ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 11,2025

Journal: https://www.academicpublishers.org/journals/index.php/ijai

УДК 631.481;631.626.87

MORPHOLOGICAL FEATURES AND PH INDICATORS OF SOIL SUBSTRATES IN THE DRIED SEABED OF THE EASTERN PART OF THE ARAL SEA

Zafarjon Jabbarov[1], X.U. Nan[2], Samad Mahammadiyev[1], Urol Nomozov[3], Otamurod Imomov[1], Shohruh Abdullayev[1],

[1]National University of Uzbekistan named after Mirzo Ulugbek, 100174 Tashkent, Uzbekistan
[2]Peking University Shenzhen Graduate School, China
[3]Samarkand State University of Veterinary Medicine, Animal Husbandry and Biotechnology, Tashkent Branch

Annotation. The drying of the Aral Sea has brought about significant consequences for Central Asia, due to climate change and the extensive reclamation of land for agricultural use. The dried area of the Aral Sea, covering more than 3.0 million hectares, is releasing dust and salt particles, causing substantial environmental damage. This article analyzes the results of studying the morphological characteristics formed in the soil profiles of the eastern part of the dried Aral Sea bottom. Based on these findings, the effects of natural and anthropogenic processes are examined. In profiles 2 and 6, the morphological characteristics of the soil were identified at depths of 0-120 cm, while in profile 10, it was at a depth of 0-138 cm. Soil samples were taken from the layers, and pH values ranged from 6.9 to 7.3 in profile 2, 7.8 to 8.0 in profile 6, and 6.8 to 7.6 in profile 10. The study recommends the planting of appropriate plant species based on the soil characteristics and pH indicators.
Keywords: Climate change, dried-up bottom of the Aral Sea, profile layers, morphological characteristics, pH indicators**.**

Abstract. Once the fourth largest lake in the world, the Aral Sea has now turned into a vast area of desertification, with dust and salt rising from these areas and polluting the atmosphere. In the 1960s, the water volume of the Aral Sea was at its peak. The expansion of agricultural lands led to a reduction in the water flowing from the Amu Darya and Syr Darya rivers. The large amount of river water used for irrigation, combined with increased evaporation, gradually led to the drying up of the Aral Sea. The rising salinity of the shrinking waters caused a decline in the diversity and number of living organisms, resulting in the closure of 17 major fishing complexes. Along with the nature of the dried-up Aral Sea, the study of soil and terrain characteristics and their morphological features, along with the recommendation to plant suitable vegetation, contributes to the increase of green areas, which, in turn, is effective in combating desertification. The establishment of green zones in the dried-up Aral Sea area helps reduce the environmental pollution caused by dust, salt, and sandstorms, accelerates the soil formation process, increases the number of micro and macro-organisms, enhances biomass, and promotes the formation of humus.
Introduction. The drying of the Aral Sea began in the 1960s, and over the past six decades, the region has experienced significant ecological degradation due to the complete desiccation of large water bodies. This ecological catastrophe, exacerbated by insufficient attention to the issue, has led to increased desertification in Central Asia, climate change, and the spread of salt-laden dust storms that harm the environment. Research efforts have focused on studying the soil cover of the eastern part of the dried Aral Sea bed and proposing the cultivation of salt-tolerant and drought-resistant plant species.

ORIGINAL ARTICLE
INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE
ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 11,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

Currently, the Aral Sea tragedy is recognized as one of the largest environmental disasters, posing ecological, climatic, socioeconomic, and humanitarian challenges that directly threaten sustainable development in the region. The disaster has adversely impacted all living organisms in the area, including human health and future generations. The Aral Sea issue has left a lasting imprint on the physical development of children living in the region, weakening their physical attributes [Makhmudova S et al. 2024].

The drying of the Aral Sea has negatively affected the stability of ecosystems in the region and throughout Central Asia. Researchers have identified soil salinization and saline dust as the most visible environmental issues, with heavily salinized soils and frequent saline dust storms concentrated mainly in the central part of the Aral Sea. Conversely, the northern Aral Sea and the lower reaches of the Amu Darya Delta exhibit lower salinity levels and denser vegetation cover [Bao A., et al. 2024].

Planting drought-resistant species like krascheninnikovia ceratoides, salsola, and haloxylon on the dried Aral seabed could transform the area into a productive pastureland. This initiative has the potential to increase livestock populations by 20–30%, making the dried seabed a critical forage reserve for livestock and opening new opportunities for the development of animal husbandry [Novitskiy Z. Et al. 2024., Jin Q et al. 2017].

The primary cause of the Aral Sea's desiccation is attributed to the excessive use of Amu Darya and Syr Darya river waters for agricultural irrigation, which significantly reduced inflow to the sea. Consequently, the Aral Sea gradually diminished [Matkholikov K. Et al. 2023] Figure 1.

