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## ANTHROPOGENIC IMPACT ON NATURE IN THE PLAINS ALONG THE ARAS IN THE NAKHCHIVAN

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## АНТРОПОГЕННОЕ ВОЗДЕЙСТВИЕ НА ПРИРОДУ РАВНИН ВДОЛЬ РЕКИ АРАКС В НАХИЧЕВАНИ

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*Abstract.* The article examines the changes that have taken place in the Nakhchivan by characterizing the anthropogenic factors affecting the natural landscape structures. In recent years, the anthropogenic dynamics of natural landscapes have accelerated by rapid population growth and the expansion of private farms. Also, the concept of nature protection and its efficient use makes the concept of landscape development (evolution) even more relevant. Anthropogenic, especially technogenic impacts on nature are manifested in both positive and negative forms in the longitudinal zone covering 32.9% of the territory of the Autonomous Republic. According to the dynamics of anthropogenic landscapes in the area can be classified as weakly altered, disturbed or strongly altered and special cultural landscapes. We have also explored cultural landscapes as follows: 1. For high productivity and economic income; 2. According to human health and the optimality of the ecological environment; The first group includes areas covering the main agricultural crops of the Autonomous Republic, and the second group includes green areas, parks, recreation areas and infrastructure serving the health of the population etc. that have been expanding in recent years. The article also discusses environmental problems in the field of anthropogenic complexes, reproductive modifications and their solutions. In the end, the causes of anthropogenization, the problems encountered the analysis of them in accordance with the physical and geographical conditions, the ways to solve them on a scientific basis, a number of recommendations and suggestions were made.

*Аннотация.* В статье исследуются изменения, произошедшие в Нахичевани, путем характеристики антропогенных факторов, влияющих на природные ландшафтные структуры. В последние годы быстрый рост населения и расширение частных хозяйств ускорили антропогенную динамику природных ландшафтов. Также концепция охраны природы и ее эффективное использование делает более актуальным развитие (эволюцию) ландшафтов. Антропогенные, особенно техногенные воздействия на природу проявляются как в положительных, так и в отрицательных формах в продольной зоне, охватывающей 32,9% территории автономной республики. По динамике антропогенных ландшафтов территорию можно разделить на слабоизмененные, нарушенные или сильно измененные и особые культурные ландшафты. Мы также изучали следующие характеристики культурных ландшафтов: 1. промышленный и экономический потенциал; 2. рекреационный и природоохранный потенциал. В первую группу входят площади, покрытые основными сельскохозяйственными культурами, а во вторую группу территории, покрытые растительностью, парки, зоны отдыха и инфраструктура, обслуживающая здоровье

населения и др. В статье также рассматриваются антропогенные комплексы и репродуктивные модификации. Обсуждаются также экологические проблемы и способы их решения. Наконец, причины антропогенизации проблемы проанализированы в соответствии с физико-географическими условиями, их решение основано на научных данных, дан ряд рекомендаций и предложений.

*Keywords:* landscape, anthropogenic impact, technogenic, ecological problem, residential complex, dynamics.

*Ключевые слова:* ландшафт, антропогенное воздействие, техногенная деятельность, экологическая проблема, селитебный комплекс, динамика.

### *Introduction*

The impact of man from the consumer to the producer on the environment, as well as on natural landscapes to meet their socio-economic needs has intensified; as a result, early anthropogenic landscapes emerged. Population development, its settlement, modern scientific and technical progress have acceded rated this process. When anthropogenic impacts are not controlled, conditions for degradation (especially desertification) are created, which in turn accelerates environmental problems. Today, there is a great need for scientific classification of anthropogenic landscapes in connection with the development of economic sectors. In recent years, experience has been gained in the field of typology and classification of anthropogenic landscapes [2–9]. These studies, having physical-geographical features, adopted taxonomic units in natural landscapes, mainly classified as class, subclass, type, group and species.

