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The role of landscape in the formation of river flow in the Nakhchivan autonomous republic

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ABSTRACT

Problem definition. In order to fully and rationally use water resources (irrigation of arid territories, water supply of the population, etc.), it is necessary to develop the most effective ways of studying river runoff and its components, identifying patterns of its formation and passage, as well as finding ways of its rational use. From this point of view, the patterns identified by the author, as well as the interrelations of river runoff elements and natural factors, acquire important scientific and practical significance and allow us to determine the nature of runoff formation, its intra-annual and long-term distribution across the territory and altitudinal zones.

Analysis of recent research. Unlike other natural resources, water resources have the ability to constantly renew themselves due to the moisture cycle in nature. This creates confidence in sufficient water supply for all human needs in the future. Meanwhile, the water resources of the republic are limited. Situated in the middle and lower reaches of two interstate rivers, the Kura and the Araz, it has an influx of river waters from neighboring countries: Turkey, Iran, Georgia, Armenia, and Dagestan. The river flow formed on the territory of the republic is very small. Reservoirs of long-term and seasonal regulation created on rivers to some extent solve the problem of irrigation. However, the issue of providing water to the population of cities, villages and urban-type settlements remains urgent today.

Formulation of the purpose of the article. Continuously changing in space and time during the water cycle in nature, all sources of water resources (precipitation, runoff, evaporation) are closely interconnected.

Studying the formation of river runoff in any mountainous country is associated with a number of difficulties caused by sharp contrasts in natural conditions. Without taking into account the interaction of these factors and their influence on river runoff, it is unlikely that it is possible to identify the main patterns of change in runoff and its components

The main material of the research. During the research, we used field research methods and modern methods. We also used materials from other researchers.

Conclusions. As a result, the following landscape-hydrological regions were distinguished in the Nakhchivan natural region. 1. Zangezur-Deralayaz landscape-hydrological region; 2. Shahbuz-Ordubad landscape-hydrological region; 3. Arazboyu landscape-hydrological region. During the analysis of the density of the river network by landscape, we determined that this indicator also affects the socio-economic infrastructure located in hydrological regions.

Keywords*: climate action, landscape, global warming, river flow, ArcGIS, hydrological map, landscape-hydrological region, natural region*

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Introduction. At the modern stage of hydrology, rivers are considered as a result of the development of the geographical landscape [2]. As various physical and geographical factors (climate, relief, soil, vegetation cover and geological structure) that are closely related to each other change [21], the morphometric indicators of the river network, the water regime and flow of the river also change [8].

The discovery of structural regularities of the river network, the study and generalization of the flow characteristics of various phases of the river regime should be based on the relationships with the qualitative and quantitative indicators of physical and geographical factors. Such a genetic approach is of both theoretical and practical importance [9]. It is precisely this type of relationship that forms the basis of modern hydrological and water management calculations, as well as hydrological forecasting methods [1].

The degradation of natural landscapes as a result of the influence of anthropogenic factors is reflected both in the regime of rivers and in their flow characteristics [3]. The construction of reservoirs and the laying of canals leads to a change in the hydrographic network, as well as the river regime [11]. Therefore, the results of landscape-hydrological studies are also used in solving the issues of planning the use of water resources and their management.

The landscape types of the basin should also be taken into account in the optimal placement of hydrological observation points in the river network [14]. The detection of rivers with zonal and azonal

regimes, the study of their regime characteristics, flow and time indicators require a landscape-hydrological approach.

The logical conclusion of the study of rivers as a landscape element should be the landscape-hydrological zoning of the territory [15]. Such zoning is of practical importance in solving the above-mentioned hydrological problems [20].

In general, the Nakhchivan natural region differs sharply from other regions of the republic in terms of its natural climatic conditions. Many of the problems indicated for this region, for example, the dependence of morphometric and flow indicators of rivers on various physical and geographical factors, have been reflected in the studies of S.H. Rutamov, R.M. Qashqai, M.A. Mammadov, R.Kh. Piriyev and others. However, the analysis of the location of hydrological observation points taking into account landscape types, landscape and hydrological zoning of the territory have not been practically carried out.

Landscapes are the reasons that directly or indirectly affect the formation of river flow [5]. All physical and geographical factors that affect the regime and flow characteristics of rivers are divided into two types: climatic and surface factors.

The distribution of climatic factors over the territory is related to the nature of climatic zones and atmospheric circulation [4]. Therefore, these types of factors are subject to the law of zonality [6].

Physical-geographical factors can be divided into two groups, taking into account the rate of their change over time: meteorological or rapidly changing factors (atmospheric precipitation, evaporation, humidity and other meteorological elements), landscape or slowly changing factors (climate, orography, lakes, glaciers, morphometric indicators of the basin). Landscape or slowly changing factors mainly include factors of the basin surface. These factors are mainly related to the lithosphere. Since the temporal variability is very weak, it is considered that they do not change at all for several decades.

The relief of the basin has a certain effect on the flow. In this regard, the following relief indicators are of greater interest: the average height of the watershed above the ocean level, the range of elevation changes in the basin, the degree of fragmentation of the territory, the exposure of the slopes [7].

