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ECOGEOGRAPHIC CHARACTERISTICS AND AGRO-PRODUCTIVE ASSESSMENT OF THE SHURUD-PARADASH DEPRESSION SOILS

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ЭКОГЕОГРАФИЧЕСКИЕ ХАРАКТЕРИСТИКИ И АГРОПРОИЗВОДСТВЕННАЯ ОЦЕНКА ПОЧВ ШУРУД-ПАРАДАШСКОЙ ДЕПРЕССИИ

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Abstract. This article presents an eco-geographical assessment of the soil cover of the Shurud-Paradash Depression, located in the lowland zone of the Nakhchivan Autonomous Republic. The main objective of the study is to investigate the eco-geographical conditions of the area and assess the current state of its soils. As a result of comprehensive field and laboratory studies conducted in 2025, 25 soil types were identified in the area, and their morphological, physical, and chemical properties were analyzed. The study used a 100-point bonit scale, classifying soils into five quality groups: the highest rating was given to mountain brown soils (100 points), and the lowest to rocky riverbeds (14 points). The article presents a detailed study of the climatic conditions, hydrology, and landscape structure of the region, emphasizing the problems of degradation and water scarcity. Based on the results of the study, important practical proposals were put forward for the sustainable development of agriculture in the region, such as the restoration of water channels from the Gilanchay, the construction of new reservoirs, the repair of irrigation systems, and the creation of forest belts to combat erosion. This assessment is of strategic importance for both preserving the ecological balance and the socio-economic revival of the area.

Аннотация. В статье представлена экогеографическая оценка почвенного покрова Шуруд-Парадашской впадины, расположенной в низменной зоне Нахчыванской Автономной Республики. Основная цель исследования – изучение экогеографических условий района и оценка современного состояния его почв. В результате комплексных полевых и лабораторных исследований, проведенных в 2025 году, в районе было выявлено 25 типов почв, проанализированы их морфологические, физические и химические свойства. В ходе исследования была применена 100-балльная шкала бонитов, классифицирующая почвы по пяти группам качества: наивысший рейтинг был присвоен горным бурным почвам (100 баллов), а наиминимальный – каменистым руслам рек (14 баллов). В статье представлено подробное исследование климатических условий, гидрологии и структуры ландшафта района с акцентом на проблемы деградации и нехватки воды. По результатам исследования были выдвинуты важные практические предложения по устойчивому развитию сельского хозяйства в регионе,

такие как восстановление водных каналов из Гилянчай, строительство новых водохранилищ, ремонт систем канатов и создание лесополос для борьбы с эрозией. Эта оценка имеет стратегическое значение как для сохранения экологического баланса, так и для социально-экономического возрождения района.

Keywords: Shurud-Paradash Depression, eco-geographical conditions, land degradation, agricultural production grouping, anthropogenic impact.

Ключевые слова: Шуруд-Парадашская впадина, экогеографические условия, деградация земель, группировка агропроизводства, антропогенное воздействие.

The Shurud-Paradaş depression, located within the Julfa and Ordubad administrative districts, is one of the fertile depressions of the autonomous republic. It is known that the processes of desertification and soil degradation occurring worldwide contribute to the degradation of the soil environment in the Nakhchivan Autonomous Republic, including in the Shurud-Paradaş depression. Therefore, evaluating the ecological and geographical characteristics of the soils in the Shurud-Paradaş depression, taking these factors into account, is of great importance for the conservation of the area's ecosystems and the optimization of land use. The Shurud-Paradaş depression is bordered to the north by the slopes of Yarpaqlı Mountain, to the east by the slopes of Gavanlı Mountain, and to the west by the slopes of İlanlı Mountain, all of which belong to the Zəngəzur Range. To the south, it is surrounded by the slopes of the Toxluca and Aydaş mountains, which belong to the Darıdag, and the Yaycı-Dizə sloping plain, which is defined by a narrow strip formed by the slopes of the İlanlı mountain to the west, the slopes of the Gəvənli mountain to the east, and the bed of the Qaradərəsu river to the northwest [1].

