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Uzbekistan's Climate Change Infrastructure: Impact on Roads and Bridges

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ABSTRACT

In recent years, climate changes are happening all over the world, which in turn affects all areas, including the impact on highways. Today, the draft strategy of the Republic of Uzbekistan on climate change until 2030 is being developed by the deputies of the Legislative Chamber of the Oliy Majlis with the participation of relevant ministries and agencies. The "Road Map" developed on the basis of this Strategy will allow targeted implementation of targeted measures for adaptation to climate change in our country.

KEYWORDS: *Climate change, floods, landslides, stagnant mud*

Studying the harmful effects of climate change (floods, avalanches, landslides, rockfalls) on highways, predicting their occurrence and developing preventive measures are among the current problems.

Among the studied factors, the impact of floods on highways was considered. A flood (floodflow) is a stagnant mud or mudstone flow consisting of a mixture of water and rock fragments that suddenly appears in the basins of small mountain rivers. It is characterized by a sudden rise in water level, wave action, short duration of action (on average from one hour to eight hours), significant erosive and accumulative destructive effect. Floods pose a threat to settlements, railways, highways and other structures.

Floods are directly caused by heavy rains, heavy melting of snow, absorption of water reservoirs, less earthquakes, volcanic eruptions.

Classification of flood flows: According to the mechanism of origin, they are divided into three types: erosive, breakthrough and landslides.

In the case of erosion, the water flow is initially saturated with soil and bedrock material due to the washing and erosion of the soil in its path, and then a flood wave is formed.

The formation of a flood is characterized by an intensive process of water accumulation, the rocks are eroded at the same time, a flood occurs in the saturated ground, and the absorption of the reservoir occurs. The flood mass moves down the slope or river bed [2].

During a landslide, a mass of water-saturated rocks (including snow and ice) breaks down. In this case, the current saturation is close to the maximum level.

Each mountain region has its own reasons for mudslides. For example, in the Caucasus, they occur mainly as a result of rain and heavy rain (85%).

In recent years, the natural causes of mudflows have been added to man-made factors, violations of the rules of use by mining enterprises, blasting during the construction of roads and other structures, deforestation, improper agricultural activities, soil and vegetation damage.

When moving, a flood flow is a constant stream of mud, rock, and water. Precipitators form a "head" of water in the steep front of a turbidity wave with a height of 5 to 15 m. the maximum height of the flood head sometimes reaches 25 m. The classification of floods based on the causes of origin is given below (Table 1).

Classification of floods based on the main causes of their occurrence

Table 1

№	Types of floods	Reasons for occurrence	Distribution and origin
1	Rainy	Heavy rains, prolonged rains	The most massive types of floods on Earth are caused by slope erosion and landslides.
2	Snowy	Heavy snowmelt	It takes place in the subarctic mountains. This is due to the destruction and swamping of snow masses
3	Icy	Strong melting of snow and ice	In high mountain areas, the origin is associated with the absorption of melted glacial waters
4	Volcanic	Volcanic eruption	In areas of active volcanoes. Largest, due to rapid snowmelt and increased water content of crater lakes
5	Seismogenic	Strong earthquakes	In highly seismic areas. Discontinuity of land masses from slopes
6	Limnogenic	Formation of lake dams	Dam failure in high mountain areas
7	Direct anthropogenic impact	Accumulation of anthropogenic rocks. Poor quality earthen dams	In storage areas of soil mass. Erosion and displacement of artificial rocks. Collapse of dams
8	Anthropogenic indirect effect	Disruption of soil and vegetation cover	In forests and meadows. Erosion of pastures and riverbanks

Based on the main factors of formation, floods are classified as follows: zonal manifestation - the main factor of formation is climatic conditions (precipitation). They depend on the characteristics of the zone. The meeting is held regularly. Pathways are relatively constant; regional views (the main factor of formation is geological processes). Aggregation is sporadic and movement patterns are erratic; anthropogenic is the result of human economic activity. Occurs where there is the greatest load in the mountain landscape. New flood basins are being created. The collection is episodic.

Classification by power (by solid mass flowed): 1. Strong (strong power) by bringing more than 100,000 m3 of materials. They happen once every 5-10 years. 2. Average capacity with bringing materials from 10 to 100 thousand m3. They happen every 2-3 years. 3. Low-strength (low-strength), with the removal of less than 10 thousand m3 of materials. They happen every year, sometimes several times a year.

Classification of flood basins according to the frequency of floods describes the intensity of development or its selectivity. According to the frequency of floods, three groups of flood basins can be distinguished: 1. High flood activity (once every 3-5 years and with frequent recurrence); 2. Average flood activity (with recurrence every 6-15 years); 3. Low flood activity (recurring once every 16 years or less).

Villages are also classified according to the impact on the structures: 1. Low capacity - small washing areas, partial clogging of culvert holes. 2. Medium strength - strong washing, complete clogging of holes, damage and destruction of buildings without foundations. 3. Strong - great destructive power, breaking bridge trusses, destroying bridge supports, stone buildings, roads. 4. Catastrophic - complete destruction of buildings, road sections together with road surface and structures, burying of structures under sedimentary rocks.