### *Relevance*

Human impact on natural landscapes is more intense within the Nakhchivan Autonomous Republic, especially in the plains along the Aras. The main reason for this is the continuous anthropogenic change of the natural land fund, population growth and rapid development of the economy and agriculture of the Autonomous Republic. The plains along the Aras are the most populated areas of the Autonomous Republic and are widely used in agriculture as well as all branches of industry. As anthropogenization accelerates, the study of the anthropogenic impact on natural landscapes inevitably creates the basis for the implementation of measures to protect natural landscapes.

Due to the rapid population growth in the Nakhchivan Autonomous Republic, the growth of residential complexes, the creation of new settlements, industrial enterprises, infrastructure has increased the dynamics of landscapes, land privatization, entrepreneurship, increasing the share of anthropogenic complexes has further intensified this process. Agro-irrigation complexes, garden plantations have been multiplied, even less useful shrubs have been mastered, reclamation measures have been intensified on the split slopes, and bare slopes have been restored in many areas. As a result, the range of anthropogenic complexes with small areals has expanded. This accelerates anthropogenic transformation in natural landscapes, with numerous anthropogenic modifications scattered in small areas being replaced by larger area landscape units.

One of the important factors influencing human settlement has been relief. Since the Enoelite period (7,000–8,000 years ago), various human settlements have been found in Nakhchivan [1]. Settlements were built mainly in riverbeds, delivery cones and ancient coastal settlements. The main goal here is to make the relief convenient and easier to master.

As the relief along the Aras zone is more suitable for settlement, the construction of railways and highways, canals, high-voltage power lines, construction of dams, reservoirs, construction of new settlements, etc. affects the natural landscape, destroys it and creates technogenic landscapes [8].

Anthropogenic landscape forms decrease as they rise in height, while in the plains they become denser and more intensive under favorable natural conditions. Therefore, when studying the area in this direction, first, its altitude zones should be taken into account and research work should be carried out on these heights.

The location of the territory of Nakhchivan AR on heights was carried out for the first time by N. I. Shelepnov. He calculated the territory of each area of 500 m, and the area of height of up to 1000 m accounted for 32.9% of the total land [2]. Since the area we are researching is the plains along the Aras, we have considered only 950–1000 m altitudes.

In order to study anthropogenic landscape forms in the plains along Aras zone, first of all, the dynamics of their development must be determined. As a result of research, it was determined that anthropogenization is higher in the plains along the Aras and decreases in the mountains. Taking this factor into account, we have allocated 4 main altitude zones against the background of natural landscapes for the study of anthropogenic landscapes in the area.

The area mainly belongs to the categories of semi-desert, dry steppe, intrazonal landscape with moderately altered regular and partially irregular use:

1. Irrigated hayfields of alluvial-meadow soils;
2. Small areal of grey, grey-brown soils, gardens, arable lands;
3. Wormwood-ephemeral pastures;
4. Irrigated crops on grey-brown saline soils;
5. Salsola, wormwood-salsola pastures.

Sharply altered, regularly used, semi-desert, dry steppe, intrazonal landscapes under the influence of anthropogenesis are represented by 2 semi-categories: 1. Grain, vegetable, melon plantation, grape, apricot, peach, cherry orchards irrigated on grey, grey-brown, grey-meadow, alluvial-meadow soils of weakly fragmented sloping plains; 2. Large-area residential, residential-garden, man-made modification, large urban complexes, railways, highways, paved roads, belts, overpasses, reservoirs, canals, collectors, etc. aquatic anthropogenic landscapes on smooth slopes, wide river valleys.

There is a great need to group these forms of technogenic influences, as they are formed as a result of human production activities. For this purpose, in accordance with the division of AG Isachenko, we considered it expedient to group the area as follows according to the creation of technogenic landscapes [4].

1. Residential complexes. Created cities, villages, as well as parks, forest belts, etc. in connection with the creation and expansion of settlements.

