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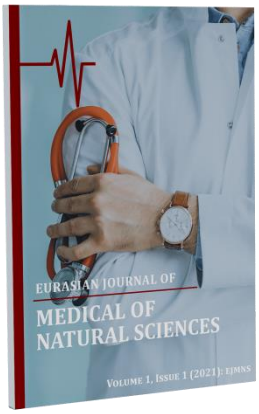


# CHARACTERISTICS OF THE PASTURES OF THE FARISH REGION AND RECOMMENDATIONS FOR THEIR RESTORATION

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**ABSTRACT**

*The article describes the types of desert pastures of the Farish district of the Jizzakh region, presents materials on the species composition of vegetation cover, the degree of degradation, technologies to increase the productivity of degraded pastures and ways of their rational use.*

**Introduction.** The Farish district of the Jizzakh region is one of the regions of Uzbekistan where the problem of pasture degradation due to excessive and unregulated grazing is particularly relevant. The total area of the district is 981 thousand hectares, of which 384 thousand hectares are occupied by desert and semi-desert pastures. The main source of income for the local population is animal husbandry, the profitability of which depends on the level of productivity of natural pastures. The number of livestock in this area significantly exceeds the safe capacity of pastures, so vegetation is seriously susceptible to degradation. The development of irrigation forage production in the region is limited due to a shortage of water resources.

The degradation of pastures and soil threatens the well-being of the rural population and the economy of the region as a whole. As the restoration of pastures becomes increasingly expensive or practically impossible, the biological diversity of ecological systems of global importance is also under threat. It is estimated that most of the pastures in the region are to some extent affected by degradation [1,4,5]. This is a consequence of the impact of a number of anthropogenic and physical factors, including climate change. Fragmentation of ecosystems, i.e. violation of their integrity significantly limits genetic exchange, threatens the survival of rare species of flora and fauna and, in general, reduces biodiversity.

**The purpose of the research.** The aim of the work was to study the condition of various types of pastures in the Farish district, the degree of their degradation, the system of using natural pastures, as well as to study the level of animal feed supply. The obtained materials are

used in the development of scientific and practical foundations for the adaptive use of agroecological resources, including optimization of flora composition, assessment of biological diversity and identification of the resource potential of natural vegetation.

**Objects and methods of research.** During the research, we used the traditional route method of geobotanical research, as well as methods of camera decryption of satellite images from Landsat, MODIS and Google. To study the seasonal dynamics of the feed mass, 10 $m^2$ transects were laid on the reference areas of pastures, and mowing was carried out, then the biomass of forage plants and their nutritional value were determined by laboratory methods. The types of pastures were distinguished according to the scheme of the typology of pastures in Uzbekistan [1]. The contour areas were determined by GIS methods. In the vegetation cover of the foothill semi–desert zone, the type of ephemeral is characteristic; for clay gypsum and salt deserts, the type of xerophytes and halophytes.

In desert sheep farming, the groupings formed by these types of vegetation are seasonal pastures used for sheep grazing. Their vegetation usually forms a sparse cover, but despite the relatively scarce reserves of plant matter, these groupings produce on average about 0.16-0.5 t/ha of dry mass. The vastness of the territory and the variety of environmental conditions also determine the heterogeneity of the vegetation cover, which serves as the basis of the forage base. Almost all high-altitude zones -chul, adyr and tau - take place on the territory.

The chul belt (altitude up to 350-400 m above sea level) is located northwest of the Nurata Mountains and falls to the southwestern outskirts of the Kyzylkum desert.

The adyr belt is the upland plains and slopes north of Nuratau. And the holes occupy the first stage of the mountains or the zone of semi-secured bogara. Their absolute height ranges from 300-400 to 600-900 m above sea level.

The tau belt is located at an altitude of 1200-1500 above sea level. It is dominated by dark gray soils and brown soils with wheatgrass and mixed vegetation. These soils are relatively fertile - the humus content in their upper (0-10 cm) layer is 4-7%. The Chul belt is represented by gypsum, sand and salt ecological types of deserts.

**Results and Discussion**. There are 14 types of pastures in the studied area. Irrigated lands, villages with private plots, roads in total occupy only 1.4% of the territory. The research area belongs to the unsecured foothill zone. Despite this, in the second half of the last century, vast areas were plowed here for foothill zone, which are currently not cultivated due to unprofitability and soil depletion. Secondary phytocenoses are developed here, representing different stages of vegetation demutation. They belong to the type of coarse-grazed ephemeral pastures and are characterized by significant species diversity (up to 40-50 species per 100 $m^2$) with low projective coverage (from 20 to 30-40%). Various ephemeral dominate (*Taeniatherum crinitum (Schreb.) Nevski*, species of the genera *Aegilops, Bromus, Trigonella, Astragalus, Poa bulbosa L.*), xerophilic perennials (*Psoralea drupacea Bunge, Cousinia resinosa Juz.* and others).