Figure 1. The decrease in the water level of the Aral Sea from 1977 to 2020
(Source: **https://landsat.nasa.gov/)**

Studies of the Aral Sea's water level dynamics between 1920 and 2020 reveal that the surface area increased by 0.04 km² from 1920 to 1960, but subsequently began to decline steadily. By 2020, the water surface area had decreased by 88% compared to 1920 [Duan, Z. et al., 2024]. The desiccation of the Aral Sea is strongly influenced by climatic factors, such as decreased precipitation, rising temperatures, and excessive water usage in agriculture [Imanmurzaev A.Q. et al., 2023]. Considering the ongoing climate and environmental changes occurring in the desertified areas of the Aral Sea, it is crucial to promote and fund green space development and support technical efforts in the region. The local population, traditionally reliant on agriculture, should prioritize alternative economic sectors, such as tourism and light industries, which are less dependent on water resources [Saidmamatov et al., 2024]. Efforts to plant and cultivate vegetation in saline, sandy, and marshy soils of the dried Aral seabed rely on multiple factors, including annual precipitation levels, selection of halophytic plants suitable for saline soils, and

ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 11,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

the consideration of extreme temperature fluctuations. Research has demonstrated that the application of bio-preparations like "Grunt Malhami" and "Bionitrogen" significantly enhances plant growth and development in haloxylon plantations. Additionally, cultivating plants using pipe irrigation has proven to be more efficient than open-field methods. Pipe irrigation slows soil moisture evaporation by 12 times, reduces direct sunlight exposure by 6–7.3 times during high summer temperatures, and creates favorable conditions for microbial activity. This method also mitigates the sharp diurnal temperature differences during summer, enabling condensation processes that benefit plant development [Jabbarov Z. et al., 2024].

Evaluating the salinity levels and physical, chemical, and biological properties of soil-ground types distributed on the dried Aral Sea bed is critical for creating a scientifically grounded classification of areas suitable for vegetation. This can be achieved by assessing soil-ground quality using a functional indicator matrix. The identified salinity levels and soil properties are essential for selecting appropriate plant species and determining planting locations, ensuring rapid adaptation and successful growth [Jabbarov Z. et al., 2024]. The eastern part of the Aral Sea has been the most severely affected by desiccation, transforming vast areas into desert-like land known as "Aralkum." This new desert has caused significant air pollution due to salt and sand particles, adversely impacting public health and damaging agricultural lands. Additionally, the region's flora and fauna have suffered substantial harm. Studies indicate that soils on the dried seabed are highly saline, nutrient-poor, and contain low humus levels, reflecting the early stages of soil-ground formation in these areas [Egamberdiyev J.A. et al., 2024]. The salinity increase and the accumulation of toxic elements in the soil-ground have been linked to the presence of microbial communities, including *Colletotrichum, Botrytis, Saccharomyces, Schizosaccharomyces, Antarcticibacterium, Egicoccus, Actinomarinicola,* and *Aquihabitans. Archaeal* communities, predominantly consisting of genera like *Haladaptatus, Halobacterium, Haloarcula, Halapricum, Halorhabdus, Halorussus*, and *Halalkalicoccus*, have also been affected [Simonovicova A. et al., 2024]. The desiccation of the Aral Sea has intensified desertification processes, driving a transition from arid-zone hydromorphic soils to automorphic soils, which plays a decisive role in soil formation. The region's landscapes now exhibit desert characteristics, with the loss of biogeocenoses and a decline in riparian vegetation [Ramazonov R.B. et al., 2018].

Efforts to reduce the environmental impact of sand and salt on the dried Aral Sea bed have shown promising results through the combined use of mechanical protection measures and increased vegetation cover. Planting techniques, such as trench cutting with paraplow furrows, resulted in an 85% seedling survival rate, compared to 25% in furrows without a paraplow and 12% in untreated control areas. This demonstrates the importance of improving the substrate's chemical composition and particle size distribution to retain moisture before planting [Bakirov N.Z. et al., 2022]. Restoring vegetation on the dried Aral seabed not only stabilizes the soil environment but also enhances microbial activity, contributing to ecosystem recovery. Selecting appropriate soil-ground types and determining salinity levels and types are crucial for successful plant growth and long-term soil rehabilitation [An J. et al., 2020].

Research on the sandy desert soils of the dried Aral Sea bed has revealed an intense accumulation of salt crystals in soil profiles due to high evaporation rates of groundwater. The sandy soils in these areas are highly saline, with dry residue ranging from 0.439% to 1.147%. The dominant salinity type has been identified as sulfate-chloride [Ismonov A. et al., 2024]. Developing a scientific basis for grouping vegetation sites on the dried seabed requires evaluating soil-ground salinity levels and their physical, chemical, and biological properties. This evaluation can be achieved using a soil function indicator matrix, which is critical for

ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 11,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

assessing soil quality. The determined salinity levels and soil properties are essential for selecting suitable plant species, ensuring their rapid adaptation and growth [Jabbarov Z. et al., 2024]. In the southeastern and southern parts of the dried seabed, significant changes in the physical-mechanical properties of soil-ground have been observed. The sandy particle structure has deteriorated, particularly in the southeastern areas, where coarse sand particles (>0.25 mm) increase with depth, ranging from 2.6% at the surface to 28.6% in lower layers. Fine sand particles (0.05–0.01 mm) vary between 19.1% and 33.5%, while medium silt particles (0.01–0.005 mm) are distributed between 3.6% and 7.1%. In the southern areas, coarse sand particles (>0.25 mm) make up 20.4% to 29.6% of the soil composition, indicating significant variation in soil texture and mechanical properties [Abdrahmanov T. et al., 2024].

The Aral Sea was once part of a series of saline lakes located in the depths between the deserts of Central Asia, but due to its drying up, it has led to the disappearance of the fishing industry and water transport routes [Micklin, P et al., 2020].

