

# LANDSCAPE ANALYSIS OF EXOGENIC PROCESSES DISTRIBUTION IN MOUNTAIN REGIONS OF THE CHECHEN REPUBLIC

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## Abstract

*The landscape structure is an important basis for analyzing the distribution of exogenous processes. Six types, 11 subtypes and 45 groups of landscapes were identified, for which an analysis was carried out of the occurrence and intensity of distribution of the main exogenous processes in the mountainous territories of the Chechen Republic such as: avalanches, mudflows, landslides, erosion, karst.*

**Keywords:** landscapes, exogenous processes, Chechen Republic.

## I. Introduction

The middle and high mountains of the Chechen Republic (CR) occupy about a quarter of its territory. However, this part of the republic is still undeveloped. The reasons for this are the eviction of Chechens in 1944 and the ban on returning to the settlements of the mountainous zone (only about 300 settlements remain abandoned) at the end of the 1950s. In connection with the changed socio-economic and natural-ecological conditions, the tasks arose for the redevelopment of this territory. In the Chechen Republic, the program "Socio-economic development of mountainous territories (Vedensky, Itum-Kalinsky, Nozhai-Yurtovsky, Shatoisky, Sharoysky municipal regions of the Chechen Republic (for 2017 – 2020 and subsequent years)", was adopted and aimed at improving the socio-economic situation of mountainous municipal regions of Chechnya. In this regard, the issues of effective development of the mountainous part of Chechnya arose, therefore, the priority task is to assess the spread of slope processes to ensure the prospective development of mountainous areas of the Chechen Republic.

## II. Methodology

Landscape research is the basis for a comprehensive analysis of the processes taking place in mountain areas. Landscape mapping tools have proven their effectiveness in assessing the risks of manifestation of exogenous processes. In mountainous regions, characterized by the dynamism and different ages of natural components and natural processes, landscape mapping is an effective way to streamline, establish the hierarchy and boundaries of natural complexes that determine the conditions for the manifestation of exogenous processes [4]. Thus, the landscape binding of the manifestation and dynamics of exogenous processes is the basis that allows the most complete assessment of the risks of a particular process for different types of nature management.

The landscape structure of the mountainous regions of the Eastern Caucasus was studied in the works of A. E. Fedina [8], A. M. Alieva [1], VV Bratkov. [3], Golovleva A. A. [2] and others.

North Caucasian complex expeditions in 2015-2021 made it possible to establish the main high-altitude-zonal regularities of the landscape structure and take the first steps to streamline knowledge about the distribution of slope processes in certain landscapes [5,6,7].

### III. Methods and materials

The main methods of field work were: landscape description, complex physical-geographical profiling and landscape mapping. When processing the data, GIS tools were used, which made it possible to create maps of inclination angles, exposure, and identify potential areas of manifestation of slope processes. In 2016-2021 detailed studies of the mountainous territory of the Chechen Republic were carried out. Based on the results of the expeditions, a database of complex landscape descriptions was compiled, which included about 60 complex descriptions. The database is a table in which the description points are plotted along one axis, and the description characteristics themselves are plotted along the other. First of all, this is the height above sea level, geographical position, names of facies, anthropogenic load, mesorelief, slope exposure, slope steepness, microrelief, rocks, size of clastic material, soil type, description of the presence and distribution of the main exogenous processes: avalanches, mudflows, landslides, erosion, karst, etc.

### IV. The main exogenous processes and their distribution

The research area covers the middle and high mountains of the Chechen Republic from about 500 to 4 493 m above sea level (city of Tebulosmta). The conditions for the formation, distribution and activity of exogenous processes are closely related to the landscape structure of the study area, which is represented by 6 types and 11 subtypes of landscapes, as well as 45 groups of landscapes.

The following types of landscapes have been identified: nival-glacial (above 3000-3500 m above sea level); mountain meadow (the lower border varies from 2000 to 2500 m, and the upper one coincides with the upper border of nival-glacial landscapes; mountain-forest, extending to an altitude of 2000 m (along some parts of the southern slopes, forests extend to an altitude of 2600 m above sea level) ); mountain-steppe (up to 1800-2400) .The mountain-forest-meadow type of landscapes, which is an anthropogenic transformation of the mountain-forest zone (2000-2600), and mountain-forest-meadow-steppe, transitional from mountain steppes to mountain forests (up to 1800- 2400).

The nival-glacial type of landscapes is divided into glacial and nival-rocky subtypes. Mountain meadow landscapes are divided into subnival-alpine, subalpine and subalpine steppe. Mountain-forest landscapes are divided into small-leaved-coniferous alpine and broad-leaved-small-leaved (up to an altitude of 1600-1800 m). Mountain-forest-meadow landscapes are represented by the pasture subtype. Mountain-forest-meadow-steppe – cultivated subtype of the same type. Mountain-steppe landscapes are divided into bush and mountain-meadow-cultivated landscapes.