Elements of the relief affect the distribution of the three main climatic elements over the territory, which indirectly or directly affects the landscapes [12]. These include precipitation, evaporation and air temperature [13]. These, in turn, determine the change in surface and underground accumulations of the river flow over time and area [19]. Relief elements affect the conditions for the formation of the flow by changing the speed of stream jets on the surface of the watershed, the duration of water runoff in the channel and on the slopes [18]. They also affect the processes of snow accumulation and melting in the basin, infiltration and accumulation of liquid precipitation. It is extremely important to study the impact of landscapes on the rivers of the Nakhchivan Autonomous Republic, which is distinguished by its arid and continental climate. The main reason for this is that the future sustainable and sustainable development of the agrocenoses developed here depends on this.

Research object. The rivers of the Nakhchivan Autonomous Republic play an important role in the development of the region. Most of the rivers here are small mountain rivers. The river network is more developed in the mountainous part, which is due to the high amount of precipitation. Since the humidity is higher in areas at an altitude of 1000-2500 m, the river network is partially well developed. In areas above 2500 m, the decrease in precipitation, the poor development of forests, plants and soil cover lead to the reduction of the river network here. In this zone, groundwater emerges in the form of numerous springs. In areas above 3000 m, the relief is mainly bare and rocky, and atmospheric sediments are relatively small, so the river network is poorly developed. In areas above 2500 m, the density of the river network decreases to 0.10 km/km^2. The main reason for the poor development of the river network in the foothills and plains below 1000 m is the lack of precipitation in this zone, intensive evaporation, and rapid absorption of river waters into sedimentary rocks. Landscapes significantly affect the formation and speed of river flow. The fact that Nakhchivan Autonomous Republic has a sharply continental climate, low precipitation, dry weather, partly rainless and warm summer and autumn months, cold winter, high temperature amplitude differences between days and seasons, has affected the formation of vegetation and led to the development of weak monotypic, that is, xerophytic plants. Therefore, the Araz-bound plain and foothills of Nakhchivan natural region belong to the semi-desert zone. This area covers an area up to 1200 m in altitude and extends from the northwest to the southeast. The semi-desert zone is especially extensive in the Sadarak, Sharur, Boyukduz and Nakhchivan plains, and covers a narrow area in the southeastern end - in the Ordubad plains. Due to the low-rainfall continental climate of the Middle Araz Depression and the Araz Ranges region and the lack of favorable relief conditions for the development of large river basins, the rivers flowing through the territory of the Nakhchivan Autonomous Republic are mainly low-water and small rivers. Due to the absence of a forest landscape in the territory of Nakhchivan, the density of the river network is mainly weak.

Research method. The research work used hydrological data, landscape, climate, and elevation

maps for the years 1928-2022. Maps were prepared in the ArcGIS program for accurate results during the research process. Information on river water consumption was taken from the periodic releases of the State Water Cadastre and the data of the National Hydrometeorology Department. Zonal-hydrological, geographical-hydrological, geographical interpolation, Horton method, comparative and statistical mathematical methods were used in the dissertation. For the first time, landscape-hydrological zoning of the Nakhchivan Autonomous Republic was carried out depending on the landscapes and a corresponding map was compiled.

Analysis and discussion. The hydrological regime of our study area is very different from that of other regions of our republic. The first reason for this is the relief, climate, in other words, natural conditions. Thus, the fact that our country consists of mountains and plains has led to a more diverse hydrological regime in these regions. Unlike our study area, a large number of floods and mudflows are observed here. For this reason, our study area has very favorable natural conditions.

In the study area, neighboring river basins located under the same climatic conditions, but with different relief, soil and vegetation, can be completely different in terms of both quantity and quality of flow. In Nakhchivan, increasing altitude leads to an increase in climatic features. The diversity of natural conditions on the mountain slopes, the interaction of individual components is reflected in the formation of various landscape types. The following landscape types exist in the Nakhchivan natural region: 1. Nival and partially nival-glacial landscape of the high mountains, 2. Alpine, subalpine and meadow-steppe landscape of the high mountains, 3. Subalpine meadow, 4. Mountain-xerophyte landscape of the middle mountains, 5. Semi-desert landscape of the lowlands and intermontane plains (Figure 1).