2. Complexes formed in connection with mining operations. Mainly various quarries, terricones, technogenic-polluted areas etc. belong to these landscape complexes.

3. Complexes formed in connection with water management works. These landscape complexes include canals, collectors, reservoirs, ponds etc.

4. Technogenic coating reshaped complexes. Asphalt roads, railways, etc. belong to these landscape complexes.

The history of the establishment of residential complexes in the territory of the Autonomous Republic is much older. Vali Aliyev notes that living in the Nakhchivan region began 5,000 years ago in the Kultapa settlement near the city and concentrated its rich material and culture [1]. This

area is one of the most important anthropogenic landscapes in the plains and river valleys. About 60% of 205 rural settlements in the territory of Nakhchivan AR, up to 80% of the population settled in the plains along Aras zone in the areas up to 1000 m in height.

It should be noted that 12,757 hectares of the land fund of the Autonomous Republic remain under rural settlements. In addition, during the land reforms, more than 12,000 hectares of land were allocated for the perspective development of villages. In the last century, the area of Nakhchivan was 1,500 hectares, but now its area has grown to 19,157 hectares [9]. Such a rapid increase in the area of habitats leads to the destruction of natural landscapes and the emergence of anthropogenic landscapes, reproductive modifications. Lack of underground structures and multistorey buildings in the territory of Nakhchivan AR leads to rapid changes in the dynamics of technogenic landscapes created in the production process.

Thus, anthropogenic modifications represent asphalt substrate, industrial enterprises, construction and infrastructure, reservoirs, canals, collectors, etc. water bodies, arable lands, winter pastures. 4079 ha of land under construction in the area, 15534 ha under reservoirs, of this, 2,330 hectares belong to canals and correctors, the area of agricultural land is 177,382 hectares, the total sown area is 63,405 hectares, and winter pastures are 13,959 hectares [9]. About 57.2 thousand hectares in the Autonomous Republic belong to anthropogenic, especially technogenic modifications. Anthropogenization is intensifying in the plains and foothills, where land reclamation measures, road construction works and the mining industry are developing faster, especially in Babek, Sharur, Ordubad and Julfa districts. The share of anthropogenic complexes of technogenic origin has increased in these regions due to the construction of new reservoirs, highways, various enterprises, collectors and drains, and the growth of stone and sand quarries.

Despite all this, due to the progressive development of agriculture in the Autonomous Republic in recent years, the share of agro-irrigation landscapes has increased significantly, while the share of a number of irregularly used complexes has decreased.

Areas with a slope of up to 5 degrees in the territory of the Autonomous Republic are 178,000 hectares and account for 34% of the total area. Anthropogenesis is accelerating as a result of the concentration of arable land and the majority of the population in this area. Roads passing through the plains along the Aras connect not only the settlements but also the territory of the Autonomous Republic with the territory of the Islamic Republic of Iran and Turkey. 5867 hectares of land remained under roads and streets [9]. Reconstruction of the Julfa-Sadarak highway has led to the rapid growth of technogenic landscapes. 1325 hectares of land remained under the railways.

Compared to other areas of the Lesser Caucasus, the river network in Nakhchivan AR is poorly developed. While the total length of rivers is 1752 km, and the territory of the autonomous republic is 5449 km<sup>2</sup>, the density of the river network is only 0.32 km/km<sup>2</sup> [2]. Historically, the region has always been looking for solutions to this problem due to water shortages during the growing season, especially in summer. For this purpose, canals were dug, underground water-supplies were built, and reservoirs were created. After the 1950s, the construction of reservoirs and canals in the territory of Nakhchivan AR accelerated. At present, the area of hydro landscapes in Nakhchivan AR has exceeded 15,534 hectares. Up to 80% of these hydro landscapes belong to the Arazboyu zone. 15,534 hectares of land in the territory of the Autonomous Republic were flooded, the main part of which is the Aras water junction [9]. School buildings have become widespread in modern times. In recent years, about 100 school buildings have been built, used and repaired. Parks have been built around the school; greenery-lawns are created. 256 hectares of the territory of the Autonomous Republic remained under school buildings. 397 hectares of arable land remain under cemeteries [9]. These technogenic landscapes form their own landscape, but such a type of