The productivity of the herbage in different areas of the fallow land is varies depending on the species composition, and also varies greatly over the years, depending on meteorological conditions. In nature, pasture grass has never been completely drained throughout the year. With constant grazing, too many plants are unable to form seeds.

Special attention is currently being paid to the problems of restoring natural phytocenoses of the arid zone and preserving biodiversity, and the issues of restoring degraded pastures, due to their ecological orientation, are becoming particularly relevant.

Our research in 2010-2024 showed that in many areas of the studied territory, the yield of lowland and foothill pastures has significantly decreased compared to the data of the second half of the twentieth century. (Table 1).

In the spring of 2024, a preliminary assessment was carried out and indicators were identified for the main global indicators and criteria for neutral balance of land degradation (NBLD):

- Ground cover (change of ground cover),
- pasture productivity (net primary productivity),
-degree of degradation,
- Sheep capacity,

Table 1. Yields of various types of pastures in the area and in terms of neutral balance (NBLD) (2010-2024)

| № | Types of pastures | Degree of degradation, score | Average long-term yield of dry eaten mass, t/ha | | NBLD, % +/- | Sheep-capacity, heads/ha |
|---|---|---|---|---|---|---|
| | | | 2010-2014 г | 2021-2024 г | | |
| 1 | *Artemisia* | 1 | 0,524 | 0,49 | -6,5 | 0,61 |
| 2 | *Peganum harmala* | 4 | 0,180 | 0,15 | -16,7 | 0,19 |
| 3 | *Pastures among bogara, fallow lands* | 3 | 0,226 | 0,18 | -8,2 | 0,28 |
| 4 | *Poa with Carex* | 3 | 0,210 | 0,19 | -9,5 | 0,24 |
| 5 | *mix grasses with Carex* | 2 | 0,340 | 0,330 | -3,0 | 0,41 |
| 6 | *Artemisia with Carex* | 1 | 0,542 | 0,535 | -1,9 | 0,68 |

The monitoring of the neutral balance indicators will allow quantifying the balance between the area with the benefits achieved (significant positive changes in NBLD indicators = improvements) and the area where losses occurred (significant negative changes in NBLD indicators = degradation) for each category of pastures throughout the landscape (Table 1.)

Based on field survey data 4 degrees of degradation were identified for the territory and decryption of satellite images:

- Weak – vegetation cover is characterized by completeness of composition and structure, good vital condition and normal renewal of most species, with weak signs of deterioration of vegetation (the appearance of a small number of weed species, a slight decrease of forage species). Photo 1.

- Medium (moderate) - negative changes in the composition and structure of vegetation are noticeable: the abundance of xerophytes, ephemeral and weed species increases, they begin to play the role of subdominants; the abundance of forage plants decreases, their vital condition and renewal deteriorates; projective coverage decreases. Photo 2.

*Photo 1. Pastures with Artemisia*

*Photo 2. Pastures among bogara, fallow lands*

- Strong - the composition and structure of communities are disrupted, the set of dominants and subdominants has changed (ephemeral, non-edible, weed species predominate). The condition of forage plants is depressed, renewal is weak. Pastures are knocked out, the grass is sparse, and productivity is low. Photo 3.

- Very strong – pastures have been severely dislodged; indigenous communities have been replaced by secondary phytocenoses dominated by weed species and ephemeral and very low productivity. Photo 4.

*Photo 3. Pastures with Phlomis*

*Photo 4. Very strong degraded pasture*

The main indicator of overgrazing in the lowland part of the region is the high abundance of *Peganum garmala L., Psoralea drupacea, Artemisia scoparia Waldst., Heliotropium lasiocarpum Fisch. et C.A. Mey., Hordeum leporinum Link, Taeniatherum crinitum, Anisantha tectorum (L.) Nevski, Aegilops triuncialis L. Phlomis nubilans Zak.,* an endemic of the Nurata

Mountains, listed in the Red Book of Uzbekistan, is not eaten by cattle and in overgrazing conditions and grows as a pasture weed.