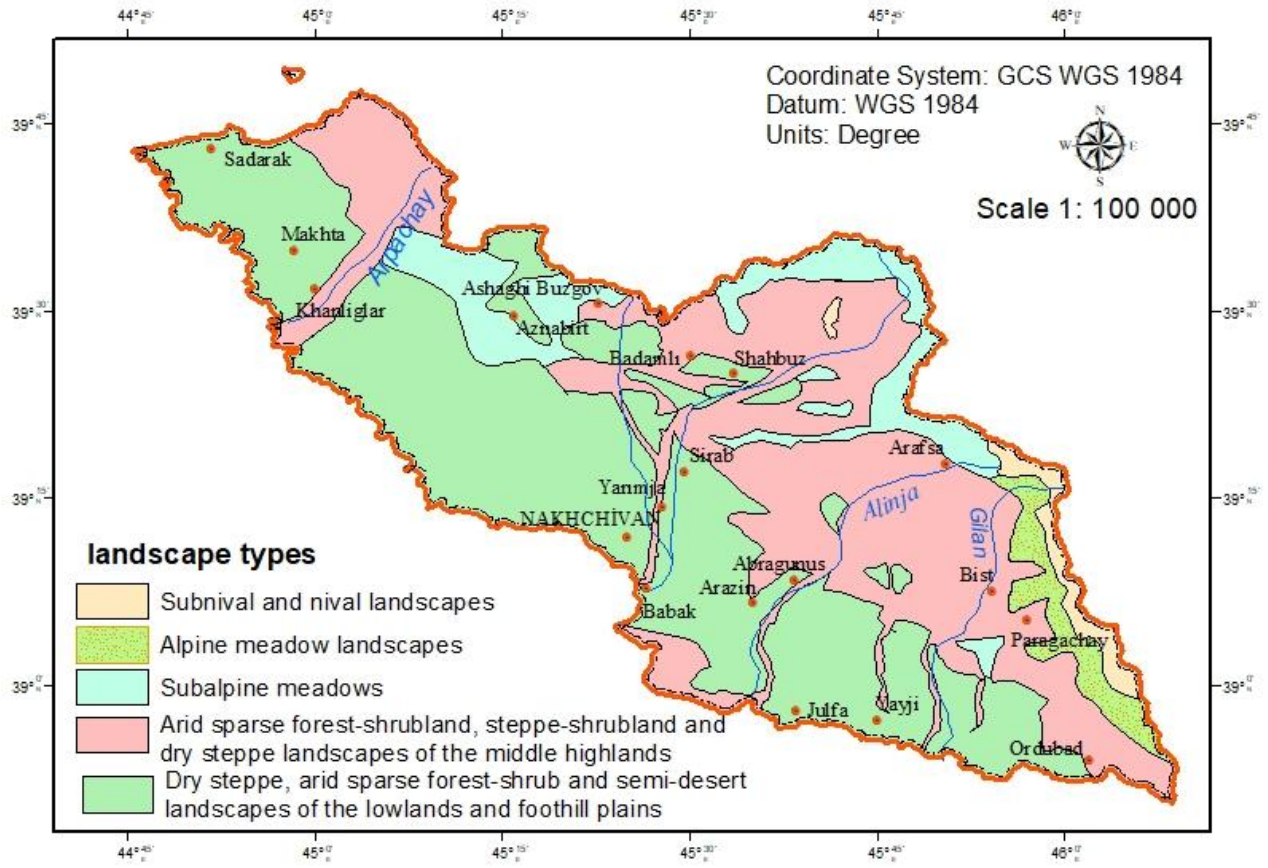

Fig. 1. Landscape map

A group of authors believe that during hydrological studies, it is necessary to take into account not the general zonality, but the specific features of the landscapes in the basin, since the reason for the specialization of each landscape is the geological-geomorphological characteristics of the territory.

It is known that the role of various morphological landscapes in the structure of the natural terrain complex is different. Some of them are widespread and occupy a relatively large area, while others are of dependent significance and are rarely found. Therefore, the decision on which landscape type of the basin to conduct hydrological observation should be based on landscape studies.

Although mountain rivers are usually not long, they flow in several different landscape belts. The-

refore, the share of the area occupied by each landscape belt or type in the total area of the basin should be determined separately. Then the role of each of them in the formation of the flow should be assessed separately.

The hydrological characteristics of the landscape depend on the joint effect of the regularity of fluctuations in climatic factors and the discrete properties of the basin surface. Seasonal fluctuations are characteristic of the hydrological characteristics of the landscape. Thus, during the period of snow cover, the albedo coefficient of the surface and the radiation balance change sharply. From this point of view, when studying the hydrological regime, it is advisable to consider the warm and cold periods separately. In the warm period of the year, the hydrological characteristics of the landscape become more contrasting.

One of the characteristic forms of mountainous terrain landscapes is various stony surfaces, which are either rocky or stony-crusted. The porosity of the stony-crusted surface is large, the moisture capacity is weak, and the capillary connections are dense. From a hydrological point of view, such a surface is more favorable and does not create conditions for the formation of avalanches and floods. The lithological and tectonic features of rocky areas, on the one hand, regulate the groundwater flow by changing the ratio of groundwater and surface flows, and on the other hand, increase the flow velocity, causing flash floods.

In the mountain meadow landscape, the surface has different types of soil and plant cover. Therefore, the difference in infiltration in different areas complicates the hydrological regime in high-altitude zones.

In the cold season, evaporation on grassy slopes is 2.8-3.2 times less than in coniferous forests, and in the warm season – 1.5-1.7 times less, which affects the amount of runoff.

Hydrological zoning is based on the basic laws of physical geography and there is a close genetic connection between them. Therefore, special attention should be paid to physical-geographical zoning. There are two main types of physical-geographical zoning: zoning by physical-geographical components and complex physical-geographical zoning. There are also two main types of hydrological zoning: zoning by hydrological elements and complex hydrological zoning. In both physical-geographical and hydrological zoning, the principles of complexity, relative homogeneity, genetic uniformity, and territorial integrity are taken into account.

The physical-geographical zoning of Azerbaijan belongs to M.A. Museyibov and B.A. Budagov. A.M. Shikhlinski and V.G. Zavriyev developed a hydrological zoning scheme based on this zoning. They proposed various hydrological zoning schemes for Azerbaijan, but did not provide a scientific and critical review of them. It should be noted that the author of the first comprehensive hydrological zoning scheme for Azerbaijan was S.H. Rustamov.

