and the damage caused by them in the XIX and early XX centuries.

56% of the mountainous regions of Georgia are covered with avalanche-dangerous slopes. Avalanches occur in 20% of the area every year, and 36% have sporadic (rare recurrence) avalanches that may recur every 2-3 years or several decades, but their sudden arrival is marked by great devastating force and human casualties.

By processing all the above-mentioned sources or materials, it has been established that avalanches are dangerous for the roads that connect the mountainous populated areas of Eastern and Western Georgia. In high mountainous areas, high voltage towers, recreational or other facilities are located in the avalanche danger zone. Between 1846 and 2021, about 700 people were killed, hundreds of homes were destroyed and damaged by avalanches.

Methods

Avalanche danger in the mountainous regions of Georgia depends on the terrain (orography, hypsometry and slope inclination), climate (air temperature, precipitation and snow cover) and vegetation. The analysis of the above mentioned elements allows us to determine the origin of avalanches, their mode of arrival and the peculiarities of their spread, and the method of determining the quantitative characteristics of avalanche danger obtained by us: Avalanche activity of the area (active area in terms of avalanche formation), frequency of avalanches (number of avalanches per unit area), frequency of avalanches (number of avalanches from avalanches per winter) and number of avalanches per day (number of avalanches per day) [1,2].

To minimize the negative consequences caused by the sudden arrival of avalanches, it is important to assess the risk and plan for avalanche mitigation measures.

In Switzerland, for example, according to the average time of avalanche impact and the arrival of avalanches, since 1993, European countries, including the Russian Federation, have been exposed to 5 levels of risk: low, limited, medium, high and very strong. Snow stability is accepted as a criterion.

The level of avalanche risk in Georgia, especially for strong, strong, medium and weak avalanche-prone areas, is determined by the avalanche catchment area (ha), avalanche impact strength (t / m²) and the expected result (Table 1), [3].

Table 1. Level of disaster risk by avalanche impact strength (Pt / m²), avalanche catchment area (F, ha) and expected outcome in Georgia

N	Risk level	P t / m ² ,	F, ha	The result of the arrival of the avalanche
1	Weak	<20	<0,5	Human casualties, minor damage to buildings, as well as light wooden structures and other damage, traffic disruption, damage to forests and orchards, killing of small cattle.
2	Medium	21-40	0,5-1,0	Human casualties, demolition of wooden buildings and ancillary buildings, removal from transport, damage to buildings and pipelines, destruction of plantations and small areas of forest.
3	Strong	41-60	1,1-10	Human casualties, demolition of all types of buildings (trees, bricks, limestone), obstruction of movement, damage of vehicles, roads, bridges, destruction of cattle and small cattle, perennial plants and forests.
4	Very Strong	>60	>10	Human casualties, demolition of all types of buildings (including reinforced concrete), damage to railways and roads, traffic jams, destruction of cattle and small cattle, plants and forests.

Results and discussion

Using many years of fieldwork and theoretical methods, we have established that 1882 valleys, 338 settlements, passages and highways in the mountainous regions of Georgia are threatened by avalanches. 63% of the total number of such settlements are located in western Georgia, and 37% in eastern Georgia.

Zemo Svaneti (61 settlements and 314 avalanches), highland Adjara (92 settlements and 161 avalanches), Dusheti municipality (45 settlements and 83 avalanches), Shida Kartli (50 settlements and 66 avalanches), Mtskheta-Gudauri-Larsi road and Stepantsminda (13 settlements and 165 avalanches), Etc. For each of these avalanches, the morphometric and dynamic characteristics of the avalanches are calculated (Fig. 1) [3-6].

Conclusion. As we have mentioned in the methodology, the degree of avalanche danger in the territory of Georgia was assessed according to the four quantitative characteristics of avalanche danger in terms of avalanche formation with an active territory: The number of avalanches per unit area in winter; The number of avalanches per unit area; And the duration of an avalanche period. Particularly strong (3% of the total area of Georgia), strong (8%), medium (33%), weak (12%) and non-hazardous (44%) areas were distinguished [1,2].

In the regions of Georgia where winter tourism is developed, despite the work of the Georgian Rescue Service, safety norms are still being ignored, which often ends in fatal consequences. For example, in 2014-2021, 21 people died and 13 were injured due to neglect of avalanche danger and falling into unpaved snow. Fortunately, 47 people survived with the help of rescuers. Among the dead are both foreign and Georgian citizens [6].

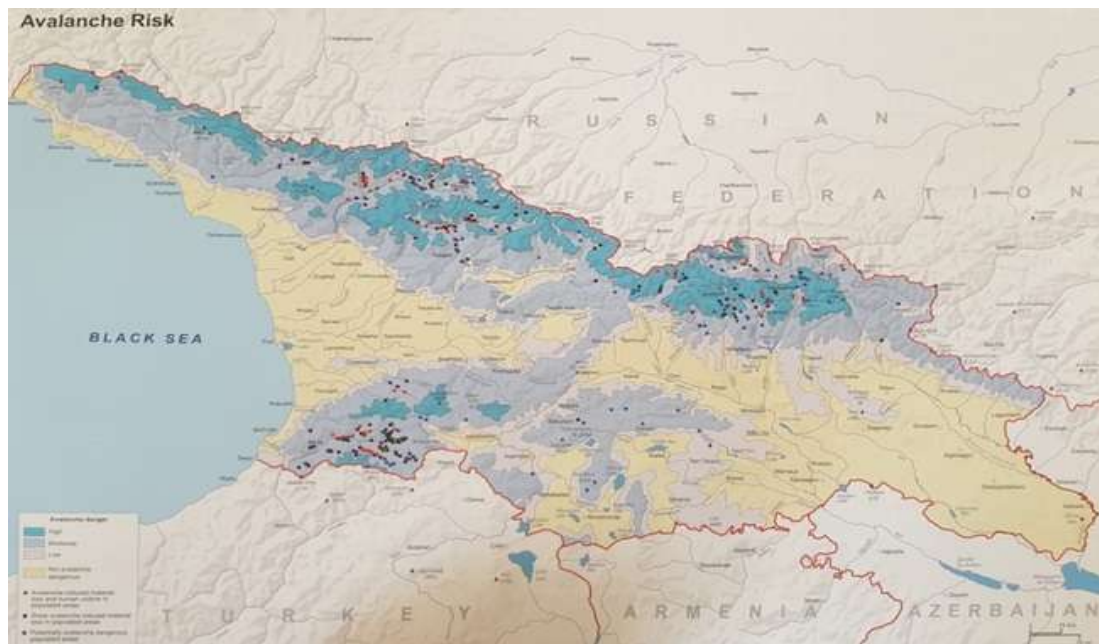


Fig. 1. Avalanche-hazardous and potentially avalanche-populated areas in Georgia

The following measures should be taken to mitigate the avalanche danger: It is necessary to assess the avalanche danger of the area as soon as the avalanche period occurs. The defense system should be activated as soon as the avalanche danger forecast is issued. In exceptional cases, for safety reasons, residents should be evacuated from the avalanche danger zone. It is also necessary to put up warning signs on the roads, mobilize the road cleaning equipment, in order to eliminate the expected damages, the energy specialists must ensure the readiness of the technical staff. When moving in mountainous areas, both locals and tourist groups should be aware of the impending avalanche danger, should know how to protect themselves in the event of an avalanche, as compliance with the rules of movement is one of the measures against avalanches. Rescue work requires great speed, because a person in an avalanche has a 50% chance of survival, and three hours after being in an avalanche this chance is 10%, sometimes even less [7].

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