The Aral Sea region is one of the most important areas for the socio-economic development of Uzbekistan, and establishing extensive cooperation with foreign countries and international organizations to address the Aral problem positively contributes to resolving the issue and improving the ecological situation [Tuygunova N., 2020]. The drying of the Aral Sea devastates biological systems and leads to environmental changes, with ecological scientists predicting its complete disappearance by 2025 [Archana Gupta, 2020].

The desiccation of the Aral Sea has become a significant global environmental problem. The water level of the Aral Sea historically depended on the seasonal flooding of the Amu Darya and Syr Darya rivers, primarily fueled by spring rains [Buriyev S. et al., 2018]. Over its history, the Aral Sea has dried up three times, with the second desiccation being mitigated by diverting water to the Caspian Sea through the Uzboy Channel [Sunnatullayeva S. et al., 2024]. The drying of the Aral Sea has severely impacted the stability of ecosystems in the region and throughout Central Asia. Researchers have identified soil salinization and salt-dust storms as the most visible environmental challenges. Heavily salinized and salt-laden storm-prone areas are predominantly found in the central part of the dried seabed. In contrast, the northern Aral Sea and the lower reaches of the Amu Darya delta have lower salinity levels and more substantial vegetation cover [Bao A. et al., 2024].

Scientific studies have demonstrated that the desiccation of the Aral Sea has resulted in vast areas covered with sand and salt, creating an ecological hazard. Dust and salt storms originating from these regions are contaminating the environment, damaging agricultural lands, and negatively affecting the health of all living organisms, including plants, animals, and humans. To mitigate these impacts, researchers advocate for increasing biomass in the Aral Sea region. This strategy aims to reduce airborne dust, retain soil moisture, regulate climate by mitigating heat, accelerate soil formation, enhance humus content, increase microbial activity, and stabilize the ecosystem. Achieving these goals requires selecting and planting vegetation species adapted to arid and saline conditions.

2. Research area and methods

2.1. Research area.

Soil profiling and sample collection in the study area were conducted in accordance with the State Interstate Standard GOST: 17.4.3.01-83. The research focused on the eastern part of the dried Aral Sea bed, spanning the southeastern region of Kazakhstan and the southwestern part of the Republic of Karakalpakstan, particularly near the Qorao‘zak district. The study area extended up to 100 km from the current dried seabed into Kazakhstan’s border region. Morphological characteristics of the soil and vegetation were analyzed within this area. Soil

ORIGINAL ARTICLE
INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE
ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 11,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

profiles were excavated at key locations, including Profile 2 (43.437409°N, 60.179305°E), Profile 6 (43.787157°N, 60.191236°E), and Profile 10 (43.932633°N, 60.254561°E), where samples were collected for laboratory analysis (Figure 2). This study is part of a three-year project: year 1: focusing on the eastern part of the dried Aral Sea bed. Years 2 and 3: expanding research to the western and southern regions of the dried seabed to examine soil-grunt properties comprehensively.

2.2. Research methods.

Field research on the soil-grunt properties and morphological features of the eastern part of the dried Aral Sea bed was conducted from August 22 to 24, 2024. A total of 10 soil profiles were excavated, with 3 primary profiles (Profile-2, Profile-6, and Profile-10) selected for detailed analysis. Soil profiles were excavated to collect samples layer by layer. Samples were carefully placed in special paper bags, labeled with the location and profile number for easy identification. These paper bags were stored. Samples were air-dried in a laboratory environment at a temperature of 20-25°C. Dried samples were sieved through a 1 mm sieve for uniformity. From the sieved soil, 20 grams were measured with a precision of 0.001 grams using an analytical balance. The sample was mixed with distilled water in a 5:1 ratio (water:soil). The mixture was shaken for 1 hour, filtered through special filter paper, and the clear solution was collected.

The pH of the filtrate was measured using an electronic pH meter (pH-электроды Orion ROSS Ultra pH/ATC Triode Thermo) .

The current state of the Aral Sea is that a large part of its water has dried up. The goal is not to refill it, but to preserve the remaining part and study the properties of the dried soil and sediments. This will help in selecting suitable plant species and increasing vegetation, which will prevent the environmental damage caused by dust and salt, as well as contribute to biomass growth. Considering that the eastern part of the Aral Sea is located 230 km away from the nearest border of neighboring countries, the roads are mainly made up of sand and sandy ridges, which requires the use of special vehicles during the research.

Figure 2. Morphological Characteristics of Soil and Ground Layers in the Eastern Part of the Dried Bed of the Aral Sea.