For the first time, schemes were developed for the elements of the water balance of the Qashqai R.M. river basins, M.A. Mammadov for the degree of flooding of rivers, and F.A. Imanov for the conditions for the formation of the minimum flow and the synchronicity of fluctuations in the minimum water consumption. However, neither the landscape-hydrological zoning scheme for the whole of Azerbaijan nor for its individual natural regions has been developed so far. Such zoning can be useful for solving many practical problems:

1. Assessment of the role of various landscape types in the formation of river flow;

2. Calculation and forecast of various characteristics of river flow;

3. Correct placement of the network of hydrological observation points;

4. Planning and management of water resources use.

Although the landscape types common in the river basin transform atmospheric precipitation into river flow, only a geographical-hydrological analysis of the landscape allows us to obtain a general idea of the hydrological characteristics of a particular region. However, the identification of objective relationships between the indicators of the landscape type and the characteristics of the river flow is already of practical importance.

In general, the determination of the boundaries of hydrological regions is one of the controversial issues. Improper border crossing results in a violation of the homogeneity of the hydrological region. Therefore, both qualitative and quantitative indicators were used in the proposed landscape-hydrological zoning. Taking all this into account, the following landscape-hydrological regions can be distinguished in the Nakhchivan natural region:

1. Zangezur-Deralayaz landscape-hydrological region. This region is located in the intensively fragmented highland nival and partially nival-glacial landscapes and highland alpine meadows, meadow-steppe landscape belt. The relief in the nival and partially nival-glacial landscape is intensively fragmented. Gravity-denudation processes are characteristic. Snow, single-track valley (trough), moraine glacial relief forms are widespread. It has a mountainous tundra climate. The average temperature in January is from -15°C to -8.5°C, in July 4-9°C, Annual precipitation is 800-1200 mm. Soil cover is underdeveloped. Very rare rocky-gravel plants, rock goat in the highlands, Dagestan tour in Azerbaijan, some species of birds and rodents are found. In the alpine meadows and meadow-steppe landscape of the high mountains, grassy mountain-meadow soils are mainly distributed. The Zangezur range covers altitudes from 2000-

2200 m to 3000 m. It is composed mainly of carbonate-terrigenous, volcanogenic, tuffaceous sediments of the Jurassic and Chalk. It has a sharply dissected relief. The mountains are of denudation-structural origin. Strong floods occur here from time to time. Floodplains are mainly located in the area of rocky and mountain meadows. River valleys are mainly beginning to form in this landscape area. The climate is cold. The average temperature in January is from -12°C to -7°C, in July 8-17°C. Annual precipitation is up to 900 mm. Dagestan tur, black grouse, bezoar goat, rodents (marsh vole, mountain vole), blind mole, Caucasian skunk, Caucasian tetra, vulture, rock lizard, etc. are settled. It is divided into alpine, subalpine meadows and meadow-steppe subtypes. Alpine meadows are located above 2400-2500 m. The height of the plants is very short, there are few species. Below the alpine meadows, at an altitude of 2000-2200 m to 2400-2500 m, a strip of subalpine meadows stretches. Subalpine meadows consist of tall perennial plants, which are rich in species, mainly forage grasses.

The rivers flowing from the Zangezur range form a dense network. The river network is more developed in the mountainous part, which is due to the excess precipitation. Since the humidity is higher in areas at an altitude of 1000-2500 m, the river network is partially well developed. In areas above 2500 m, the decrease in precipitation, the poor development of forests, plants and soil cover lead to the reduction of the river network here. In this zone, groundwater emerges in the form of numerous springs. In areas above 3000 m, the relief is mainly bare and rocky, and atmospheric sediments are relatively small, so the river network is poorly developed. The density of the river network in some river basins (Nakhchivanchay, Alinjachay, Gilanchay) in areas above 2500 m decreases to 0.10 km/km^2. The main reason for the poor development of the river network in the foothills and plains below 1000 m is the low rainfall in this zone, intensive evaporation, and rapid absorption of river waters into sedimentary rocks [2].

All rivers of Nakhchivan province are included in the Araz basin. In the central and southeastern part of the territory, rivers originate from the steep slopes of the Zangezur and Daralayaz ranges.

In the high mountainous belt, the air temperature varies between 1-2° at an altitude of 2500-3000 m. In the highest mountainous part (3500 m), located in the southwest of the Zangezur range, the average annual temperature drops to -4° (Figure 2).

