ANALYSIS OF LANDSLIDE HAZARD IN THE SOUTH-EAST OF THE KYRGYZ REPUBLIC

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The territory of the Kyrgyz Republic is characterized by high seismicity, the complexity of the geological structure, the great dissection of the relief with the alternation of mountain ranges and depressions. Hazardous natural processes and phenomena are widely developed and often lead to emergency situations. Emergencies due to the activation of landslide processes account for 8.53% of the total number of registered emergencies.

On the territory of the Kyrgyz Republic, there are currently about 5,000 modern landslides. Landslides are developed mainly in low- and middle-mountainous zones coinciding with the area of distribution of the Meso-Cenozoic sediments, represented by interbedded variegated clay, sandstone, limestone, marl, gypsum with numerous aquifers and loesslike loam. In connection with the intensification of interacting modern geodynamic movements, seismicity, rising groundwater levels, anomalous amount of precipitation, as well as engineering and economic activities of man in mountain areas, the number of landslides increases annually.

A landslide is the mass of rocks, slipping or sliding down the slope or slope (artificial slope) under the influence of gravity, hydrodynamic pressure, seismic and some other forces [2]. The formation of a landslide is the result of a geological landslide process, manifested in vertical and horizontal displacements of rock masses due to the violation of their stability - equilibrium.

Landslides destroy the slopes, change their outlines, create a specific landslide relief. In addition, landslide displacements create peculiar forms of the internal structure of landslide accumulations, i.e. their structure. The slide of rock masses during a landslide process always occurs along one or several sliding surfaces, which are an obligatory and characteristic element of the structure of each landslide. Consequently, landslide phenomena are always accompanied by a change in the terrain, its geological structure, and indicate that the rocks on the slope or in the slope have lost stability under the influence of some reasons.

Southeast of the Kyrgyz Republic is Naryn region. The territory of the region includes: sublatitudinally elongated alternation of high-mountain (Ak-Say, Arpinskaya, At-Bashy-Karakoyun, Chatyr-Kel, Son-Kel) and mid-mountain (Jumgal, Kochkor, Min-Kush, Srednenarynskaya) intermountain hollows, and the environmental components of the mountain basins (Jumgal, Kochkor, Min-Kush, Middle-Daryn), and the environmental components of the mountain basins (Jumgal, Kochkor, Min-Kush, Srednenaryn) system consisting of the Moldo-Too, Jumgal-Too, At-Bashy, Jaman-Too, Naryn-Too, Son-Kul Too, Torugart-Too, Kokshaal-Too ranges. The absolute height of the bottoms of the depressions varies: for high-altitude valleys from 3000 to 3800 m, middle-mountain - from 1500 to 2600 m. The average height of the ridges varies from 3600 to 4500 m. The absolute elevations of individual peaks exceed 5100 m. Intermountain depressions are closed (separated by diagonal bridges) areas connected by deep canyon-shaped gorges. Dissection of the relief increases from east to west. The eastern part of the region is characterized by the development of hollow-hilly syrtovy surfaces with glacial alpine lakes. The altitudinal zonality of the relief forms several natural belts from deserts and semi-deserts to alpine ones [3].

The mountainous territory is characterized by a high dissection of the relief and a large gravitational energy of the slopes. The difference in absolute elevations of the bottom of the depression varies from 1,500 to 2,600 m, the mountain zone from 2,600 m to 4,185 m.

According to geotechnical features, the structure of the territory of the region is represented by ancient rocks of the bedrock with rigid structural bonds and younger, less durable quaternary surface sediments.

The root base rocks consist of igneous, metamorphic and sedimentary complexes combined in rock and semi-rock groups. Outcrops of rock and semi-rock soils are observed in high and middle mountain zones (less often in low mountains), while rock formations predict the development of dangerous exogenous processes - landslides, rock falls, talus, karst (for limestone and carbonate rocks), and in semi-rock soils it is also expected landslide phenomena.

Surface sediments in high-, middle-, low-mountain, and lowland areas are combined into formations of mountain slopes, intermontane depressions, and mountain glaciation consisting of loose, cohesive, and softly cohesive soils, and they are predicted to develop landslides, gully erosion, mudflows, solifluction, flat washout and other exogenous processes and phenomena.

In the Naryn region occurs from 8 to 47 emergencies for the year, an average of 15-16. Man-made emergencies make up 12.7%, the number of victims in them is 65% of the total number of victims. The emergencies caused by avalanches make up (21.1%), dangerous meteorological events (15.7%), mudflows and floods (16.2%), earthquakes (8.3%), landslides and rockfalls (6.9 %) [3].

In the Naryn region, landslide processes are developed in the foothill zones bordering the bottoms of the intermontane depressions of Atbashyn, Jumgal, Kochkor, Kara-Kudzhur, Alabuga-Naryn, and along the valley of the Naryn river. Most of the sites have a small and very small degree of damage.

On the territory of the region, a third degree of landslide hazard with a rare spread of landslides, activated in abnormally wet years, is highlighted. The volumes of landslide bodies vary from several hundred to several million cubic meters, large landslides are usually confined to zones of tectonic disturbances.