In this area, soil degradation processes resulting from various natural and anthropogenic impacts lead to a decrease in fertility, a drop in productivity, and socioeconomic difficulties in meeting the food needs of the population. Conducting research on water reserves to protect and effectively utilize soil fertility in this area is one of the main issues [2, 8].

Agricultural development in mountainous and sloping areas depends on soil quality. Therefore, an ecological assessment of soils will provide essential information for the conservation and productive use of these resources. The Shurud-Paradaş depression is an ecosystem-rich area with productive soils and various plant and animal species, which increases the importance of ecological land assessment. The ecogeographic assessment of soils will help protect ecosystems, ensure biodiversity, and enhance landscape stability. For agricultural activities in the area to be sustainable, an environmentally sound assessment of the soils will create economic benefits for the local population and contribute to sustainable development. Climate change and its associated changing environmental conditions can affect soil productivity and use [5].

In mountainous and sloping regions, this impact can be more pronounced. An ecological assessment of the soils will enable appropriate measures to be taken to adapt to these changes. Therefore, conducting an ecological and geographical assessment of the soils in the Shurud-Paradash depression is of great importance for the effective management of the area's soil reserves, agricultural development, and the protection of ecosystems [3, 4].

The results of this work will provide practical recommendations for the future sustainable use of the area's soil resources and the protection of the environment. In this regard, the research is highly relevant.

Materials and methods

The material basis of the study consists of soil and plant samples collected during comprehensive field expeditions to the area from May to July 2025, as well as topographic and cartographic materials. The research employed complex geographic analysis, comparative-geographic, field-spatial, and laboratory analysis methods.

Considering the relief and landscape features of the area, soil profiles were established in the northern, central, and southern parts of the depression. The placement of these profiles and the description of genetic horizons followed standard pedological methodology. Soil evaluation was conducted using methodological materials developed by G. Sh. Mammadov and R. H. Mammadov, utilizing a 100-point bonity scale based on internal diagnostic indicators (humus, nitrogen, phosphorus, and granulometric composition). To determine actual soil quality, correction coefficients were applied to the base scores to account for terrain slope, salinity, erosion, and stoniness [6].

The productivity of natural and cultivated vegetation (sagebrush thickets, ephemerals, and cereal and alfalfa crops) was determined according to A. Ibragimov's methodology. Plant samples were measured in terms of yield per hectare (ha), accounting for phenological phases (in May and September-October).

Based on the collected data, the area's soils were categorized into five classes according to their bonity scores and quality groups (High, Good, Average, Low, and Conditionally Unfit).

Results and discussion

The Sharur-Paradaş depression was formed from several small inclined plains in the alluvial cones of the Karadereh River, which lies within the Ordubad syncline. The primary fold in the study area is the Sharur-Jolfa anticline. This fold is oriented in a pan-Caucasian direction. Within the Ordubad syncline, linear, pre-Cretaceous folds are closely related to the development of other surrounding folds. The formations developed within these structures correspond to the province's development during the Hercynian stage and are characterized by sub-platform sedimentation conditions. This anticline is composed of two secondary structures separated by the Nakhchivan depression: the Sharur structure to the northwest and the Jolfa structure to the southwest. The northeastern limb of the Jolfa structure is located almost entirely within Iran. The limb in the study area consists of Permian and Triassic rocks and is complicated by thrusts, overthrusts, and lateral throws. The folding age of the syncline is pre-Cretaceous, while the age of the fault displacements is determined to be post-Eocene [7].

The basement of the Ordubad syncline, which underlies the area, consists of black, coal-bearing argillaceous shales (1200-1400 m) with interbedded limestone, quartzite, and sandstone. These are most likely Ordovician in age and were drilled into from beneath the more complex deposits near the left bank of the Aras.

Hydrology. The only water sources for the soils of the Shurud-Paradash depression are the Karadereçay River and the natural and artificial small lakes located in its basin [7]. During the Soviet era, irrigation water was drawn from the Gilançay River, located within the Ordubad administrative district, to the soils of these areas through iron pipes approximately 30 cm in diameter. This was because the eastern part of the Qaradərəçay basin falls within the territory of the Ordubad administrative district.