The water regime of the rivers in this region is

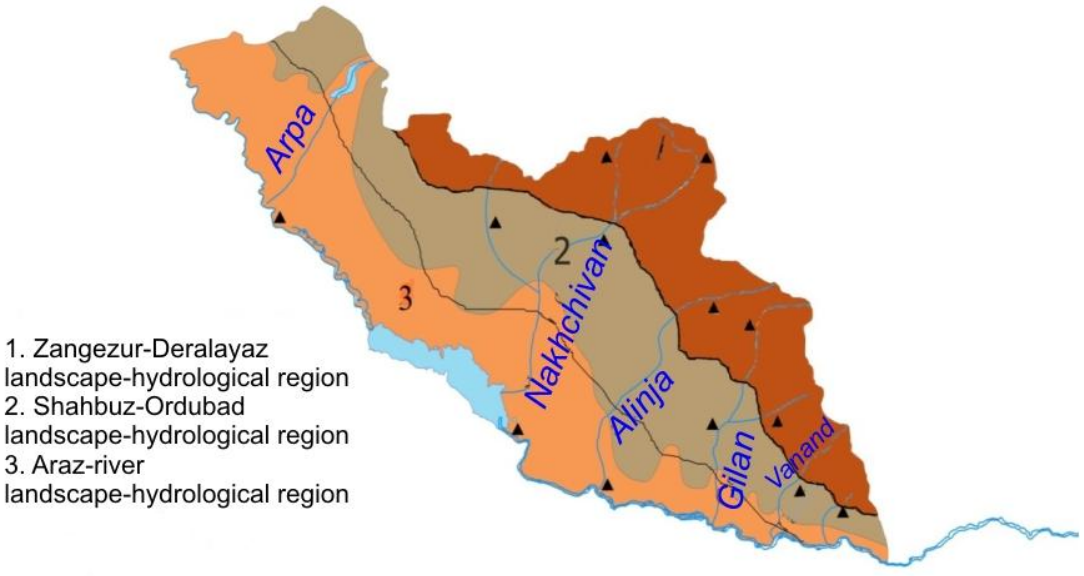

Fig. 2. Map-scheme of landscape-hydrological zoning of the Nakhchivan natural region

characterized by spring-summer high water, rain floods, summer-autumn and winter low water periods. The high water period covers the months of March-June. During this period, 45-70% of the annual flow passes.

For the Nakhchivanchay-Garababa settlement, 1949 is characterized as a low-water year, 1972 as an average-water year, and 1958 as a high-water year. In the low-water year, the start date of the summer-autumn low-water period coincided with 23.VIII and the end date with 27.X, and 66 days were observed. No floods were observed in the low-water year. In the low-water year, the high-water period lasts from 01.III to the summer-autumn low-water period, and the maximum water flow was 25.5m^3/s. In the average-water year, these quantities are 04.VIII, 07.X, and 65 days, respectively. In the high-water year, characterized as 1958, the summer-autumn low-water period began on 16.VII, ended on 09.X, and lasted 86 days. In the average water year, the flood period

lasts from 16.III month to 01.III month in the high-water year, and their maximum water discharges were 41.7m^3/s and 79.4m^3/s, respectively. In the average water year, there were no floods in the 3-time high-water year (Figure 3, 4, 5).

2. Shahbuz-Ordubad landscape-hydrological region. This region is located in the mountain-xerophyte landscape belt of the middle highlands. It developed in the Zangezur and Daralayaz ranges in the Nakhchivan Autonomous Republic. The middle highland belt occupies the northwestern, central and southeastern parts of the region. It was formed mainly on volcanogenic, volcanogenic-sedimentary rocks of the Paleogene. It covers altitudes from approximately 1100 m to 2000 m. A cold climate prevails. The average temperature in January is from -5°C to -4°C, in July from 18°C to 25°C, annual precipitation in the Nakhchivan Autonomous Republic is 400-500 mm. The dry summer in the area has led to the formation of a xerophyte landscape. Mountain-chestnut and brown mountain-forest soils are widespread. The vegetation is of the mountain-xerophyte (phryganoid) type (cave, tisttis, etc.). The average annual air temperature is 5-8°C.

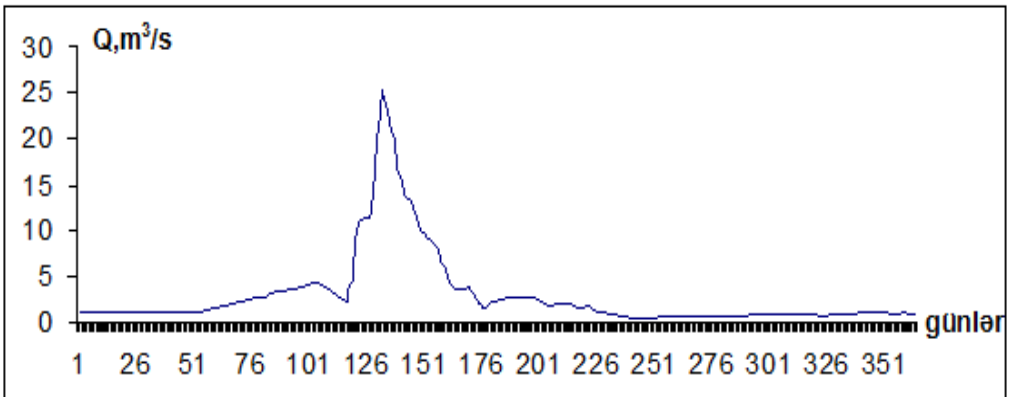

Fig. 3. Hydrograph of the Nakhchivanchay-Garababa region for 1949 (low-water year)