The formation of landslides depends on the geological structure and engineering-geological properties of rocks, relief, causing the stability of mountain slopes. Waterlogging of slopes, lack of vegetation, active geodynamic, seismic and man-made modes of exposure cause the activity of the manifestation of landslides.

In connection with the expected increase in the level of groundwater, precipitation and activation of seismic processes in 2015-2020, active manifestation of landslide processes is possible [1].

The danger is a large modern landslide, formed in the spring of 2004 on the right bank of the r. Tuyuk-Suu near the village of Min-Kush of the Jumgal region with a volume of unstable rocks of about 1 million m^3. When it is displaced, this landslide can form a dam up to 20 meters high and a dam lake with a volume of 250-300 thousand m^3.

On the map-scheme of a typological engineering-geological zoning of a landslide hazard (Fig. 1) in a designated typological area the first category of vulnerability in the area of the settlement was determined. For Min-Kush zone of the second degree of landslide risk is 0.8% of the area. On the typological region of the second category of vulnerability, the first-risk zone, which occupies 6% of the area, is developed on the slopes of the Moldo-Too, Suusamyr-Too, and Dzhumgal-Too ranges. The zone of the II degree of risk is developed in the central part of the district at 9% of the area of the district. Up to 69% of the area on mountain slopes refers to a typological area of category III vulnerability with the first degree of risk from exogenous slope processes and phenomena, including rockfalls, landslide landslides and debris.

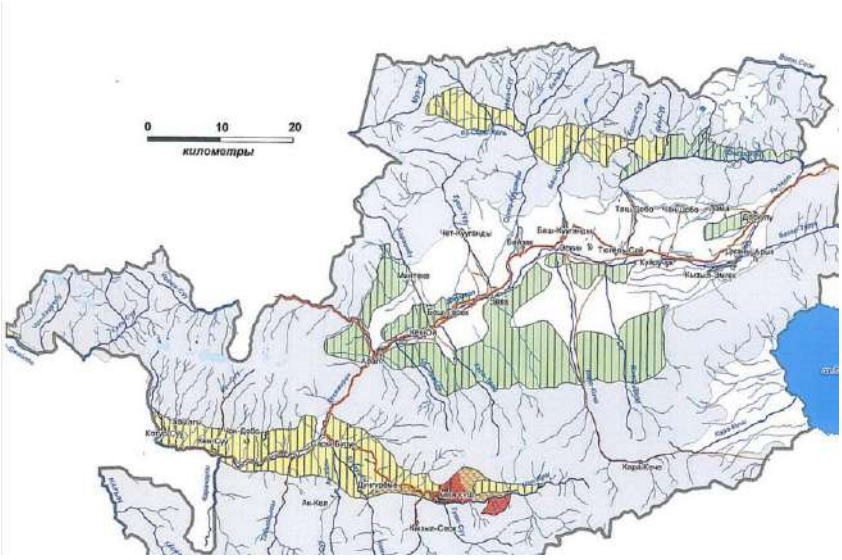

Fig. 1 Map of typological zoning and forecasting landslide hazard of Jumgal region

In the village of Min-Kush, landslides threaten residential buildings, the Office Equipment plant, power transmission towers, and engineering communications. In 2010, landslides were activated on the site of the Min-Kush-Dalniy Min-Kush highway (the danger was eliminated by partially unloading the landslide). The landslide is located to the west of the village of Min-Kush. The landslide masses squeeze the Min-Kush riverbed to the Aral-Min-Kush highway and undermine the coast with the threat of the highway. Local governments and the Ministry of Transport and Communications of the Kyrgyz Republic need to take measures to protect the highway at the erosion site.

In this regard, in order to obtain in advance information about the threat of the "Tuyuk-Suu" landslide and to implement an emergency prevention action plan, it was recommended to provide regular measurements of displacements in the lower and middle landslide with a frequency of at least once every 10-15 days in the winter 2014 and at least once every 3-5 days, starting in March 2014.

Reliable assessment of landslide risk and prediction of the danger of landslides during monitoring is carried out on the basis of a comprehensive analysis of diverse information obtained using various methods and technical means.

To date, over 5,000 landslide foci and plots have been recorded in Kyrgyzstan, approximately 700 of which pose a serious danger and threat to human settlements, economic facilities and infrastructure. However, due to the lack of modern affordable tracking equipment for landslide processes, only dozens of the most dangerous landslides in Mailuu-Suu, Min-Kush, at the Kumtor high-mountain mine, are monitored using measuring tools from the entire huge number of potentially dangerous landslide sites. For this reason, landslide processes cause very significant economic damage and cause an unjustifiably large number of human victims.

Monitoring of landslide processes in geodynamically active mountain-folded regions is the most important element of the entire system of forecasting and warning of geocatastrophes and ensuring the safety of the population and objects of the technosphere.

The main task of future work should consist in the scientific, methodological and feasibility study of the development of the observation network and the information and communication network of a unified system for monitoring and forecasting landslide threats, primarily in the most landslide-prone regions of Kyrgyzstan, including Naryn oblast.

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