Sometimes the classification of basins according to the height of the sources of water bodies is used: 1. High mountain. The origin is higher than 2500 m, the volume of outflow from 1 km2 is 15-25 thousand m3 for one village; 2. Middle mountain. Sources lie within 1000-2500 m, the volume of removal from 1 km2 is 5-15 thousand m3 for one flood; 3. Low mountains. Sources are below 1000 m, the flow volume from 1 km2 is less than 5 thousand m3 in one flood.

The Republic of Uzbekistan is located in the Central Asian region, this region is located in the continental sector of the southern part of the temperate zone and has a significant area, characterized by a relatively monotonous climate. The highest amount of precipitation falls on the northern slopes of Tien Shan and the southeastern part of Kunlun.

Several models are used for forecasting flood flows in mountain and sub-mountain areas where highways are located and determining the damage caused by them [2].

1. Methodology of assessing the economic risk of floods of Moscow State University;
2. Assessment of individual and collective risk of floods;
3. Methodology for assessing the economic risk of floods;
4. Methodology of multi-criteria assessment of flood risks.

Methodology of economic risk assessment of floods of Moscow State University: The first group of risk assessment methods can include methods that replace the concept of risk with the concept of risk in practice, which is fundamentally wrong. Risk is the possibility of unwanted consequences, while risk is a potential threat. Risk, as a rule, is a qualitative characteristic obtained in various ways. Among them, it is possible to highlight the expert assessment, the widespread point assessment. Another group of risk assessment methods includes those that assess the probability of consequences. They are usually based on theoretical and statistical studies. Risk is based on the statement that the object is a function of exposure, vulnerability and protection from dangerous natural effects.

Assessment of individual and collective risk of floods: Today, there is very little scientific work on flood risk assessment. A.L. Shnyparkov et al [3]. For the first time, the individual and collective risk of floods across Russia was assessed on a small scale.

The following indicators are used to assess the risk of floods:

- Probability of human death due to flooding in a given area during the year. The indicator is the individual flood risk.
- Probable number of people affected by floods in a given area during the year. The indicator is a collective risk.

The formulas for calculating individual and collective risks take into account the frequency of their flow, the duration of their main period, the influence of area and social factors (the dependence on quantitative indicators of flood activity, such as the number and density of the population, the population, the vulnerability of the population in space and time, the mortality rate).

Collective risk assessment is carried out according to the formula (formula 1):

$R_{mf} = P_{mf} \cdot V_s \cdot V_t \cdot d \cdot K_l \cdot F$; (1)

Here: Rmf — collective flood risk, dead/year; Pmf - frequency of floods, how many times a year; Vs — vulnerability of the population at the location, number of days; W is the vulnerability of the population during floods, without unit of measure.; d — population density in the assessed area, people/km2; Kl is the coefficient of mortality from floods, without unit of measure; F is a location in a flood-prone area, km2.

Vulnerability of the population in Vs area to floods (number of days) depends on the flood damage of the area (formula 2):

$V_s = S_a / S_t$, (2)

Here: Sa is the area of the flood-prone area within the studied basin, St is the total area of the basin.

Methodology of economic risk assessment of floods: Since the risk assessment of flood processes in economic indicators is carried out on an average scale, the conditional gross urban product at the city level was taken as the basis of the economic indicator.

Local self-government is the level of government that represents the area under control of the average basic life cycle of a person's life. It allows using the level of municipal formation (MSh) as an accounting unit to determine the level of socio-economic development of an administrative unit for modeling purposes and to relate it to natural and emerging risks.