In the alluvial cones and channels of the Karadereçay, there are many qanat systems and captage systems fed by the area's groundwater. Of the 30 qanats registered in the district, 12 are active qanats fed by the groundwater of the Julfah slope and the area. The total length of these qanats is 12,238 meters, and there are 518 wells. Some qanats temporarily dry up depending on the season, most notably the Gülüstan Qanat, M. Oruc Qanat, and K. Habib Qanat in Gülüstan village.

The main sources for the village of Karimqulu Dizə are considered to be the qehriz. For this reason, attention has been paid to the permanent qehrizes in this settlement. All three of the area's qehrizes are active. Although attention waned in the 1970s, they were later renovated with the help of the International Organization for Migration.

Climate. The Nakhchivan Autonomous Republic is distinguished from other physical-geographical regions of Azerbaijan by its sharply continental climate. The region's climate is shaped by abundant solar radiation, atmospheric complexity, and highly intricate relief. The Shurud-Paradash depression further differs from other areas within the region in its climatic characteristics.

Climate researchers such as I. V. Figarovskiy, A. M. Shikhlinski, and A. A. Medetzadeh have identified specific climate types for the area. In the Shurud-Paradash Depression, a cold climate type with hot, dry summers prevails. This type, covering elevations of approximately 1100–1600 m above sea level, is characterized by relatively high precipitation and low temperatures. E. M. Shikhlinski determined a vertical gradient for the radiation balance of approximately 1 kkal/cm² per 100 meters. The radiation balance varies depending on the surface cover: the area's albedo is 75% in winter and 20% in summer. Like other climatic elements, the radiation balance follows a distinct annual cycle, reaching its minimum in January and its maximum in July.

Solar radiation plays a decisive role in climate formation. It heats the surface and the atmosphere, creating pressure and temperature fields that drive air movement. The eastern sub-region under study is a continuation of the western sub-region, encompassing the narrow Gülüstan and Yaycı plateaus, as well as the lower courses of several river valleys between the southward-extending branches of the Zangezur Range along the Aras Valley. This sub-region is bordered to the east by the high branches of the Zangezur Range extending to the Aras River valley. It is distinguished as one of the areas in Transcaucasia where flash floods are most intense, characterized by the formation of alluvial cones at river mouths and the deposition of large volumes of alluvial material. Annual precipitation is 250–330 mm, with 125–160 mm occurring during the growing season. The average annual relative humidity in the area is 30–40%, dropping to 3–4% during the summer months.

Landscape types and soil-plant cover. The absolute elevation of this gently sloping plain, composed of alluvial and proluvial deposits, ranges from 600 to 1,300 meters. In the lower areas, alluvial deposits predominate. The main vegetation here consists of wormwoods, and various halophytes are also widespread. In the steppe zone, areas used as winter pastures contain a number of noxious and poisonous weeds within the wormwood thickets. Plants such as Karelian juniper, fine cuscuta, bladder campion, anise, and others are common.

The alluvial fan of the Karadere River extends up to 10 km from north to south, with its widest point reaching 5 km in the south. This alluvial fan, known as Yaycı düzü, is composed of alluvial-proluvial deposits. The absolute elevation of Yaycı düzü ranges from 720 to 960 meters. Primarily, primitive gray soils have developed in the area. Sagebrush, saltbush, sorrel, thistle, and chickweed are widespread here, along with occasional pimpernel and ephemeral plants. In the surrounding parts of the plain, the prickly pear can also be found. Cereal crops are grown on the plain, alongside vineyards and orchards. Up to 1,000 hectares of farmland are irrigated by a pumping station on the Aras River. In the low and middle mountains of the Gara River, the landscape components are much more limited compared to other areas. On the moderately dissected sloping plains, sagebrush steppe has developed on gray soils. On the weakly dissected sloping plains, ephemeral, sagebrush-dominated frigate phytocenoses predominate on chestnut soils. On terraced plains, ephemeral plants, sparse juniper, and thorny shrubs are widespread on gray soils. In the mountainous zone, however, erosion and denudation processes are intense, as the weak vegetation cover and more extensive unstable rocks contribute to this [2]. The landscape of this zone is characterized as follows:

- In the intensely dissected mountains, a juniper steppe landscape dominates over light brown and grayish-brown soils.

