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DYNAMICS OF PRODUCTIVITY AND SOIL MOISTURE IN VARIOUS TYPES OF PASTURES

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Abstract. This study investigates the productivity and soil moisture dynamics of sandy desert pastures located in Konimekh District, Navoi Region, and foothill ("adyr") pastures situated in Nurata District over a five-year observation period (2021–2025). The results demonstrate that the average productivity of protected sandy desert pastures reached 2.74 centners ha^{-1}, whereas continuously grazed pastures produced only 1.65 centners ha^{-1}. The highest soil moisture content was recorded within the 80–120 cm soil layer, ranging from 10.5% to 16.5%. Similarly, the average productivity of protected foothill (adyr) pastures amounted to 2.81 centners ha^{-1}, while continuously grazed sites yielded 1.58 centners ha^{-1}. Maximum soil moisture within the 80–120 cm soil layer varied between 7.2% and 7.6%. The findings indicate a close relationship between pasture productivity and soil moisture conditions, confirming that protected grazing regimes contribute significantly to maintaining pasture productivity and vegetation sustainability.

Keywords: pasture, foothill pasture, sandy desert, productivity, soil moisture, grazing, vegetation, monitoring, geobotany, phytocoenology, transect method, herbarium, biodiversity.

Introduction. Approximately 80% of Uzbekistan's agricultural land resources consist of desert and semi-desert ecosystems. These areas serve as the principal forage base for extensive pastoral livestock production. Natural desert pastures represent one of the most economical sources of animal feed. However, desert livestock farming continues to rely predominantly on extensive management practices, making its productivity highly dependent on natural climatic conditions. Consequently, sustainable pasture management has not yet been fully achieved. One of the major constraints affecting desert pasture livestock production is the instability of forage resources, which are largely determined by annual precipitation. During drought years, severe forage shortages frequently occur, resulting in substantial economic losses for livestock producers. In recent years, many Karakul sheep farms have been compelled to relocate thousands of animals over hundreds of kilometers in search of adequate grazing resources. Such movements require considerable financial investment and labor, thereby reducing the overall efficiency of livestock production. The Government of Uzbekistan has adopted a number of measures aimed at increasing livestock populations and improving livestock production, creating favorable conditions for farmers and livestock breeders. Nevertheless, the continuous increase in the number of livestock owned by farmers and rural households has substantially intensified grazing pressure on natural pasture ecosystems. Failure to regulate stocking rates and the continuous year-round utilization of pastures have resulted in significant degradation of vegetation cover, reduced biodiversity, declining pasture productivity, and deterioration of forage quality. In addition, recent climate change and prolonged drought conditions have further accelerated pasture degradation. These negative trends have become particularly evident in the wormwood–ephemeral pastures of the Karnab Desert, where valuable forage species of Artemisia are gradually being replaced by less palatable foothill plant species that are generally avoided by grazing animals. Under these circumstances, comprehensive studies of pasture productivity and soil moisture dynamics across different pasture

types are essential for developing scientifically based pasture management strategies and ensuring the sustainable use of natural grazing resources.

Objective and Methods. The objective of this study was to investigate the dynamics of pasture productivity and soil moisture in the sandy desert and foothill (adyr) pastures of the Republic of Uzbekistan. Soil moisture content was determined according to the method developed by Shalyt (1959). Pasture productivity was assessed using the transect method described in previous studies [1; 2; 3; 4]. The collected data were processed and statistically analyzed using standard biostatistical methods [5].

Results and Discussion The composition of vegetation varies considerably among different pasture types. In wormwood–ephemeral pastures, Artemisia species constitute the dominant vegetation, accounting for approximately 50–56% of the total plant cover. Ephemeral and ephemeroid species comprise about 30%, annual saltworts account for 6%, and coarse forage grasses represent approximately 8% of the vegetation cover (Gaevskaya & Salmanov, 1975).

The vegetation of sandy desert pastures is predominantly composed of shrubs and semi-shrubs. The principal plant species include black saxaul (Haloxylon aphyllum), white saxaul (Haloxylon persicum), sand acacia, Singren, Boyalich, tree-like Calligonum, tamarisk (Tamarix spp.), Cherkez, Kuyravuk, Borjoq, Sazaghan, Chogon, Juzgun, Biyurgun, Peganum harmala, and various species of Artemisia.

Foothill (adyr) pastures occupy approximately 9.5% of the territory of Uzbekistan and represent one of the most valuable natural resources for pasture-based livestock production. Compared with desert pastures, adyr pastures provide more favorable conditions for the growth of ephemeral and ephemeroid forage species. Long-term studies have shown that the productivity of these pastures varies substantially depending on annual climatic conditions, ranging from 0.6 to 6.5 centners ha^{-1}. During the summer season, however, ephemeral plants wither, become brittle, and are dispersed by wind, resulting in a sharp decline in the quantity of available pasture forage.

During the period 2021–2025, comprehensive field investigations were conducted in the sandy desert pastures of Konimekh District (Navoi Region) and the foothill (adyr) pastures of Nurata District. In addition to evaluating pasture productivity, the dynamics of soil moisture were also investigated. Productivity assessments were carried out using the transect method across different pasture types. The results showed that the productivity of the sandy desert pastures in Konimekh District was high during two years, moderate during two years, and low during one year of the study period, reflecting considerable interannual variation associated with environmental conditions.