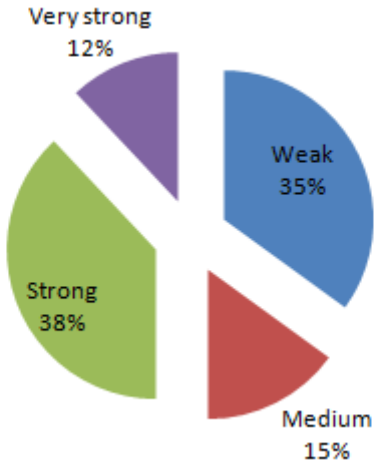


Fig. 1. The ratio of areas with varying degrees of vegetation degradation in the research area (in %).

Due to the lack of a rational management system, the pasture lands of the region are used unevenly. Near settlements and farms, grazing is carried out year-round and with excessive load, the grass is drained almost completely, pastures are heavily clogged with poisonous and weedy species (*Peganum garmala, Psoralea drupacea, Artemisia scoparia, Heliotropium lasiocarpum*, etc.). At the same time, significant areas remote from villages and wells are underutilized and *Artemisia* is aging on them [4,5].

**Restoration of pastures.** The productivity of pastures, and therefore the possible income, is directly dependent on the degree of degradation of the soil and vegetation cover and on the degree of desertification. Pastures generally have a moderate degree of degradation, which characterizes the reversibility of negative processes while observing rational use regimes. Most pastures still retain the ability to self-heal and do not need special measures for phytomelioration, grass species with relatively high potential yields and forage qualities remain among the edifiers.

Based on the results of studies of pasture degradation, the following ways of their restoration/improvement are proposed:

- Radical improvement of pastures through the creation of artificial agrophytocenoses, consisting of a mixture of various life forms (shrubs, semi-shrubs, grasses), as they make more rational use of the water and mineral resources of the environment and more fully satisfy the requirements of animals for a variety of feed.

- Creation of pasture protection strips is an effective method of improving natural pastures in the karakul sheep farming zone. Large shrubs are used for pasture protection strips, mainly *Haloxylon*, *Salsola paletzkiana* and *Calligonum* (600-1200 pcs/ha). Pasture protection strips reduce the speed of winds, delay snow and protect the soil from deflation, create a milder microclimate in the strip itself and in adjacent areas. This, in turn, creates more favorable conditions for the growth and formation of a relatively large crop of pasture feed. Among other things, the *Haloxylon* itself is also considered a satisfactory autumn-winter food for sheep and

camels. It is also recommended to create pasture-protective strips of *Haloxylon aphyllum*, which prevent wind erosion, create a favorable microclimate for the development of grass and can serve as additional winter fodder for livestock. The use of these methods makes it possible to increase pasture forage by 2-3 times.

In degraded areas of pastures, it is recommended to sow *Artemisia*, *Kochia, Salsola orientalis*, *Ceratoides ewersmanniana*, *Halothamnus subaphyllus*, which develop well without watering and give up to 1.2-1.5 t/ha of feed. When processing seeds of desert forage plants with UZGUMI biofertilizer, the survival rate of plants was 99.4%, in the control variant 96.0%. The yield of dry weight was 1.21 t/ha in the second year of 2015 in the treatment variant and 1.02 t/ha in the control variant.[6]

*Haloxylon aphyllum* is a perennial woody shrub from the family of - *Chenopodiaceae* – up to 4-5 m high. The growing season is 240-250 days. Productive longevity is 35 years or more [3]. Feed productivity – 1.6 t/ha of dry weight; contains 10-12% protein, 2.2-2.7% fat, 28.9-38.6% ash and up to 39.3% nitrogen-free extractives. 100 kg of dry food contains 28 feed units in early spring, 46 in autumn and 37 in winter.

*Kochia prostrata (L.) Shrad*. A perennial semi-shrub with a height of 75-130 cm. The growing season is 260-265 days. Productive longevity is 15-20 years. The yield of dry fodder mass is 1.73 – 2.25 t/ha, seeds - 0.1- 0.12 t/ha. The dry weight contains crude protein - 14.9%, in 100 kg the price is 44.9 feed units.

*Halothamnus subaphyllus (Aelen).* A perennial semi-shrub with a height of 75-120 cm. The growing season is 245-250 days. The yield of dry fodder mass is 1.56 – 1.9 t/ha, seeds – 0.16 t/ha. The dry weight contains crude protein - 14.6-16.6%, in 100 kg the price is 43.5 feed units. Productive longevity is 20-25 years.

*Ceratoides ewersmanniana (Stschegl.) Grub*. A perennial semi-shrub with a height of 75-85 cm. The growing season is 210-220 days. Productive longevity is 25-30 years. The yield of dry feed mass is 1.2-1.6 t/ha, seeds are 0.1 t/ ha, in 100 kg of dry feed there are 40-45 feed units and 9.1 kg of digestible protein.