If the ratio of heat and moisture plays a leading role in the identification of high-altitude-zonal types and subtypes of landscapes, then the identification of groups of landscapes is associated with geological and geomorphological features. Within the region, several types of rocks are distinguished, which have different resistance to the development of exogenous processes: Maikop clays, calcareous rocks of the Cretaceous-Jurassic, siltstones and sandstones of the Jurassic, mudstones and sandstones of the Jurassic. The southern part of the territory is dominated by Lower Jurassic mudstones. They are represented by clays, often serving as aquicludes, as a result of which the steep relief is combined with landslide processes. Further, a narrow strip is the Middle Jurassic siltstones, more silty, sandy. They serve as a fertile substrate for soils, in particular, in the Galanchozhbasin depression, which is considered the historical core of

the settlement of Chechens, as well as in the Itumkala and Sharo-Argun basins. Upper Jurassic-Lower Cretaceous and Cretaceous rocks are represented in the very north. They make up the Pasture Ridge. In these areas, there are developed calcareous soils, karst, and partly also gypsum karst. The distribution of the main exogenous processes in the types of landscapes of the study area is given in Table 1.

**Table 1:** *Distribution of the main exogenous processes in the types of landscapes of the mountainous part of the Czech Republic: ++ - often, + - sporadically*

Landscape types	Main exogenous processes				
	Avalanches	Mudflows	Landslides	Erosion	Karst
Nival-glacial	++				
Mountain meadow	++			+	
Mountain-forest meadow	+		+	++	+
Mountain forest	+	+	++	+	+
Mountain-forest-meadow-steppe		+	+	+	+
Mountain-steppe		+	+	++	+

In the mountain-meadow and nival-glacial zones, the steepness and dissection of slopes play an important differentiating role in the formation of various groups of landscapes and the confinement of certain slope processes. Typical groups of landscapes, in which avalanches appear, are confined to the slopes of the northern exposure. A decrease in snowiness in high-mountainous landscapes is manifested by the disappearance of glaciers.

In the mountain-forest-meadow zone, the main groups of landscapes, where erosion and landslide processes are widespread, are slopes composed of flysch deposits of siltstones and mudstones, with meadows degraded in the course of long-term grazing.

Below 1800-1600 meters above sea level, broad-leaved and mixed forests have formed on calcareous rocks. Gorges cut by the river in calcareous rocks often represent a complex combination of precipices, caves and slopes of different steepness and exposures with hornbeams with an admixture of oak on calcareous and skeletal soils. The close bedding of calcareous rocks leads to fragmentation of the forest cover into groves of birch with an admixture of hornbeam and oak on loamy-gravelly skeletal soils in places. Typical broad-leaved forests with hornbeam and beech forests formed on the northern exposure slopes, composed of Maikop clays. Landslide processes here have intensified due to intense precipitation in the early summer period. Quite often their activation is associated with the construction of roads. However, there are also hard-to-reach areas, in which fresh landslides descended in 2016, destroying century-old beech forests.

Mountain-forest-meadow-steppe landscapes were formed under the influence of anthropogenic activity under conditions of moisture deficit. Human activities leading to deforestation have stimulated processes leading to the spread of erosion and landslides.

## V. Conclusion

It was revealed that slope processes have different activity and distribution in different landscapes. This is primarily due to the heterogeneous nature of the lithogenic base, climate features, and the degree of development of the vegetation cover. The distribution of many slope processes is subject to altitudinal zoning. Karst processes are confined to landscapes formed on calcareous rocks. There are sinkholes and caves can be found in the research area.. Landslides are common in landscapes on flysch rocks, especially with a predominance of mudstones, which usually play the role of an aquiclude. To a greater extent, they are observed in mountain-forest-meadow and partly mountain-steppe types of landscapes. The development of landslides here is often stimulated by pasture digression.

Avalanches are confined to the high chains of the Lateral Ridge. The avalanche activity mainly affected the nival-glacial, mountain-meadow and, in part, mountain-forest landscapes adjacent to the mountain-meadow. Mudflow manifestations are more typical for mountain-steppe landscapes, where the slopes are subject to pasture digression and the soil and vegetation cover is disturbed.

As a rule, the manifestation of erosion is correlated with pasture digression, in particular, with the spread of the so-called "goat" trails. In some cases, erosion is stimulated by road construction. The compiled maps of the distribution of the main exogenous processes in landscapes can be used as the basis for developing a strategy for the development of mountainous territories in the Chechen Republic, taking into account modern trends: population growth in the Chechen Republic and the gradual settlement of mountain and high-mountain villages abandoned in the middle of the 20<sup>th</sup> century. On the other hand, it is necessary to take into account the changed natural and economic conditions in the mountains: climate variability, lack of roads and exposure of landscapes to dangerous natural phenomena.

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