landscape is not yet recorded worldwide, and the question of its study remains out of focus. Landscaping programs implemented in recent years have accelerated the development of cultural landscapes. According to statistics, about 150 hectares of forest have been planted in the AR every year since 2005. In 2020, landscaping measures were implemented on 404 hectares [10]. So, after 2005, a lot of forest area was planted in the area. The development of agriculture in the plains along the Aras zone and the weak control of irrigation water, the creation of the Aras water junction led to a violation of the filtration capacity of the Aras River. This caused the rise of groundwater level, which led to the formation of swamps and salinities.

As lands transferred to private and private ownership were out of state control, the pressure on the lands increased, and as a result, arable lands were withdrawn from the production cycle. As a result, the process of desertification has intensified, the expansion of arable land has led to the destruction of natural landscapes and the gradual acceleration of anthropogenization. In areas used as winter pastures, natural landscapes have been disturbed and useful forage crops have been replaced by harmful weeds. *Acantholimon karelinii*, delicate cousinia, *Verbascum saccatum*, rue etc. have been replaced. A large area of 13,959 hectares of winter pastures in the area has fallen into disrepair.

One of the factors seriously affecting the nature of the Aras region is the drywall cooking shops, exploited travertine deposits and a number of construction materials enterprises. Extraction of raw materials, especially in travertine cliffs, has caused serious damage to the surrounding landscapes. These deposits, which are more than 15 m thick, have been exploited since the 1960s [1]. During the USSR, it was exported not only to our republic, but also to Moscow, Leningrad, Minsk, Tashkent and Sochi, and the natural landscapes in the area were seriously disturbed. It is true that in connection with economic development, reconstruction work has been carried out and the destruction of natural landscapes has been reduced. However, air pollution in drywall shops is still growing rapidly.

Reservoirs are one of the factors causing the destruction of natural landscapes in the area. They cause ecological problems such as salinization, rising groundwater levels, etc., as well as flooding of arable lands. I would like to remind that the Aras Reservoir (maximum area of 14.5 km<sup>2</sup>), located at an altitude of 774.5 meters above sea level on the Aras River, faces very serious environmental problems [3]. The reservoir is directly or indirectly polluted by the wastewater of Zangi (Razdan) industrial enterprises and radioactive substances discharged into the Metsamor NPP, which are discharged into the Aras River in the territory of the Republic of Armenia. For this reason, in his researches, N. S. Bababeyli identified five ecological regions according to the degree of pollution in the reservoir [2, 5].

It should be noted that anthropogenization in any region can be perceived in two forms, negative and positive. As long as human society and its productive activities exist, its impact on nature will also exist. The steady growth of the population and the growth of anthropogenic and technogenic landscapes will continue in accordance with these dynamics. Given that the average annual growth of the world's population is 1.5–2.0%, it means that the world's anthropogenic landscape types should increase by at least 2%. This process is more intensive in the territory of Nakhchivan AR, and prevention is impossible. However, anthropogenesis cannot be left to chance. It accelerates the process of desertification; therefore, this process must be constantly monitored.

Studies show that the classification of anthropogenic landscapes is difficult due to the presence of different forms of farming in the same area. However, in spite of all this, it is necessary to distinguish them as an independent complex, based on the dominant and background landscape types and their directions of use [6]. Over the past 20 years, there have been fundamental changes in

the process of anthropogenization of the natural landscapes of the Autonomous Republic, as well as in the structure of the natural landscape units of the area. At present, about 30% of the natural landscapes of Nakhchivan AR are suitable for farming, horticulture and other areas of agriculture. About 60% of the useful lands are concentrated in Sharur, Sadarak, Boyukduz, Nakhchivan plains, Julfa, Yayji and Ordubad plains. The share of arable lands has sharply decreased due to intensive desertification along Aras's zone, where arid-denudation relief forms are widespread.