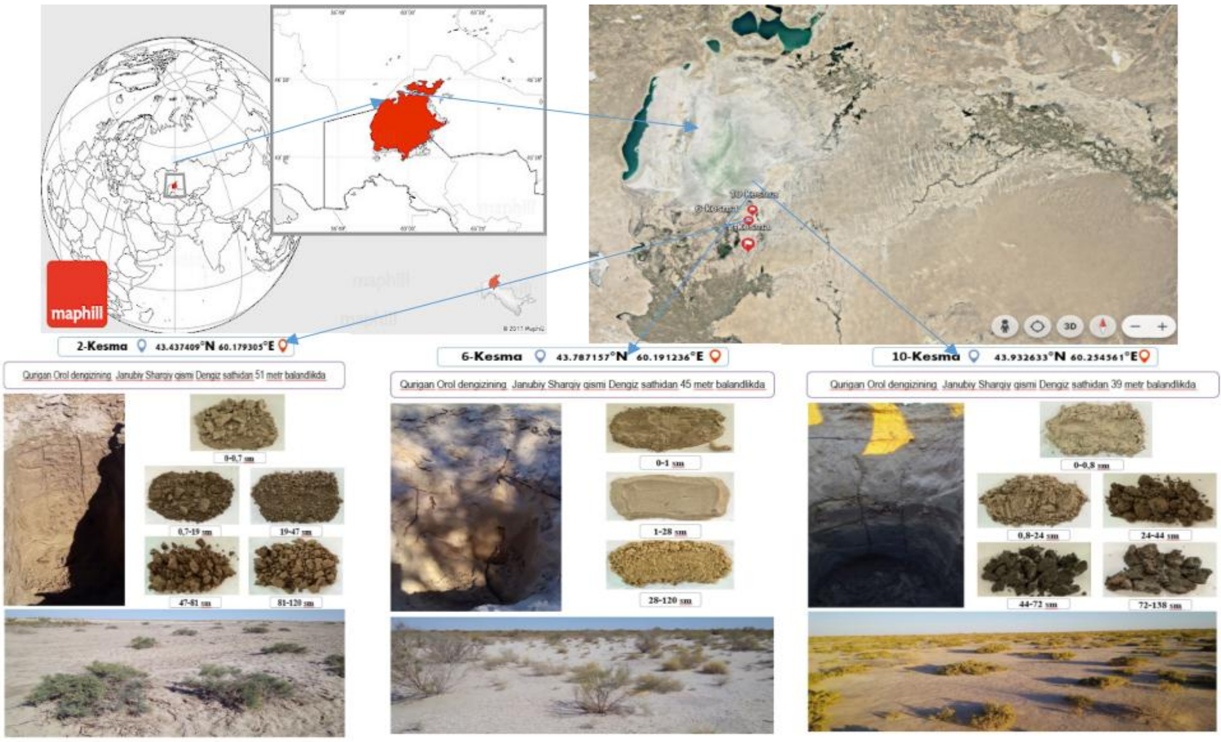
ORIGINAL ARTICLE

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-5206, Impact Factor: 12,23

American Academic publishers, volume 05, issue 11,2025

Journal: https://www.academicpublishers.org/journals/index.php/ijai



3. Results and discussion

3.1. Soil Layer Morphological Characteristics.

A total of 10 soil profiles were excavated from the eastern entrance of the dried bed of the Aral Sea, covering a distance of 100 km. Out of these, three main profiles were selected for further research. The morphological characteristics of the soil layers in these profiles were analyzed and are presented in Table 1.

Table 1

Research area's soil morphological features

Soil profile	**Soil layers, cm**	**Soil morphological features**
Section 2	**0-0,7**	Hard, light gray, mechanical composition: light sandy, dry, not moist, few pebbles, sandy texture, not compacted.
	0,7-19	Grayish-blue, mechanical composition: heavy sandy layer, medium sandy soils, moderately moist, flaky and angular structure, white gypsum crystal spots, few rusty spots, few plant roots and insect traces, transitions to the next layer with color change.
	19-47	Light brown, mechanical composition: heavy sandy layer with medium mechanical composition, few white gypsum crystal spots, moderately moist, medium compacted, flaky structure, frequent rusty spots, few plant roots and insect traces, transitions to the next layer with color change.

INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE

ISSN: 2692-5206, Impact Factor: 12,23

American Academic publishers, volume 05, issue 11,2025

Journal: https://www.academicpublishers.org/journals/index.php/ijai

	19-47	Light brown, mechanical composition: medium sandy, moderately moist, medium compacted, flaky structure, few rusty spots, sparse plant roots, no insect traces, transitions to the next layer with changes in mechanical composition.
	47-81	Light brown, mechanical composition: medium sandy, moderately moist, medium compacted, flaky structure, few rusty spots, sparse plant roots, no insect traces, transitions to the next layer with changes in mechanical composition.
	81-120	Light brown, mechanical composition: light sandy, moderately moist, loosely compacted, sandy and flaky texture, few rusty spots, sparse plant roots, no insect traces.
	0-1	Hard, light gray, mechanical composition: sand and sandy, dry, not moist, many pebbles, sandy texture, many plant roots, not compacted.
Section 6	**1-28**	Light gray, mechanical composition: sand and sandy, dry, not moist, many pebbles, not compacted, sandy texture, few rusty spots, many plant roots and insect traces, transitions to the next layer with color change.
	28-120	Light yellow field color, mechanical composition: sand and sandy, dry, not moist, few pebbles, not compacted, sandy texture, many rusty spots, few plant roots and insect traces, few root remnants.

Soil profile	**Soil layers, cm**	**Soil morphological features**
	0-0,8	Hard, light gray, mechanical composition: sand and sandy, dry, not moist, very many pebbles, sandy texture, many plant roots, not compacted.
	0,8-24	Light gray, mechanical composition: sand and sandy, slightly moist, many pebbles, not compacted, sandy texture, many plant roots and insect traces, transitions to the next layer with increased mechanical composition and moisture.
Section 10	**24-44**	Light brown, mechanical composition: medium sandy layer, boggy and rusty, moderately moist, moderately compacted, flaky texture, many rusty spots, few plant roots and insect traces, few root remnants, transitions to the next layer with changes in moisture.
	44-72	Dark blue, muddy green color, mechanical composition: sand, strongly moist, clayey, loosely compacted, many rust and rusty spots, few plant roots, no insect traces, few root remnants,

ORIGINAL ARTICLE
INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE
ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 11,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

	transitions to the next layer with changes in mechanical composition.
72-138	Dark blue, muddy green color, mechanical composition: light sandy, very strongly moist, clayey mud layer, loosely compacted, many rust and rusty spots, few plant roots, no insect traces, few root remnants.