*Ephedra strobilacea. Family of Ephedraceae Dumort, genus Ephedra L*. A bisexual shrub up to 2 m high. The root system extends horizontally up to 5 m. One of the ancient medicinal plants.

*Artemisia diffuza H.Krasch.* A semi-shrub with a height of 20-60 cm. In the hot summer months it goes into suspended animation, in September the leaves grow back. Life expectancy is 12-25 years. The growing season is 240-280 days. 100 kg of hay contains 18-66 fodder units. The yield of dry feed mass is 0.5-0.7 t/ha.

*Camphorosma monspeliaca L. subspecies C. lessingi,* deserves special attention in the natural habitats of the Farish district (photos 5-6).

This semi-shrub, 25-80 cm high, forming turf with tufts of leaves on the soil, occupies an important place among halophytic species as a forage crop (the consumption of *Camphorosma* hay by cattle reaches 80%). The root system of the rod type penetrates to a depth of 2-8 m, the projective coverage of the earth's surface by plants reaches 85-90%. The duration of the growing season is 235 days. The yield of dry fodder biomass in the fruit ripening phase reaches 0.5-1.2 t/ha, seeds - 0.03 t/ ha. 100 kg of hay contains 3.4 kg of digestible protein, 26.8 feed units. As a salt-resistant, frost-resistant and grazing-resistant plant, it is widely used to improve

natural and cultural long-growing autumn-winter pastures, can be used to improve salt and salt pastures.


Photo *5 - 6. Camphorosma Lessingi Litw*

For the possibility of using this plant in the conditions of the Aral Sea region in November 2023 we have studied thickets (populations) *Camphorosma* organisms of natural habitat in the salt marshes of the Farish district of the Jizzakh region of Uzbekistan (Issyk-Kul lake). The plant associations of camphorosma are concentrated on a gently sloping slightly bumpy slope – the sole of a small rise (10-12 m) near the Issyk Kul lake (photo 7).

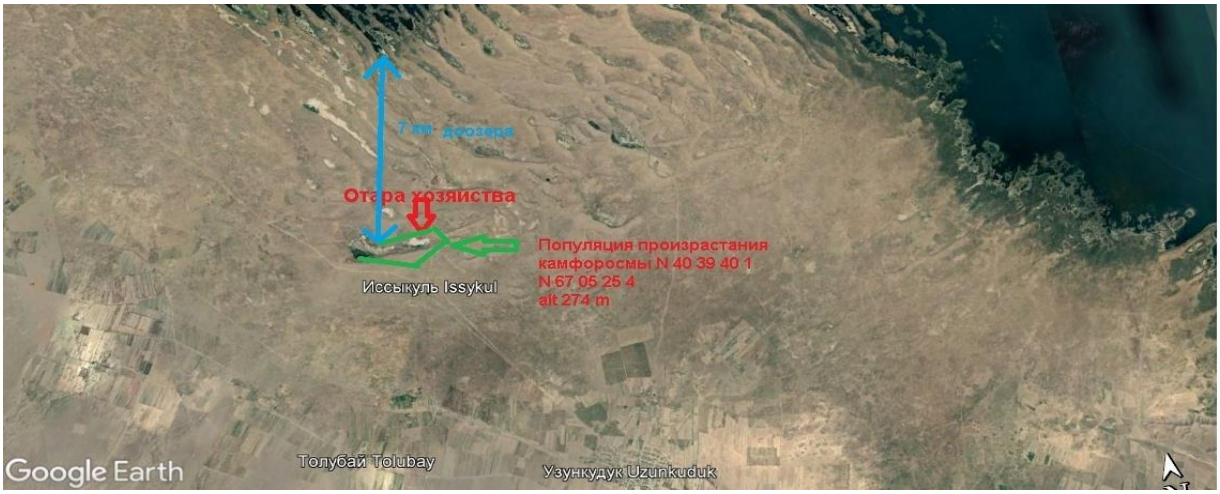


*Photo 7. The area of Camphorosma growth in the Farish district of the Jizzakh region*

The soil cover is represented by salt marsh desert-sand accumulations and silty lake sediments. The soil surface is covered with semi-decomposed remnants of *Camphorosma* vegetation in the form of a salty dusty-sandy mixture. Visually, medium-strong salinity is detected on the soil surface, which can be traced throughout the soil profile, gradually decreasing to a depth of 1m. The hydrogen index (pH) and the specific electrical conductivity of water ((EC, mS/cm) near the Issyk Kul lake were 12.02 pH and 5.43 mS/cm, respectively, which indicates a high salinity of water and soil.

