Modern American Journal of Biological and Environmental Sciences
ISSN (E): 3067-7920
Volume 01, Issue 05, August, 2025
Website: usajournals.org

BIOECOPHYSIOLOGICAL AND ADAPTIVE PROPERTIES OF DESERT PLANTS UNDER CONDITIONS OF GLOBAL CLIMATE CHANGE

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Abstract
The article presents comprehensive research on the ecological status of natural pastures in the Karakul district of the Bukhara region, Uzbekistan. It examines the causes and consequences of pasture degradation due to overgrazing, climate change, and unsustainable land use practices. The authors analyze the current dynamics of desert ecosystems and propose practical measures aimed at mitigating degradation through the rational use and restoration of pasture lands. Particular emphasis is placed on the importance of maintaining ecological balance, conserving biodiversity, and applying phytomeliorative methods to rehabilitate degraded lands. The study concludes that desert pasture ecosystems demonstrate a certain degree of resilience to climate variability, which can be strengthened through informed management strategies and the integration of traditional and scientific knowledge.

Keywords: Pastures, grazing, degradation, desert, ecosystems, plant associations, phytomelioration, sustainable land use, climate resilience.

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Introduction

The pastures of desert-based livestock farms are generally characterized by relatively stable productivity. However, certain natural plant communities within these areas show a significant degree of degradation. The pastures of the Karakul district are located in the Kyzylkum Desert, where the climate is sharply continental. This is reflected in wide annual and diurnal temperature fluctuations, unstable climatic indicators from year to year, low levels of atmospheric precipitation, and increased solar radiation. Some years are marked by severe droughts, which result in extremely low forage yields on the rangelands.

Climatic Conditions of 2025. It is well known that the species composition and productivity of desert pastures are directly dependent on weather conditions—particularly precipitation and air temperature. According to long-term data from the Karakul meteorological station, the average annual precipitation in the region is 126 mm, ranging from as little as 60 mm during drought years to as much as 184 mm in favorable years.

The spring of 2025 was notably dry compared to the previous year, 2024. By the end of March, the amount of soil moisture from atmospheric precipitation was minimal across various soil types in the region. This was insufficient for the proper development of semi-shrub and herbaceous vegetation. Additionally, the temperature regime during this period was significantly lower than the multi-year average, which also negatively affected the growth and development of plant cover.

Unsystematic and unregulated grazing, excessive livestock concentration per unit area, and inefficient extensive livestock management practices are among the main causes of pasture degradation. In these regions, overgrazing can lead to the complete destruction of vegetation cover. The neglect of traditional pasture rotation systems and seasonal transitions between grazing lands has resulted in severe degradation, particularly in pastures near villages, which could otherwise be used more productively.

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Livestock farming remains the primary source of livelihood and economic well-being for the local population, accounting for 75% or more of household income. Therefore, the effectiveness and sustainability of livestock production are directly tied to the condition and management of pasture resources [2–4].

Research Objective

The aim of this study is to assess the condition of various types of pastures in the Karakul district of the Bukhara region, determine the extent of their degradation, and identify effective approaches for their sustainable and rational use. The collected data serve as a basis for developing scientifically grounded and practical strategies for the adaptive utilization of agro-ecological resources. This includes the optimization of flora composition, evaluation of biological diversity, identification of the resource potential of natural vegetation, and the establishment of efficient systems for the use of both natural and forest pastures.

Materials and Methods

The identification and delineation of pasture areas were carried out based on literature sources as well as field surveys conducted within the distribution zones in the Karakul district of the Bukhara region. The classification of pasture types was performed according to the typological scheme for the pastures of Uzbekistan, as outlined in the *Methodological Guidelines for the Geobotanical Survey of Natural Forage Lands of Uzbekistan* (1980) [1].

Results and Discussion

The pastures of the Karakul district in the Bukhara region, covering an area of 490,592 hectares, are characterized by five dominant plant associations. The average forage yield of these pastures in different years typically ranges between 1.5 to 2.0 centners per hectare of dry matter. However, under the climatic conditions of 2025, the accumulation of forage biomass was minimal.

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A significant portion of the watering wells is in need of repair, which has led to the underutilization of adjacent pasture lands. Approximately 30% of the total pasture area is affected by varying degrees of degradation.

Overall, the condition of the pastures can be considered satisfactory. In some areas, forage productivity reached up to 3.5 centners per hectare. This year, a strong vegetative development of Astragalus species was observed, along with the emergence of many new plant species (see Table 1).