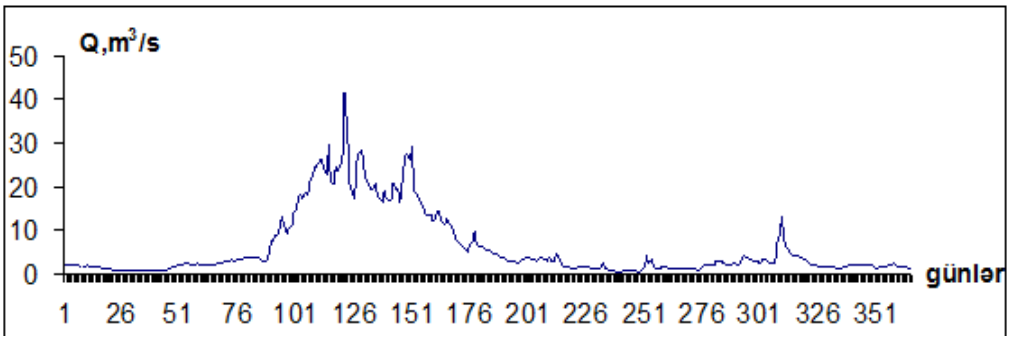

Fig. 4. Hydrograph of the Nakhchivanchay-Garababa region for 2022 (mid-water year)

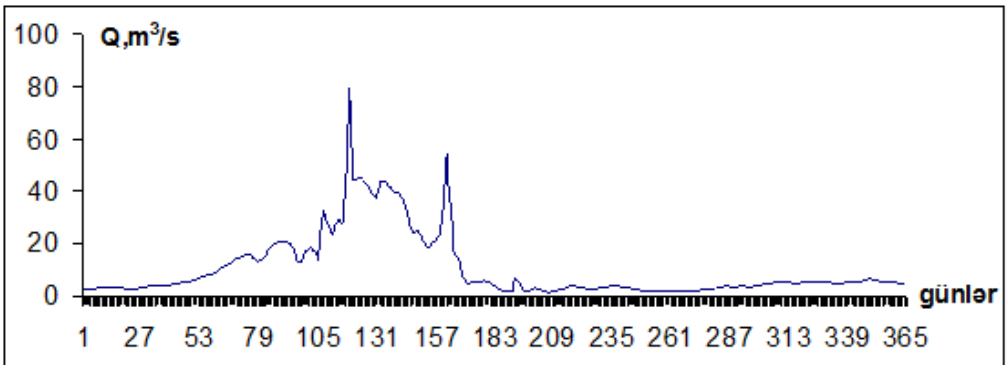

Fig. 5. Hydrograph of the Nakhchivanchay-Qarababa region for 2022 (high-water year)

3. Araz-river landscape-hydrological region. This region is located in the semi-desert landscape belt of lowlands and intermontane plains. This landscape zone in the Republic of Azerbaijan has the largest area (approximately 25% of the territory). It covers the Araz-bound plains of the Nakhchivan Autonomous Republic. The altitude is up to 600-1000 m. It is composed of alluvial-proluvial deposits of the Anthropocene, alluvial, proluvial-deluvial deposits of the Holocene. It has a cold semi-desert and dry

steppe climate. Summer is dry. The average temperature in January is from -4 °C to 2 °C, in July from 23 °C to 28 °C. Annual precipitation is 130 mm-300 mm. Gray-meadow, gray, gray-brown, etc. soils are widespread. Semi-desert plants with wormwood, kengiz, wormwood-salt-leaved, and gavan are dominant.

The average altitude of the Arazboyu plain, which constitutes one third of the territory and is considered the lowest area of the republic, is about 800 meters. The annual air temperature there is 12-14 °C in the Arazboyu plains and low mountainous belt. The average monthly temperature of the coldest month of the year (January) is -6-10 °C in the Arazboyu plain and low mountainous part, and the average monthly temperature of the main warm month of the year (July) fluctuates between 24-28 °C in the plain and low mountainous belt.

In the Bilev settlement of Paragachay, the rainy period for 1972 begins in the 27th month of the fifth month and lasts until the middle of the seventh month. It covers the winter dry period from the end of the eleventh month to the beginning of the third month (Figure 5).