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Photos 8-9. Study of the soil profile at the site of collection of seeds and seedlings of camphor and *Artemisia halophyla*

In this area, *Camphorosma* grows as a landscape plant and prevails over other species of the community in terms of mass 45.6± 0.78 and coverage 89.6±1.33. The population is relatively constant. The most constant indicators are for the average statistical population size of 33.0± 0.44, as well as by weight. The data on the Cv coefficient of variation indicate a slight variability of 3.32-5.33%, which indicates the equalization of individuals in the natural population. The average variable indicator was the value of the number of Cv shoots equal to 15.1% (Table 2).

Table 2. Abundance indicators of Camphorosma Camphorosma monspeliaca subspecies lessingi in the natural population near (Issyk-Kul lake)

| № | Indicator | *M ±m* | *G* | *Cv* | *t* |
|---|---|---|---|---|---|
| 1 | Plant weight, g | 45,6±0,78 | 1,83 | 4,01 | 60,0 |
| 2 | Projective coating, % | 89,6±1,33 | 2,98 | 3,32 | 67,4 |
| 3 | Population size, pcs | 33,0±0,44 | 1,76 | 5,33 | 75,0 |
| 4 | Number of shoots, pcs | 10,4±0,70 | 1,57 | 15,1 | 14,9 |

**Note:** M is the arithmetic mean, m is the error of the mean, G is the mean square deviation, Cv is the coefficient of variation, t is the indicator of the accuracy of the study.

The yield of *Camphorosma* fodder mass in natural conditions, in the seeds ripening phase, reaches 1.2-1.5 t/ha. At the end of the growing season, in November, plants are eaten by animals up to 70-85%. *Artemisia halophila* and amber *Alhagi pseudalhagi* grow in the composition of the cenosis.

In 2022 and 2023, seeds were collected and seedlings of *Camphorosma* and *Artemisia halophyla* in order to form artificial agrobiocenoses of desert vegetation and conduct tests within the framework of the SATREPS project at the “Panaev Farm” experimental site of republic of Karakalpakistan.

Table 3. Coordinates of the place of collection of seeds and seedlings of forage plants on 11/23/2023

| № | The name of the plants | N | E | Alt,м |
|---|---|---|---|---|
| 1 | *Camphorosma lessingi***)** | 40⁰39’40,1 | 067⁰06’26,4 | 274 |
| 2 | *Artemisia halophyla* | 40⁰39’34,5 | 067⁰03’59,1 | 279 |

**Conclusion.** Our research in 2010-2024 showed that in many areas of the studied territory, the yield of lowland and foothill pastures has significantly decreased compared to the data of the second half of the twentieth century. The results of the field survey and interpretation of satellite images allowed us to identify 4 degrees of degradation of pastures (weak, medium, strong and very strong) with a predominance of medium degree, which characterizes the reversibility of negative processes while observing rational use regimes. Most pastures still retain the ability to self-heal. The following ways of their restoration/improvement of pastures are proposed:

- Radical improvement of pastures through the creation of artificial agrophytocenoses.

- Creation of pasture protection strips from large shrubs *Haloxylon*, *Salsola paletzkiana* and *Calligonum* (600-1200 pcs/ha). It is also recommended to create pasture protection strips from *Haloxylon aphyllum*. The use of these methods makes it possible to increase pasture forage by 2-3 times.

- In the most degraded areas of fallow lands, it is recommended to sow *Artemisia*, *Kochia, Salsola orientalis*, *Ceratoides ewersmanniana*, *Halothamnus subaphyllus*.

According to the results of studies in 2022 and 2023, it was found that, along with other halophytic species, it is advisable to grow *Camphorosma* in saline areas. Halophytic species in mixed farming on saline farmland with limited irrigation form a huge amount of green biomass. The ability to resume the growth of halophytes allows them to be used for repeated bites and hay harvesting. Repeated mowing allows you to get easily eaten feed on the aftermaths. The quality of seeds is not affected by toxic salts, which makes it possible to gradually introduce these species into the livestock feeding system. Intensive cultivation of the land with the sowing of forage crops is the fastest method of restoring degraded pastures. When treating seeds with UZGUMI biofertilizer, the survival rate of plants was 99.4%, in the control variant 96.0%, the dry weight yield was 1.21 and 1.02 t/ha in the control variant in the second year of 2015.

**Conflicts of Interest**

The authors declare no conflicts of interest regarding the publication of this paper.

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