Table 1. Coordinates of Pasture Variants of the Karakul Livestock Farm

№	Name of Well / Site	Coordinates (Lat / Long)	Alt (m)	Pasture Type Association
1	Qoq Yotoq	N 40°08′32.7″ / E 63°09′58.7″	176	Chogonovo-Tasbuyurgun-Artemisia with ephemeral species
2	Shirin Drilling Site	N 40°04′05.4″ / E 62°52′11.9″	179	Tasbuyurgun-Chogonovo-Artemisia with Keyreuk
3	Uchkir-2	N 40°10′04.4″ / E 63°04′05.9″	177	Saxaul-Cherkez-Kandym association with Rhang
4	"Chori Khoja" Area	N 40°01′19.2″ / E 63°12′23.0″	183	Saxaul-Singren association
5	Uchkir-1	N 40°09′31.3″ / E 62°56′45.0″	182	Saxaul-Boyalich-Singren-Artemisia association
6	Pastures near the Amu Darya Canal	N 39°55′28.9″ / E 63°20′38.9″	187	Boyalich-Keyreuk-Artemisia-Chogonovo association
7	"G‘arbiy" (Western) deposit	N 40°14′24.5″ / E 62°49′57.3″ *(approx)*	194	Saxaul-Kandym-Singren association
8	Konli Quduk	N 40°09′05.5″ / E 62°52′10″	176	Saxaul-Cherkez-Singren association
9	Southern Border of Karakul Farm	N 39°48′01.5″ / E 63°31′41.4″	200	Saxaul-Cherkez-Keyreuk with Boyalich

To study the current state of the pastures in the Karakul district, field research was conducted to identify the main pasture types and plant associations. The spring assessment of desert vegetation was carried out on previously selected

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pasture plots within the Karakul Livestock Farm (LLC "Karakul"). The farm's pastures are primarily divided into three main types, in accordance with the *Methodological Guidelines for the Geobotanical Survey of Natural Forage Lands of Uzbekistan* (1980):

1. Artemisia (wormwood) plant association
2. Boyalich-Artemisia plant association
3. White saxaul-semi-shrub plant association

In total, five plant associations characteristic of the arid zone of Uzbekistan were identified on the territory of LLC "Karakul." Geobotanical descriptions of the vegetation cover were carried out on each of these selected associations during the research project.

1. Saxaul Plant Community. This community is used primarily in winter. It is the most widespread across the western and northwestern parts of the farm, predominantly located on hilly and ridged sandy areas. The dominant species is white saxaul (*Haloxylon persicum*). Other associated vegetation includes various shrubs, semi-shrubs, and perennial grasses such as tree-like kandym (*Calligonum arborescens*), light-barked kandym (*C. leucocladum*), Richter's saltwort (*Salsola richteri*), sand acacia (*Ammodendron conollyi*), hairy milkvetch (*Astragalus villosissimus*), feathery aristida (*Aristida pennata*), and bipinnate cousinia (*Cousinia bipinnata*), among others. This pasture can support approximately 17,500 sheep for a period of 90 days during the spring. The site is also used in autumn.

2. Ephedra and Saxaul Plant Community. In this community, the dominant species is strobilaceous ephedra (*Ephedra strobilacea*), while white saxaul acts as a subdominant. This community is found on more stabilized and moderately hilly sands with low soil salinity. A distinctive feature is that the hilltops are covered with ephedra, whereas the depressions contain groupings of white saxaul, feathery aristida (*Aristida pennata*), and other semi-shrubs. Observations indicate that in inter-dune depressions, white saxaul disappears from the community and

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is replaced by widely distributed annual saltwort species. Swollen sedge (*Carex physodes*) is relatively abundant in interdune areas compared to slopes and dune tops.

3. Kandym Plant Community. Located on low, stabilized sandy mounds, this plant community is dominated by kandym species with the inclusion of semi-shrubs such as hairy milkvetch (*Astragalus villosissimus*), woolly-fruited mausolea (*Mausolea eriocarpa*), and shrubby saltwort (*Salsola arbuscula*). The overall species diversity and abundance in this association are relatively low compared to other sandy plant communities. The sands in this area are well stabilized due to the widespread presence of swollen sedge.

4. Semi-shrub Plant Community. This community is used in both spring and autumn and is primarily located on sandy plains between dunes. A defining feature is the high density of spreading wormwood (*Artemisia diffusa*), especially in the central, lower-lying areas. Slight elevation changes in the soil surface introduce species such as *Mausolea eriocarpa*, *Calligonum leucocladum*, and *Salsola arbuscula* as subdominants. The herbaceous layer includes swollen sedge (*Carex physodes*), bulbous bluegrass (*Poa bulbosa*), and roof brome (*Anisantha tectorum*).

5. Spreading Artemisia Plant Community. Used mainly in summer and autumn, this community occurs on weakly saline flatlands. The dominant species is spreading wormwood (*Artemisia diffusa*), with occasional individuals of shrubby saltwort (*Salsola arbuscula*). The soil surface is often covered with patches of swollen sedge. A pure Artemisia-dominated community is not typically found over large areas.

Pasture Productivity and Use. Pasture productivity in this region is generally low and fluctuates significantly depending on the year and season. Nearby herders actively use adjacent pastures and watering wells. The nearest herding points to

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the farm center are: Konli – 19 km, Bobomurod – 20 km, Bok – 17 km, Kukyotok – 11 km, and Shirin Drilling Site – 15 km.