- In riverbeds and floodplains, a shrub-steppe landscape has developed on alluvial, stony meadow soils.

- In the intensely dissected mountains, the dominant landscape type is a montane meadow on light brown mountain soils, with a predominance of montane xerophytic phryganoid plants.

- In the intensely fragmented high and partly middle mountains, a landscape type dominated by mountain xerophytic phryganoid plants on mountain meadow-steppe soils predominates.

The mid and high mountains of the Qaradərəçay basin are dominated by low-growing shrubs, herbaceous flowering plants, thornbushes, sagebrush species, grasses, and graminoids. The plant and soil cover is not particularly rich, as the area's geological structure and the mechanical, chemical, and mineralogical composition of its rocks differ from those of the surrounding areas. For this reason, the area is prone to flash floods. The main vegetation of the sloping plain consists of sagebrush, broomgrass, and saltbush. In addition, various grasses, graminoids, steppe vegetation, and thorns are widespread, especially in the southwestern part.

The surface of the sloping plain is covered with sagebrush, saltbush, broomweed, grasses, bare juniper, Steven's saltbush, and others. The shrub cover decreases in a southward direction, while ephemeral plants gradually increase. These areas are used as pastureland [6].

On the right bank of the Qara Derya, on alluvial-proluvial deposits, open brown mountain soils are poorly developed. Sages and grasses are the dominant vegetation here.

Ecological assessment of the soils of the Shurud-Paradaş depression. Expeditions were organized to the area to study the soil structural composition in the Shurud-Paradaş depression along the following directions. On June 6, 2025, three sections were established in the montane gray-brown, montane brown, grayish-montane brown, and stony-gravelly subsoil alluvial soils that cover the northern part of the Shurud-Paradash depression. Samples were taken from the genetic horizons of each profile, and their morphological properties were studied using Form 1, as is standard in pedology. On June 20, 2025, four sections were established in the light gray, subaqueous-alluvial, silty soils spreading across the central part of the Shurud-Paradash depression; samples were taken from the genetic horizons of each section, and their morphological characteristics were studied using Form 1, as is standard in pedology. In the gravelly light-tan (brown) and sandy light-tan (brown) soils, four sections were established. In the strongly weathered, medium-thickness, light brown gravelly soils, four profiles were established. Samples were taken from the genetic horizons of each profile, and Form 1, detailing their morphological characteristics, was completed. On July 4, 2025, four sections were established in the southern part of the Shurud-Paradash depression in the medium-thickness, weakly leached brown loam; six profiles were established in the thick, weakly leached light gray (brown) and alluvial-subsoil soils, and a single form was completed to reflect their morphological characteristics.

During expeditions to the Shurud-Paradash depression in May–June 2025, the productivity of cultivated and natural plants growing in the areas where soil and plant samples were collected was studied. Using specific methodologies, the ecological conditions and the physical, chemical, and morphological properties of the soils were analyzed, and 25 species were identified in the area. The productivity of ephemerals in the soil plots was determined from mid-to-late May, while the productivity of sagebrush and saltgrass was determined between late September and mid-October. In accordance with the project work plan, the productivity of cultivated and natural plants at the research site was studied using the aforementioned soil evaluation methodologies (Table 1).