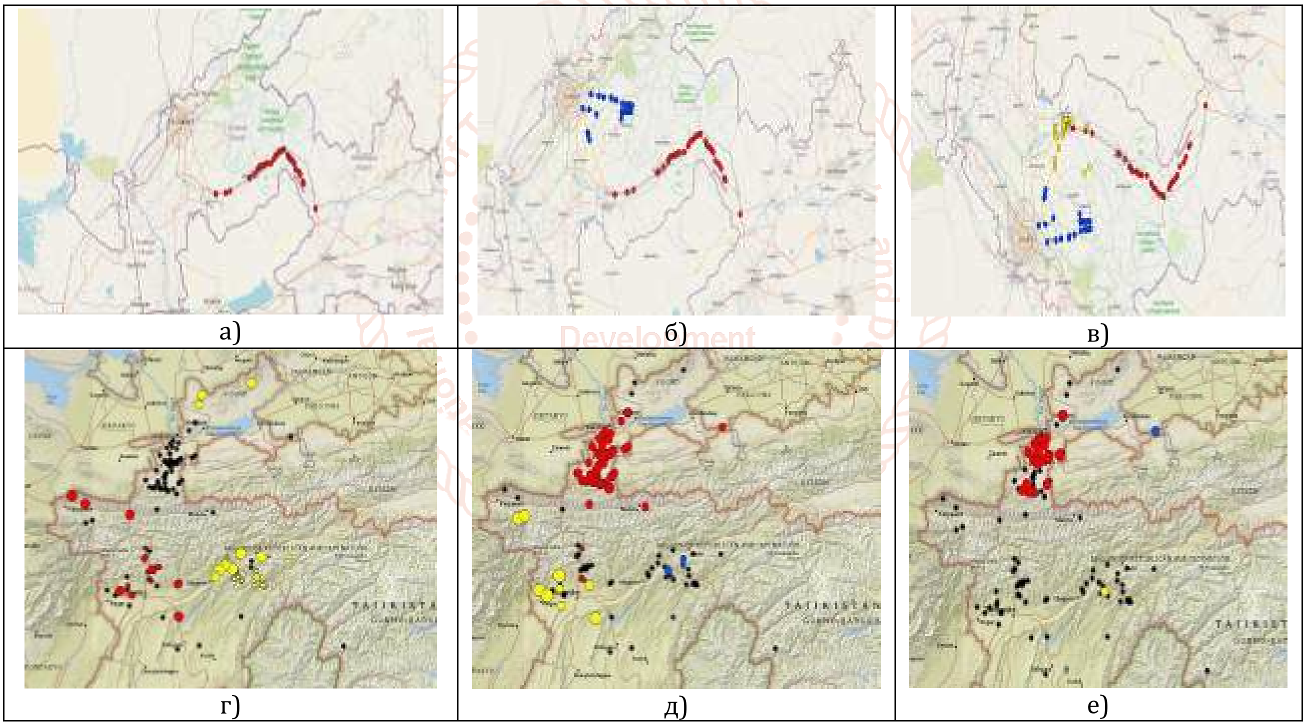
Thus, the following data are available to assess the risk of floods at this level: area size, population, commercial and non-commercial fixed assets, industrial and agricultural output. All this is not enough to calculate such a basic general indicator of the state of the Ministry of Defense as a typical gross city product [3].

In economic indicators, values of notional gross urban product in administrative areas were used instead of population density and population size to assess flood risk.

Methodology of multi-criteria assessment of flood risks: We will consider in detail the procedure for constructing a flood risk index using the idea of summary index method (XKU), the basis of which is N.V. It is given in Khovanova's works [4]. The characteristics of the flood can be described with sufficient completeness by taking into account the following relatively independent initial characteristics: x1 – areas of the flood basin (F), x2 – the slope of the flood basin (N), x3 – the diameter of the largest stone carried by the flow (D). , x4 – flood flow rate (V), x5 – maximum flood flow (Qmax), x6 – population density in the region (r).

Six morphometric traits were used in the study. Calculations were made for three, four and six characteristics (slope of the flood stream, cross-sectional area, diameter of the largest stone, maximum flow speed of the stream, speed of the stream, as well as population density in the region).

With the help of the above-mentioned models, places where floods can occur are presented and they are divided into types, different variants of flood hazard classification are shown depending on the number of primary features used, the genesis of the origin and the type of flood. Maps of the occurrence of floods were created with the help of geoinformation systems (Figure 1) [5].



1 – picture. a) – Classification of floods using three primary characteristics. 2 – Classification of floods using four primary characteristics. 3 – Classification of floods using six primary characteristics. 4 – Classification of landslides. 5 – Classification of sedimentary floods. 6 – Classification of floods using three primary characteristics.

Flood Forecasting Techniques: Forecasting of normal targets is possible based on the amount of rainfall. Experience shows that in order for a mudslide to form, a very significant amount of heavy precipitation must fall as a result of rain. 35-40 mm of rainfall in the Rezaksoi and Okhangaron river basins, where most ridges are composed of sedimentary rocks, is sufficient for the occurrence of floods. The rocks are somewhat harder, in the south of the metamorphosed republic, 40-50 mm of rain is necessary for the formation of floods. Kamchik pass Ohongaron basin, including rocks - granites, diorites, Ohongaron, where floods prevail, requires a heavy rain with a sediment of at least 70-80 mm.

The formation of floods is associated with the season when the largest amount of precipitation falls into liquid form. In the south of the country, floods occur in early spring, in March and April, in the north of Uzbekistan - in late spring, in May and June, and in the Ohongaron valley, the most muddy months are in April and May. Ohongaron glaciers are observed mainly in July and August [4].

In 1989, the best hydrometeorological specialists of the Department of Hydrometeorology of Uzbekistan, using the calculations made by the scientists of the Central Asian Research Institute of Hydrometeorology, created a project of methodological instructions "Method of short-term forecasting of flood risk in the main regions of Uzbekistan". Although the amount of precipitation was taken as a basis, this method was based on synoptic rather than meteorological characteristics [6].

This method has proven reliable in making long-term and heavy rainfall forecasts.

The duration of the forecast is from 12 to 24 hours, with high and high cyclones during the transition to cold weather - up to one or two days.

At the moment, the State Institute of Hydrometeorology predicts the formation of floods caused by precipitation within 24-48 hours.

Warnings are issued based on general weather forecasts: in which area, when precipitation is expected, in what form and how much. Due to the lack of experienced specialists, detailed forecasts are not given. Monthly and year-end review of goals is conducted with analysis of their causes, location of flood, its flow, volume, damage, etc.

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