Table 1. Dynamics of Pasture Productivity in the Sandy Desert Pastures of Konimekh District, Navoi Region (centners ha^{-1})

Pasture type	Years					Average (centners ha^{-1})
	2021	2022	2023	2024	2025	
Protected natural pasture	2,2	2,6	2,1	3,8	3,0	2,74
Continuously grazed pasture	1,05	1,2	1,1	2,9	2,0	1,65

As shown in Table 1, the average productivity of the protected (ungrazed) natural pasture over the five-year study period was 2.74 centners ha^{-1}, whereas the average productivity of the continuously grazed pasture was 1.65 centners ha^{-1}.

Table 2 presents the dynamics of soil moisture in the sandy desert pastures expressed as percentages. Soil moisture content varied considerably with soil depth, reaching a maximum depth of 120 cm. During 2021–2022, soil moisture in the 80–120 cm layer ranged from 10.8% to 16.5%. In

contrast, during 2024–2025, this value did not exceed 4.9–7.6%. Over the study period (2021–2025), soil moisture in the surface 0–20 cm layer ranged from 0.9% to 2.5%, while moisture content in the 20–40 cm layer varied between 2.1% and 5.4%, and in the 40–60 cm layer between 4.3% and 6.5%. The low moisture content in the upper soil horizons of sandy desert pastures is insufficient to support the normal growth and development of annual plant species. Consequently, these plants rapidly desiccate under arid environmental conditions.

Table 2. Soil Moisture Dynamics in Sandy Desert Pastures of Konimekh District, Navoi Region (%)

Soil depth (cm)	Year			
	2021	2022	2024	2025
0-20	0,9	2,5	1,73	1,3
20-40	2,6	4,2	2,1	5,4
40-60	4,3	6,5	4,9	5,1
60-80	11,9	10,8	7,6	5,0
80-100	16,4	12,3	7,2	6,9
100-120	16,5	12,7	6,5	7,2

Analysis of the productivity dynamics of the foothill (adyr) pastures in Nurata District showed considerable interannual variation. In 2021 and 2025, the productivity of the protected pastures was 2.15 and 2.9 centners ha^{-1}, respectively. Higher productivity was recorded in 2022 and 2024, when forage yield reached 3.2–3.9 centners ha^{-1}. In contrast, 2023 was characterized by relatively low pasture productivity, with a yield of only 1.9 centners ha^{-1}.

Table 3. Dynamics of Pasture Productivity in the Foothill (Adyr) Pastures of Nurata District (centners ha^{-1})

Pasture type	Years					Average (centners ha^{-1})
	2021	2022	2023	2024	2025	
Protected natural pasture	2,15	3,2	1,9	3,9	2,9	2,81
Continuously grazed pasture	1,4	1,6	1,3	2,1	1,5	1,58

Based on the five-year dataset, the average productivity of the protected foothill (adyr) pastures was 2.81 centners ha^{-1}. As shown in Table 3, the productivity of the continuously grazed pastures reached 2.1 centners ha^{-1} only in 2024. In the remaining years (2021, 2022, 2023, and 2025), pasture productivity ranged from 1.4 to 1.6 centners ha^{-1}. Overall, the five-year average productivity was 2.81 centners ha^{-1} for the protected (ungrazed) pastures and 1.58 centners ha^{-1} for the continuously grazed pastures, indicating a substantial reduction in forage yield under continuous grazing. The dynamics of soil moisture in the foothill (adyr) pastures of Nurata District are presented in Table 4. In 2021, soil moisture content was 4.6% in the 0–20 cm layer, 4.5% and 4.4% in the 20–40 cm and 40–60 cm layers, respectively, 4.6–4.7% in the 60–100 cm layer, and 3.8% at a depth of 100–120 cm.

In 2022, soil moisture was 2.4% in the 0–20 cm layer, 4.3–4.8% in the 20–60 cm layer, 5.2% at a depth of 60–80 cm, and increased to 8.1–9.5% within the 80–120 cm soil layer. In 2024, soil moisture content measured 1.73% in the 0–20 cm layer, 2.1% in the 20–40 cm layer, 4.9% in the 40–60 cm layer, 7.2–7.6% in the 60–100 cm layer, and 6.5% at a depth of 100–120 cm. In 2025, soil moisture in

the surface 0–20 cm layer was 3.3%. Moisture content in the 20–60 cm layer ranged from 3.8% to 3.9%, while values of 2.8% and 3.2–3.5% were recorded in the 60–80 cm and 80–120 cm soil layers, respectively. These results demonstrate considerable interannual variation in soil moisture across different soil depths in the foothill pasture ecosystem.

Table 4. Soil Moisture Dynamics in the Foothill (Adyr) Pastures of Nurata District, Navoi Region (%)

Soil depth (cm)	Years			
	2021	2022	2024	2025
0-20	4,6	2,4	1,73	3,3
20-40	4,5	4,3	2,1	3,8
40-60	4,4	4,8	4,9	3,9
60-80	4,6	5,2	7,6	2,8
80-100	4,7	8,1	7,2	3,5
100-120	3,8	9,5	6,5	3,2

Conclusions. The results of the present study indicate that the productivity of sandy desert pastures exhibited considerable interannual variation during the five-year observation period. Specifically, pasture productivity was high in two years, moderate in two years, and low in one year. The relatively high soil moisture content recorded in the deeper soil layers (10.8–16.5%) created favorable conditions for the growth and development of shrub and semi-shrub vegetation, thereby contributing positively to pasture productivity.

The productivity of the foothill (adyr) pastures was found to be closely associated with soil moisture availability. During 2022–2024, soil moisture content in the deeper soil layers was relatively high (7.2–9.5%) compared with the other years of the study period. Correspondingly, pasture productivity also increased during these years, reaching 3.2–3.9 centners ha^{-1}, demonstrating the significant influence of soil moisture on forage production in foothill pasture ecosystems.

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