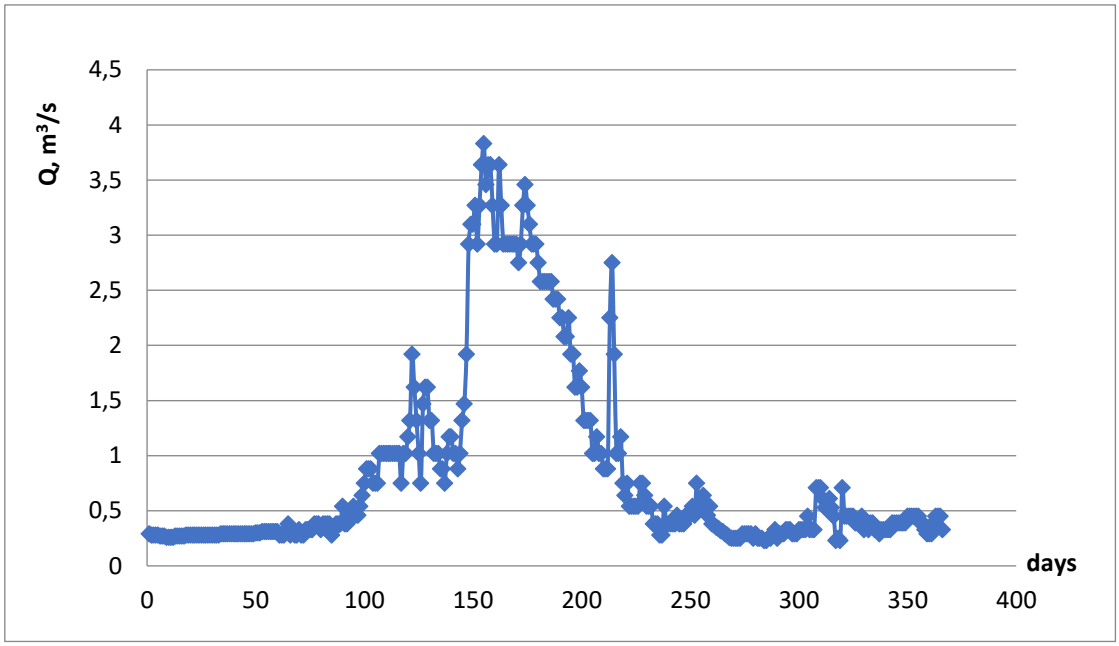

Fig. 5. Hydrograph of the Paragachay-Bilev area for 1972 (interval year)

It should be noted that the average monthly temperature in July (28°) in the plain part of the Nakhchivan region is not found anywhere else in Azerbaijan. Such high temperatures are observed only in Central Asia.

In the winter months, as a result of strong cooling, severe frosts sometimes occur here. The average absolute minimum of air temperature can drop to -15-18° in the plain and partly in the low mountainous belt.

The Araz-river belt, which forms the lower plain zone of the Nakhchivan region, covers a large area of the region located at an altitude of 600-1000 meters. This area starts from the Sadarak plain in the northwest and is squeezed by high mountains in the form of a narrow strip near Kotam in the Ordubad region to the banks of the Araz. The plain part is located between the Araz River and the low mountainous region, sometimes covering a wide and sometimes narrow area. The Araz-river plain constitutes 32% of the region's territory and connects to the Ararat plain in Armenia in the northwest. This belt is not a single plain, but in several places within the republic - through the branches or heights of the Daralayaz and Zangezur mountains extending in the meridian direction – it is divided into a number of sloping plains (Sederak, Sharur, Boyukduz, Nakhchivan, Ordubad, etc.).

The flow recorded at the stations that can be considered satisfactory in terms of assessing the role of various landscape types in the formation of the flow is formed entirely within the same landscape type or they are located on the border of different landscape types.

A general physical and geographical justification is important in the placement of the network, taking into account geological and hydrogeological conditions. This requirement arises from the fact that the conditions for the formation of water balance elements of river basins located in different geographical regions, natural zones and altitudinal belts are different. Ignoring physical and geographical conditions when creating a network of observation stations leads to large errors in the assessment of individual components of the water balance and elements of the hydrological regime.

In hydrologically well-studied regions, when closing any station, the observation data should be analyzed. If the nearest stations have recorded a similar character of the hydrological regime, then the station with a shorter observation period can be closed or relocated to another place. To clarify this issue, the hydrographs of the considered stations for a parallel observation period can be analyzed together. Only those stations can be relocated that were incorrectly located in the past or repeat neighboring stations.

When placing stations, special attention should be paid to rivers whose regime has changed as a result of the influence of anthropogenic factors, since the number of such rivers is constantly increasing.

In order to develop the existing network of observation stations, both new stations should be opened and almost all stations that were closed in different years and for different reasons should be restored [13].

During the analysis of the density of the river network by landscape, we determined that this indicator also affects the socio-economic infrastructure located in hydrological regions. Thus, in the Zangezur-Deralayaz hydrological region, rivers affect only the location of settlements. In the Shahbuz-Ordubag hydrological region, they affect all socio-economic regions in the region, and their location and future development depend on them. We can especially note settlements and agricultural areas that suffer from water. Since the Arazboyu hydrological region passes through a plain, irrigation of agricultural areas is brought to the fore. Because the water shortage here makes this problem even more urgent. Among the mentioned hydrological regions, the majority of socio-economic facilities in the Shahbuz-Ordubad hydrological region were built on the banks of the river.

Result. 1. A hydrological map of the rivers of the area was prepared and hydrographs of the low-water, medium-water and high-water years of the Nakhchivanchay-Garababa and Paraghachay-Bilav points were compiled. The analysis of the hydrographs shows that the Nakhchivanchay is a river with spring flow, and during the flow period, 85% is surface water, and 15% is groundwater. In general, the share of surface water in the annual flow is 66%, and the share of groundwater is 34%. Paraghachay is a tributary of the Gilanchay and has spring-summer flow. The role of snow waters is great.

2. Within the framework of the analysis of the hydrological observation series, the flow characteristics of the Nakhchivan rivers were calculated, a graph of the relationship between the height of the water catchments and the flow modules was compiled, and it was determined that the flow module quantity also increases with height. Also, the errors of the series were calculated and it was determined that the relative error of the Nakhchivan rivers varied between 3.56%-6%, and the error of the coefficient of variation varied between 10.16%-12.91%. In addition, a statistical analysis of the series was carried out according to the Fisher and Student criteria. As a result, it was concluded that the results obtained for the Jagrichay-Paiz station were homogeneous according to both criteria, for the Arpa-Areni, Alinjachay-Arafsa, Paraghachay-Bilev, Kukuchay-Kuku stations according to the Student criterion, and for the Vanandchay-Danagirt station according to the Fisher criterion. Inhomogeneity was determined for both criteria for the Ordubachay-Nusnus station.