Due to the progressive development of agriculture in the Autonomous Republic in recent years, the share of agro-irrigation landscapes has increased significantly, while the share of a number of irregularly used complexes has decreased. Between 1992 and 2015, there had been a deeper structural change in anthropogenic complexes. First of all, due to the expansion of settlements, the area of urban and rural complexes, road construction of industrial facilities, water objects, etc. anthropogenic modifications increased by 28,000 hectares, and the area of agro-irrigation, garden-plantation complexes increased by 18.5 thousand hectares. In the 80s of the XX century, grape plantations occupying a larger area in the Ordubad, Julfa, Yayji, Nakhchivan plains were replaced by grains, vegetables and citrus fruits. If we pay attention to the modern landscape map, we can see that large massifs of vineyards are located in Sharur, Sadarak plains, Arpachay cone, Nakhchivan plain on the left bank of Nakhchivanchay, Alinjachay gorge, Julfa, Ordubad and Yayji plains with relatively small areas.

In Nakhchivan AR, there are scattered, group, chain, circular, etc. configurations, which are located close to each other along the Arpachay, Nakhchivanchay, Gilanchay, Paragachay, Ordubadchay valleys and extend the chain.

Anthropogenization of arid-denudation, fragmented dry steppes is very low (0.3–0.4%). Anthropogenization in the dry steppes of the Sharur and Sadarak plains reaches 0.7-0.8% in some areas. In the Nakhchivanchay and Ordubadchay valleys, it varies between 0,3–0,6 %.

*Purpose of the research.* To identify anthropogenic changes in the along the Aras in the Nakhchivan Autonomous Republic.

#### *Result of the research*

The above-mentioned and other local anthropogenization in the plains along Aras of the Nakhchivan Autonomous Republic seems insignificant externally. However, if the problems are not prevented in time, they can rise from the local level and manifest themselves at the regional and national levels [7]. From this point of view, it is expedient to take the following measures to eliminate the problems caused by anthropogenization in the area:

1. When implementing measures to develop the country's economy, increase socio-economic development: the area of natural complexes, biological productivity, etc. should not be changed during the expansion of settlements, construction of communication lines, land reclamation measures. In particular, in order to achieve this in the territory of Nakhchivan AR, first of all, it is necessary to achieve the construction of multistorey buildings and underground structures in settlements.

2. The construction of reservoirs in the area should be controlled, taking into account the shortage of arable land per capita (0.4 ha) in the plains, new reservoirs should be created in the middle mountains. Due to the irrigation nature of the canals in the territory of Nakhchivan AR, it would be expedient to build these canals in the form of underground, covered canals. In this case, the lands will not be damaged and canals failure time can be extended.

3. Slope reinforcement works along the Aras River are commendable. The main goal here is to implement measures to prevent natural disasters, especially floods. It is better to strengthen the slope in parallel with the planting of forests and shrubs.

4. In order to restore the productivity of agricultural lands and prevent desertification, crop rotation maps should be developed and made available to owners. Land reclamation measures should be carried out on lands that have fallen out of production and they should be returned to industrial process. A system of measures must be implemented to gradually transfer agriculture to the path of intensive development. Cultivation work should be carried out in expired mineral deposits and cultural landscapes should be laid.

Thus, starting from the second half of the 20th century, as a result of human economic activity in the Sadarak-Ordubad plain, the integrity and completeness of natural complexes were fundamentally violated, and new natural-economic systems were formed due to their structural features. In order to maintain ecological balance in natural-economic systems, anthropogenization of landscapes should be controlled and landscape management should be applied.

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