3.2. pH indicators. The distribution of plants and pH indicator. Profile-2 is located at an elevation of 52 meters above sea level. In the eastern part of the Aral Sea, plant distribution varies, and in the area surrounding the excavated Profile-2, vegetation is sparse, with plant heights not exceeding 1 meter. In these areas, strong winds cause the top layer of soil to be eroded by sand, leading to a high level of dust storms and salt particle pollution in the environment. This area is primarily located near residential areas in the eastern part of the dried Aral Sea.

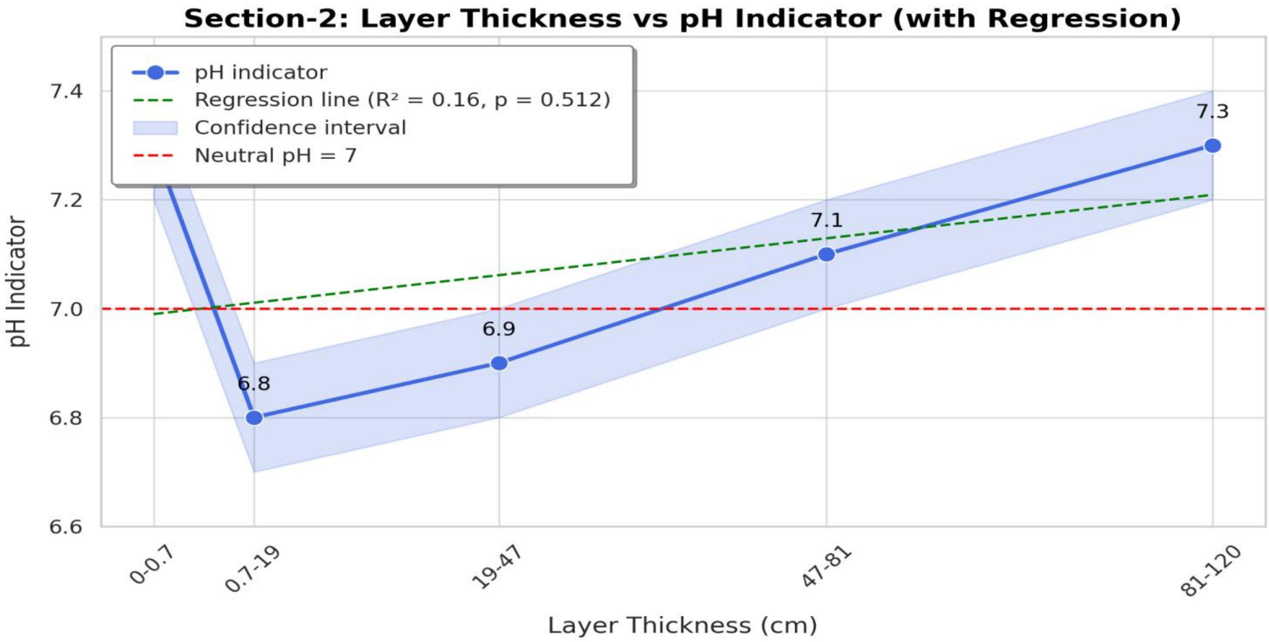


Figure 3. The dried seabed of the eastern part of the Aral Sea.

In Section-2, the pH values of the soil layers range from pH 6.9 to 7.3, with the highest pH of 7.3 found in the top and bottom layers, and the lowest pH of 6.9 at the 0.7-19 cm depth.
In Section-6, located 45 meters above sea level, the plant life around the excavation site is significantly more abundant compared to the previous section. Despite the sparse distribution of Haloxylon plants, annual plants are well established, with several plants found in every meter of the area. The high density of plants in these areas contributes to increased biomass, which enhances the population of living organisms and, most importantly, helps protect the environment from the harmful effects of dust and salt. As noted by scientists, considering that it is not feasible to refill the dried-up parts of the Aral Sea with water, planting vegetation in the dried seabed to green the area would not only increase biomass but also improve the living conditions of the micro and macroorganisms, as well as animals in the soil.

ORIGINAL ARTICLE
INTERNATIONAL JOURNAL OF ARTIFICIAL INTELLIGENCE
ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 11,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