3. Difference-integral curves were constructed to determine the flow fluctuations. According to these curves, the flow decreased between 1931-1984 and increased between 1984-1997. Also, an increase in the flow was observed between 1963-1980 in the Alijachay-Arafsa section, and a decrease in the 1980s, an increase in the Gilanchay-Nurgut section was observed between 1962-1976 and a decrease in the 1976-1999, and a decrease in the flow in the Kukuchay-Kukyu section was observed between 1931-1962 and an increase in the 1962-1988 period. The increase in the flow at the Nakhchivanchay-Garababa station was observed between 1951-1978, and the decrease between 1978-1998, the decrease in the flow at the Paragachay-Bilav station was observed between 1931-1984, and the increase between 1984-1996, the decrease in the flow at the Vanandchay-Danagirt station was observed between 1931-1972, and the increase was observed between 1972-1996. In order to make the relationship between the stations more efficient and to provide more accurate results of the calculation, a correlation matrix was compiled based on the calculated correlation coefficients. The series with less observation data were restored using the analogy method and relationships between the average annual water consumption were established.

4. The Nakhchivan natural region was studied in terms of landscape and the role of landscapes in the formation of river flows was studied. Using data from observation points located in the area, it was clarified what characteristics the river basins have in each landscape belt. Using various hydrological and geographical zoning schemes, landscape-hydrological zoning of the area was carried out. Zoning was carried out according to the zonal principle and 3 regions were distinguished. Landscape type was accepted as the main indicator of the homogeneity of these regions. Thus, the landscape type reflects both leading (relief, climate) and derived (soil and vegetation) components. The boundaries of landscape-hydrological regions were specified by taking into account the quantities of the average annual, maximum, minimum summer-autumn and winter flow modules of rivers for a multi-year period. In addition, the regime characteristics of the rivers, food sources, and the

nature of the distribution of flow throughout the year were also taken into account and the characteristics of landscape-hydrological regions were given.

As a result, the following landscape-hydrological regions were distinguished in the Nakhchivan natural region.

1. Zangezur-Deralayaz landscape-hydrological region;
2. Shahbuz-Ordubad landscape-hydrological region;
3. Arazboyu landscape-hydrological region.

The characteristics of each landscape-hydrological region were investigated and explained, and graphs and maps were compiled.

As a result of the analysis of the network of hydrological observation points in the rivers of Nakhchivan, the landscape types in which the hydrological observation points operating in different years were located were determined. The observation points were unevenly distributed across landscape types.

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Роль ландшафту у формуванні річкового стоку в Нахічеванській автономній республіці

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Для повноцінного та раціонального використання водних ресурсів (зрошення посушливих територій, водопостачання населення тощо) необхідно розробити найефективніші способи вивчення річкового стоку та його складових, виявлення закономірностей його формування та проходження, а також пошуку шляхів його раціонального використання. З цієї точки зору, закономірності, виявлені автором, а також взаємозв'язки елементів річкового стоку та природних факторів, набувають важливого наукового та практичного значення та дозволяють визначити характер формування стоку, його внутрішньорічний та багаторічний розподіл по території та висотним зонам. На відміну від інших природних ресурсів, водні ресурси мають здатність постійно оновлюватися завдяки кругообігу вологи в природі. Це створює впевненість у достатньому водозабезпеченні всіх потреб людства в майбутньому. Тим часом водні ресурси республіки обмежені. Розташована в середній та нижній течії двох міждержавних річок, Кури та Аразу, вона має приплив річкових вод із сусідніх країн: Туреччини, Ірану, Грузії, Вірменії та Дагестану. Річковий стік, що формується на території республіки, дуже невеликий. Водосховища довготривалого та сезонного регулювання, створені на річках, певною мірою вирішують проблему зрошення. Однак питання забезпечення водою населення міст, сіл та селищ міського типу залишається актуальним і сьогодні. Вивчення формування річкового стоку в будь-якій гірській країні пов'язане з низкою труднощів, спричинених різкими контрастами в природних умовах. Без урахування взаємодії цих факторів та їх впливу на річковий стік навряд чи можна виявити основні закономірності зміни стоку та його компонентів. В результаті в Нахічеванському природному регіоні було виділено такі ландшафтно-гідрологічні регіони. 1. Зангезурсько-Дералаязський ландшафтно-гідрологічний регіон; 2. Шахбузсько-Ордубадський ландшафтно-гідрологічний район; 3. Аразбоюйський ландшафтно-гідрологічний район. Під час аналізу густоти річкової мережі за ландшафтами ми визначили, що цей показник також впливає на соціально-економічну інфраструктуру, розташовану в гідрологічних районах.

Ключові слова*: кліматичні зміни, ландшафт, глобальне потепління, річковий стік, ArcGIS, гідрологічна карта, ландшафтно-гідрологічний регіон, природний регіон.*

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