Table 1
 YIELD OF CULTIVATED AND NATURAL VEGETATION FOR 2025 DATA IN DESIGNATED
 AREAS OF THE SHURUD-PARADASH DEPRESSION, t/ha

<i>Name of Lands</i>	<i>Cereal</i>	<i>Alfalfa</i>	<i>Natural Grasses</i>
Brown	45-50	150-155	6-7
Brown-grey	40-45	145-150	5-6
Sandy light-yellowish (brown)	35-40	140-145	4-5
Floodplain alluvial	30-35	135-140	3-4
Sandy loamy fine, brown	25-30	130-135	2-3

Based on our soil-plant studies in the Shurud-Paradash depression soils in 2025 and the investigation of materials collected from various sources (regarding their morphological, physical, chemical properties, and ecological conditions), 25 varietal diversities were identified in the area. By grouping these identified varietal types into 13 types and subtypes, the soils were evaluated and an agro-production grouping was conducted. Here, the soils received a maximum of 100 and a minimum of 14 points based on the full bonification scale (Table 2).

Table 2
 FULL BONITAS SCALE FOR THE SOILS OF THE SHURUD-PARADASH DEPRESSION
 (on a 100-point scale)

<i>Name of Lands</i>	<i>Credit score</i>	<i>Score class</i>	<i>Quality group</i>
Mountain brown	100	X	I High
Mountain gray-brown	90	X	
Sandy light tan (brown)	82	IX	
Floodplain alluvial	76	VIII	II Good
Sandy loamy, thin, grayish-brown,	72	VIII	
Browned mountain-brown	62	VII	
Sandy loamy, thick, slightly saline, grayish-brown	56	VI	III Medium
Sandy, thick, alluvial-floodplain	52	VI	
Sandy, thick, alluvial-meadow	50	V	
Sandy, boggy meadow-shrub	42	V	
Sandy, boggy-meadow	34	IV	IV Low
Stony-gravelly riverbeds	16	II	V Conditionally unsuitable
Stony riverbeds	14	II	

These lands have varying qualities and values due to their defined characteristics; 'adjustment' factors (salinity, erosion, grain-size composition, etc.) were also used to compile a full bonanza scale.

Conclusion

1. For the first time, the soil cover of the Shurud-Paradash depression has been comprehensively classified, and the agro-production characteristics of the soil types and subtypes prevalent in the area have been determined. This classification serves as a scientific basis for the management of soil resources.

2. In the study area, the bonitet scores for the taxonomic soil units were refined using adjustment coefficients (for erosion, salinization, lithification, etc.). This allows for an objective assessment of the actual productivity potential of each soil type.

3. Based on the determined quality scores and agro-production groups, an individual agri-improvement plan (irrigation, fertilization, erosion control, and cleaning) has been developed for each area. The implementation of these measures is the main practical recommendation for increasing the productivity of both natural biocenoses and cultivated crops.

Proposals

The following proposals have been made for the efficient use of the Shurud-Paradaş depression lands:

1. To bring the arid areas of the region into cultivation, the water pipelines from Gilançay should be restored, and a new reservoir should be built in the Qaradərəçay riverbed (between the Oxluca-Aydaş ravines and Quraultəpə mountain) to collect seasonal rainfall and floodwaters.

2. Taking into account the hydrogeological conditions, existing qanat systems should be repaired and new ones established for the efficient use of groundwater. This is a key factor for both the economy and the revitalization of former settlements (Shurud, Paradash, Gal).

3. In the northern and northeastern parts of the depression, protective tree belts should be established and fruit orchards planted according to the terrain to prevent wind and water erosion and to preserve the humus layer.

4. In grazing areas, the boundaries of the vegetation cover should be clearly defined to create conditions for the natural restoration of phytocenoses.

5. To maximize the potential of the lands, farmers should be provided with soil cartograms, and expert support for planting drought-resistant crops suitable for the local climate and for the application of modern irrigation technologies (drip, etc.) should be strengthened.

Thus, our eco-geographic assessment of the Shurud-Paradash depression shows that while the area has high fertility potential, water scarcity and anthropogenic impacts are accelerating degradation processes. The implementation of the proposed comprehensive ameliorative measures and water infrastructure restoration projects will directly contribute to both preserving the region's ecological balance and the sustainable development of strategic agricultural resources. This scientifically grounded approach also creates a crucial foundation for the socio-economic revival of historic settlements.

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