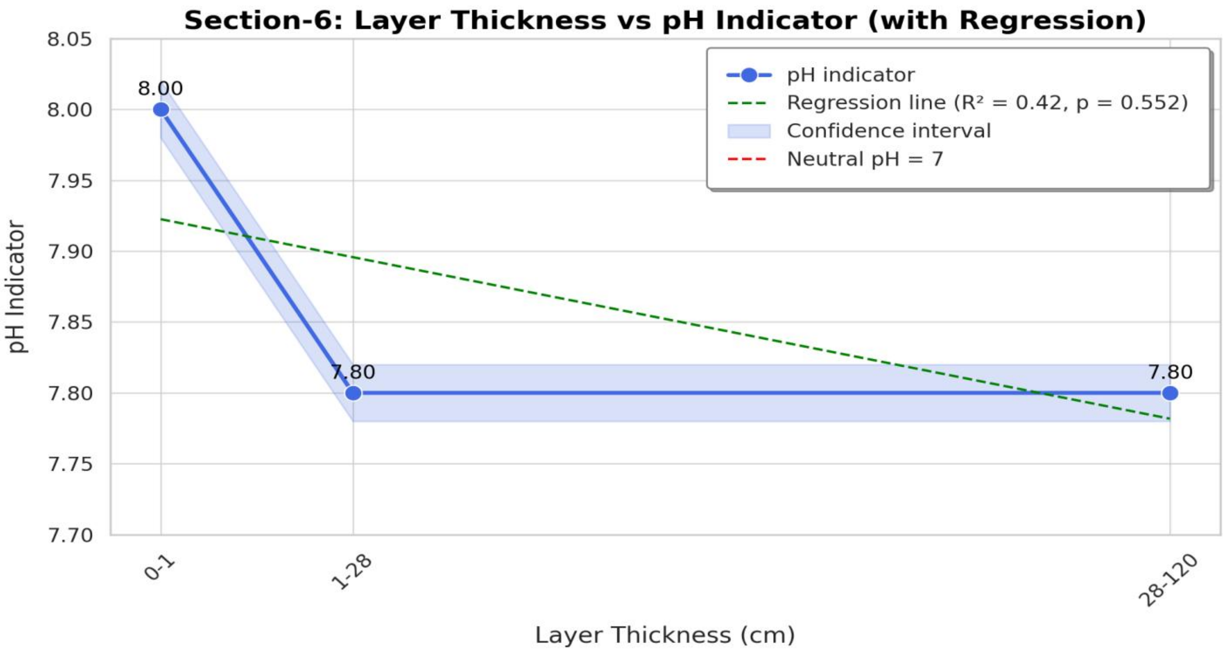


Figure 4. The dried seabed of the eastern part of the Aral Sea.

In Soil Section 6, the pH values of the layers range from pH 7.8 to 8.0. The highest pH of 8.0 was recorded in the 0-1 cm layer, while the remaining lower layers, extending up to 120 cm, showed no significant change, maintaining a pH value of 7,8.

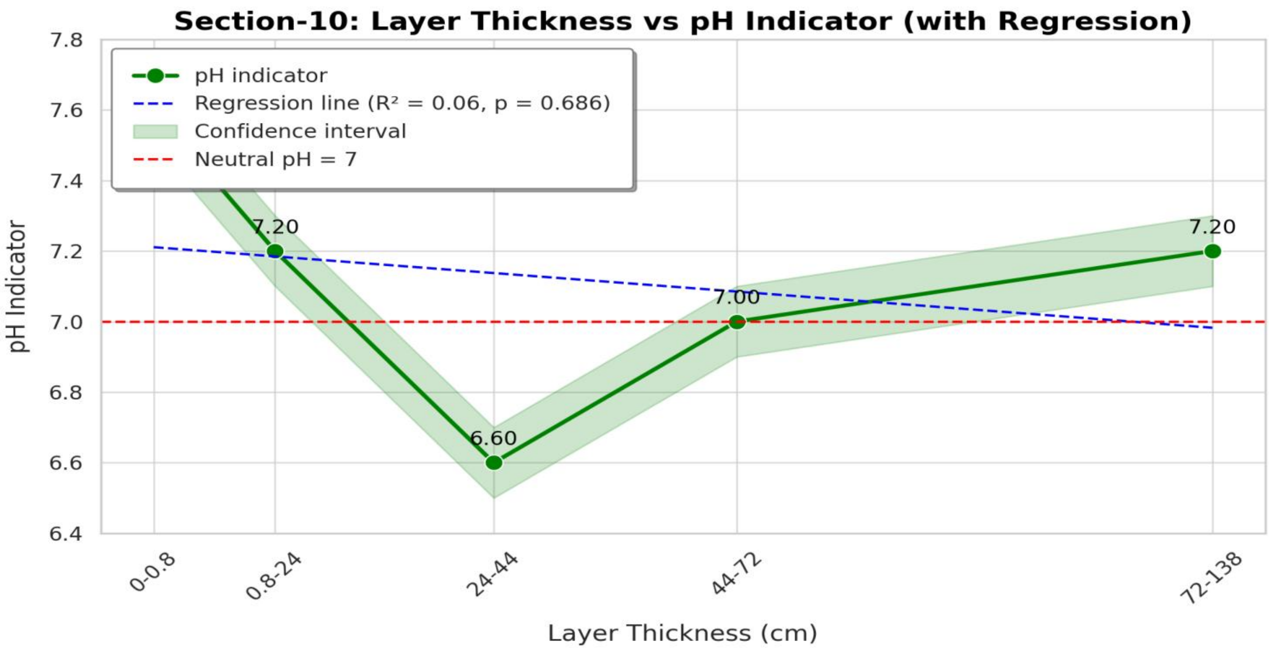


Figure 5. The dried seabed of the eastern part of the Aral Sea.

In Soil Section 10, located 39 meters above sea level, the surrounding area is well-covered with vegetation. Each meter contains plant life, although the plant height ranges between 0.50-0.60

ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 11,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

cm, with the area predominantly covered by saxaul plants. The soil profile shows a 0-24 cm layer of sand, followed by swampy soils with rust-colored spots. The increase in soil compaction and the presence of a muddy layer may create anaerobic conditions, possibly limiting the growth of plants. More accurate information can be obtained from laboratory analyses of the soil samples.