Growth and Development of Vegetation Cover in the Pastures of Karakul Livestock Farm

Due to relatively low air temperatures during the first half of the spring season this year, the development of pasture vegetation followed several notable trends:

- In the saxaul (Haloxylon) plant community, only the early stages of white saxaul (*Haloxylon persicum*) vegetation were observed. Similar delayed growth was noted in light-barked kandym (*Calligonum leucocladum*), *Salsola richteri*, and sand acacia (*Ammodendron conollyi*). However, the annual growth of small-leaved Astragalus (*Astragalus villosissimus*, locally known as singren) ranged from 7 to 12 cm. During this period, the main component of green biomass in the saxaul association was swollen sedge (*Carex physodes*), with an average plant height of 10–12 cm and a green mass yield of 0.55 c/ha.
- In the Ephedra-dominated community (*Ephedra strobilacea*), white saxaul acted as a subdominant species, and *Aristida pennata* (selin) was quite abundant. In interdune depressions, annual saltworts were in the germination stage, with their vegetation period continuing into late autumn. Roof brome (*Anisantha tectorum*) was also widespread in this association. The forage yield, composed mainly of selin and brome, averaged 0.62 c/ha of green mass.

The kandym plant community, distributed on stabilized low sandy mounds, was dominated by light-barked kandym. Semi-shrub species such as singren (*Astragalus villosissimus*), woolly-fruited mausolea (*Mausolea eriocarpa*), and *Salsola arbuscula* were also frequently observed. All shrub and semi-shrub species were in the early stages of vegetation. During this period, the main forage biomass was provided by *Carex physodes*, with a yield of 0.35 c/ha of green mass.

In the semi-shrub plant community located on sandy plains between dunes, spreading wormwood (*Artemisia diffusa*) was widely distributed. The plant composition also included *Mausolea eriocarpa*, *Calligonum leucocladum*, and *Salsola arbuscula*. The annual growth of *A. diffusa* reached 12–15 cm, while

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other semi-shrubs showed 6–7 cm of growth. The herbaceous layer consisted primarily of *Carex physodes* and bulbous bluegrass (*Poa bulbosa*). The green biomass yield of the herbaceous vegetation was 0.65 c/ha.

The Keyreuk-Boyalich association, a relatively less common pasture type found on gravelly-sandy soils, was dominated by *Salsola orientalis* (keyreuk) and *Salsola arbuscula* (boyalich). The dominant and subdominant species were observed to be in the early stages of vegetation. The herbaceous layer was mainly composed of *Carex physodes*, which yielded 1.9 c/ha of green mass.

The Boyalich plant community, mainly distributed on saline soils in the central-eastern part of the farm, was dominated by *Salsola arbuscula*, with frequent occurrence of *Salsola orientalis* and annual *Salsola* species. Unlike other associations, this one also featured dense patches of *Mortuk* (*Limonium orientale*).

In the first half of the spring season, the main forage species were *Carex physodes*, various species of *Malcolmia*, and *Limonium orientale*. Annual saltworts were in the germination phase. The yield of ephemeral vegetation in this area reached 0.5 c/ha of green mass.

Table 2. Forage Productivity of Various Plant Communities in the Pastures of Karakul Livestock Farm (LLC "Karakul"), May 29–30, 2025

Plant Community Type	Green Biomass Yield of Ephemeral Vegetation (c/ha)
White Saxaul Association	1.65
Bordzhok-Cherkez-Saxaul Associations	1.92
Semi-Shrub–Herbaceous Associations	2.10
Keyreuk–Boyalich Associations	1.90
Boyalich Plant Communities	1.50

Thus, the monitoring of the pastures at Karakul Livestock Farm during the first half of the 2025 spring season indicates that the period was relatively cool, which had a significant impact on the development of vegetation.

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Conclusion

Pastoral livestock farming in desert zones carries significant risks, particularly during extremely dry years with low levels of atmospheric precipitation. These conditions often lead to poor pasture productivity in the early spring, a critical period when previously stored fodder reserves are depleted prematurely.

Therefore, the rational use of different types of desert pastures, the implementation of grazing rotation systems, adherence to proper livestock grazing practices, and especially the introduction of innovative technologies aimed at improving pasture productivity through reseeding of valuable species are essential. These measures ensure the long-term sustainable use of pasture ecosystems and contribute to the conservation of biodiversity.

Desert pasture ecosystems demonstrate resilience to climate change. However, vegetation in the studied area will require approximately 4–5 years to fully recovering.

References

1. Methodological Guidelines for the Geobotanical Survey of Natural Forage Lands of Uzbekistan (1980). Tashkent: 170 p.
2. Talipov, Kh., Mukimov, T., & Sattarov, S. (2023). Current State and Methods for Improvement and Use of Pasture Lands in the Production Landscapes of Bukhara Region. International Scientific Journal "Science and Innovation", Special Issue: “Sustainable Forestry”, November 2023, pp. 32–37. https://doi.org/10.5281/zenodo.10078330
3. Arifdzhanov, G., Talipov, Kh., Mukimov, T., & Sattarov, S. (2023). Improvement of Pasture Land Use: A Case Study of Landscapes in Bukhara Region. Economic Review, No. 9 (285), pp. 66–71.
4. Talipov, Kh., & Mukimov, T. (2022). Creation of an Agricultural Security System: An Effective Model of Sustainable Land Use. American Journal of Plant Sciences, 13, 613–622. https://doi.org/10.4236/ajps.2022.135041.