In this section, pH values range from 6.8 to 7.6. The highest pH value of 7.6 was found in the 0-0.8 cm layer, while the lowest pH of 6.8 was recorded in the 24-44 cm layer.

When studying the soil profiles, vegetation, and fauna around the eastern entrance of the Aral Sea, it was found that the plant cover was sparse, with plant heights not exceeding 1 meter. This situation was found to vary across different sections, with Section 10 having better vegetation coverage and plant heights of 50-60 cm. The distribution of worms, ants, and other insects also varied, with higher concentrations in areas with better vegetation cover.

The soil samples taken from different sections are located at varying elevations above sea level, and it was observed that the surrounding plant and animal life, as well as the soil properties, vary accordingly. In the eastern part of the Aral Sea, the plant cover in the entrance section stands out as more abundant compared to the interior part of the sea, while the number of shells is noticeably lower. In the entrance area, sand dunes were not observed due to the dense vegetation, but after traveling 15-20 km inland, low and high sand dunes begin to appear and increase as one moves further into the region. The distribution of plant cover is uneven. Compared to the plants in the entrance section, those found 45 km away are more abundant and taller. This area is primarily dominated by the stable growth of saxaul plants, which reach heights of 3-5 meters in certain sections.

The soil samples from each region vary in their particle composition and morphological characteristics, predominantly representing sandy soils [Matsui K. et al., 2019]. The observation of the area's vegetation highlights the significant role of soil properties in determining plant growth and distribution.

4. Conclusion.

The physical, chemical, and biological properties of the soil in the eastern part of the dried Aral Sea, along with the distribution of natural plants, plant cover levels, and climatic factors, were studied together. This approach showed that selecting plant species suited to the region leads to better outcomes. The results of the study on the morphological features of the soil profiles in the eastern part of the Aral Sea, specifically in sections 2, 6, and 10, were analyzed. Soil samples were collected at depths ranging from 0-120 cm for sections 2 and 6, and from 0-138 cm for section 10. The pH values ranged between 6.9-7.3 in section 2, 7.8-8.0 in section 6, and 6.8-7.6 in section 10. Improving the dried seabed of the Aral Sea positively impacts all living organisms in the area by enhancing their activity. It helps retain moisture, prevents environmental damage caused by sand and salt dust, improves soil properties, increases biomass and organic matter, and leads to the formation of humus through decomposition.

5. Recommendations: During the research, it is advisable to systematically organize and develop special polygons, recreation areas, and artesian groundwater systems around the roads in the dried seabed of the Aral Sea. This will create comprehensive convenience for researchers and improve their working conditions.

In the course of this research, the natural plants, soil characteristics, and climatic conditions of the eastern part of the dried Aral Sea will be examined, and appropriate plant species will be selected, along with the development of planting norms. This will ensure optimal ecological restoration and sustainable management of the area.

ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 11,2025
Journal: https://www.academicpublishers.org/journals/index.php/ijai

Note: This article is part of the project FL-8323102111-R1, titled "Scientific Basis for Grouping Planting Areas Based on the Salinity Status, Physical, Chemical, and Biological Properties of Soils and Subsoils in the Dried Bed of the Aral Sea" and was conducted within the scope of the respective project.

References

1. Abdrahmanov T., Jabbarov Z.A., Mahammadiyev S.Q., Fayzullayev O., Abdullayev Sh.Z., Yagmurova D.A. Orol dengizi qurigan tubida hosil bo'lgan tuproq-gruntlarini mexanik xossalar // Turli tuproq-iqlim sharoitida organik qishloq xo'jaligi mahsulotlari yetishtirishda innovatsion texnologiyalarni qo'llashning dolzarbligi. Xalqaro ilmiy-amaliy anjuman materiallari Qarshi-2024. 11-12-iyun B. 379-384.
2. An J., Chang H., Han S.H., Khamzina A., Son Y. Changes in basic soil properties and enzyme activities along an afforestation series on the dry Aral Sea Bed, Kazakhstan // *Forest Science and Technology*, *16*(1), 2020. P. 26-31. https://doi.org/10.1080/21580103.2019.1705401.
3. Archana Gupta. Shrinking of Aral Sea: An Environmental Disaster in Central Asia // International Journal of Humanities, Arts and Social Sciences. volume 6. issue.4. 2020. pp. 162-170 doi: https://dx.doi.org/10.20469/ijhss.6.20003-4.
4. Bakirov N.Z., Novitskiy Z.B., Khamzaev A.K. Methods of creating various forest plantations on the dried-up bottom of the Aral Sea // *Contemporary Problems of Ecology*, *15*(7), 2022. P. 799-805. https://doi.org/10.1134/S1995425522070046.
5. Bao A., Yu T., Xu W., Lei J., Jiapaer G., Chen X., Kamalatdin I. Ecological problems and ecological restoration zoning of the Aral Sea // *Journal of Arid Land*. Vol. *16*. №3, 2024. P. 315-330. https://doi.org/10.1007/s40333-024-0055-6.
6. Bao A., Yu T., Xu W., Lei J., Jiapaer G., Chen X., Kamalatdin I. Ecological problems and ecological restoration zoning of the Aral Sea // *Journal of Arid Land*. Vol. *16*. №3, 2024. P. 315-330. https://doi.org/10.1007/s40333-024-0055-6.
7. Buriyev S., Maxkamova D., Sherimbetov V. Ekologiya va atrof muhit muhofazasi // O'quv qo'llanma №531-sonli 14-iyun. 2018 y. 247-b
8. Duan Z., Afzal M.M., Liu X., Chen S., Du R., Zhao B., Awais M. Effects of climate change and human activities on environment and area variations of the Aral Sea in Central Asia // *International Journal of Environmental Science and Technology*. Vol. *21* №2. P.1715-1728.
9. Egamberdiyev J.A., Qalandarov N.N., Abduraxmonov N.Yu. Qoldiq dengiz bo'yi avtomorf sho'rxoklarning xossa-xususiyatlari (Orol dengizi qurigan tubi) // International scientific journal science and innovation. Special Issue 21. №3. 2024. B. 534-538. https://doi.org/10.5281/zenodo.10935309.
10. Imanmurzaev A.Q., Kalmurzaev J.S., Abdullaev T.J., Xudaybergenov N. Qishloq xojalig'iga ta'sir etuvchi xavfli gidrometeorologik hodisalarni baholash (Qoraqalpog'iston Respublikasi) misolida // Жанубий оролбуйи гидрологик ва гидроэкологик муаммолари: бугун ва келажаги республика илмий-амалий конференцияси материаллари. Конференция таникли гидролог ва гидрохимик олим география фанлари доктори, профессор Эльмир Исмаилович Чембарисовнинг 75-йиллик юбилейига бағишланади ТУПЛАМИ. Нукус ш., 2023 йил 25-26 апрел.

ISSN: 2692-5206, Impact Factor: 12,23
American Academic publishers, volume 05, issue 11,2025

Journal: https://www.academicpublishers.org/journals/index.php/ijai

11. Ismonov A., Dusaliev A., Kalandarov N., Mamajanova U., Kattaeva G. Profile of desert sandy soils formed in the Aral Sea dried-up seabed // In *E3S Web of Conferences.* EDP Sciences.Vol. 486. 2024. p. 04010. https://doi.org/10.1051/e3sconf/202448604010.
12. Jabbarov Z., Abdrakhmanov T., Tashkuziev M., Abdurakhmonov N., Makhammadiev S., Fayzullaev O., Nomozov U., Kenjaev Yu., Abdullaev Sh., Yagmurova D., Abdushukurova Z., Iskhakova Sh., Kováčik P. Cultivation of plants based on new technologies in the dry soil of the Aral Sea // In*E3S Web of Conferences.* EDP Sciences. Vol. 497. 2024. P. 03008. https://doi.org/10.1051/e3sconf/202449703008.
13. Jabbarov Z.A., Abdrahmanov T., Abdurahmonov N.Yu., Mahammadiyev S.Q., Xoldorov Sh.M., Aslanov I.M., Nomozov U.M., Imomov O.N., Abdullayev Sh.Z., Abdukarimov J.J., Abdukarimov B.B., Ortiqova O.F. Orol dengizining qurigan tubi Hududida tarqalgan tuproq-gruntlarining sho‘rlanganlik holati, fizik, kimyoviy va biologik xossalariga ko‘ra o‘simliklar ekish hududlarini guruhlashning ilmiy asosini yaratishbo‘yicha amalga oshiriladigan tadqiqot ishlar ketma-ketligi // Orol dengizi havzasida global iqlim o‘zgarishlari sharoitida xalq xo‘jaligi sohalarini rivojlantirish istiqbollari mavzusidagi xalqaro ilmiy-amaliy konferensiya Materiallari to‘plami. Nukus, O‘zbekiston 2024-jıl 10-11-oktyabr. B-36-40. https://academicsbook.com/index.php/konferensiya/article/view/385.
14. Jabbarov Z.A., Abdraxmanov T., Mahammadiyev S.Q., Nomozov U.M., Imomov O.N., Abdullayev Sh.Z. Iqlim o‘zgarishi sharoitida tuproq xossa-xususiyatlarining o‘zgarishi indekatorlari (Orol dengizi qurigan tubi sharqiy qismi misolida). Orol dengizi havzasida global iqlim o‘zgarishlari sharoitida xalq xo‘jaligi sohalarini rivojlantirish istiqbollari mavzusidagi xalqaro ilmiy-amaliy konferensiya Materiallari to‘plami. Nukus, O‘zbekiston 2024-jıl 10-11-oktyabr. B-31-35. https://academicsbook.com/index.php/konferensiya/article/view/385.
15. Jabbarov Z.A., Abdraxmanov T., Mahammadiyev S.Q., Nomozov U.M., Imomov O.N., Abdullayev Sh.Z. Iqlim o‘zgarishi sharoitida tuproq xossa-xususiyatlarining o‘zgarishi indekatorlari (Orol dengizi qurigan tubi sharqiy qismi misolida). Orol dengizi havzasida global iqlim o‘zgarishlari sharoitida xalq xo‘jaligi sohalarini rivojlantirish istiqbollari mavzusidagi xalqaro ilmiy-amaliy konferensiya MATERIALLARI TO‘PLAMI. Nukus, O‘zbekiston 2024-jıl 10-11-oktyabr. B-31-35. https://academicsbook.com/index.php/konferensiya/article/view/385.