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INFLUENCE OF DISTURBANCE FACTORS ON THE COMPOSITION AND STRUCTURE OF VEGETATION IN THE DESERT PART OF THE SYRDARYA RIVER VALLEY (KYZYLORDA REGION)

The article examines in detail the impact of various natural and anthropogenic disturbance factors on the composition, structure, and spatial organisation of vegetation in the desert part of the Syrdarya River valley within the Kyzylorda region. Field studies carried out during 2015–2023 indicate widespread and progressive degradation of vegetation cover, resulting primarily from intensive year-round grazing, unsustainable rice cultivation practices, expansion of irrigated agriculture, and the growing influence of transport and industrial infrastructure. These pressures lead to the simplification of plant communities, reduction of phytocoenotic stability, and fragmentation of habitats. The most heavily transformed areas are marked by a sharp decline in species richness and the displacement of fodder and ecologically significant taxa by weedy, ruderal, and often toxic species such as *Peganum harmala* L., *Zygophyllum fabago* L., and *Pseudosophora alopecuroides* (L.) Sweet, which form persistent secondary communities. The study also highlights the role of soil salinisation, periodic droughts, and microrelief changes in accelerating vegetation degradation under arid-climatic conditions. The conclusions underline the importance of integrating disturbance assessment into regional land-use planning and developing evidence-based programmes for the rehabilitation, conservation, and sustainable management of degraded desert ecosystems.

Keywords: anthropogenic impact; degradation; Kyzylorda region; Syrdarya river valley; vegetation.

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Сырдария өзені аңғарының шөлейт бөлігіндегі (Қызылорда облысы) өсімдіктердің құрамы мен құрылымына бұзылу факторларының әсері

Мақала Қызылорда облысы аумағындағы Сырдария өзенінің шөлейт бөлігіндегі өсімдік жамылғысының құрамына, құрылымына және кеңістіктік ұйымдасуына әртүрлі табиғи және антропогендік бүлдіру факторларының әсерін жан-жақты қарастырады. 2015–2023 жылдары жүргізілген далалық зерттеулер өсімдік жамылғысының кең таралған және үдемелі деградациясын анықтады. Оның негізгі себептері – жыл бойы қарқынды мал жаю, күріш өсірудің тиімсіз әдістері, суармалы егіншіліктің кеңеюі, сондай-ақ көлік және өнеркәсіп инфрақұрылымының күшейіп келе жатқан ықпалы. Бұл қысымдар өсімдік қауымдастықтарының қарапайымдануына, фитоценоздардың тұрақтылығының төмендеуіне және мекендеу ортасының фрагментациясына әкеледі. Ең көп өзгеріске ұшыраған учаскелерде түрлік алуандықтың күрт азаюы және *Peganum harmala* L., *Zygophyllum fabago* L., *Pseudosophora alopecuroides* (L.) Sweet сынды арамшөптік әрі жиі уытты өсімдіктердің басым болуы нәтижесінде құнды мал азықтық және экологиялық маңызды түрлер ығыстырылған. Зерттеу сондай-ақ топырақтың тұзденуы, мерзімді қуаңшылықтар және микрорельефтің өзгеруі сияқты факторлардың құрғақ климат жағдайында деградацияны жеделдететінін атап өтеді. Қорытындылар бүліну деңгейін өңірлік жерді пайдалану жоспарлауына енгізудің, сондай-ақ шөлейттенген экожүйелерді қалпына келтіру, сақтау және тұрақты басқаруға бағытталған ғылыми негізделген бағдарламалар әзірлеудің маңыздылығын көрсетеді.

Түйін сөздер: антропогендік әсер ету, тозу; Сырдария алқабы; өсімдік жамылғысы; Қызылорда облысы.

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Влияние факторов нарушенности на состав и структуру растительности в пустынной части долины реки Сырдарьи (Кызылординской области)

Статья подробно рассматривает влияние различных природных и антропогенных факторов нарушенности на состав, структуру и пространственную организацию растительности в пустынной части долины реки Сырдарья в пределах Кызылординской области. Полевые исследования, проведённые в 2015–2023 гг., свидетельствуют о широком распространении и прогрессирующем характере деградации растительного покрова, обусловленной прежде всего интенсивным круглогодичным выпасом скота, неустойчивыми методами возделывания риса, расширением площадей орошаемого земледелия, а также возрастающим влиянием транспортной и промышленной инфраструктуры. Эти факторы приводят к упрощению растительных сообществ, снижению фитоценотической устойчивости и фрагментации местообитаний. Наиболее трансформированные участки характеризуются резким сокращением видового богатства и вытеснением кормовых и экологически значимых таксонов сорными, рудеральными и нередко токсичными видами, такими как *Peganum harmala* L., *Zygophyllum fabago* L. и *Pseudosophora alopecuroides* (L.) Sweet, формирующими устойчивые вторичные сообщества. В исследовании также подчёркивается роль засоления почв, периодических засух и изменений микрорельефа, ускоряющих деградацию растительности в аридных климатических условиях. В выводах акцентируется необходимость учёта степени нарушенности при планировании регионального землепользования и разработке научно обоснованных программ по восстановлению, охране и устойчивому управлению деградированными пустынными экосистемами.

Ключевые слова: антропогенное воздействие, деградация, долина Сырдарьи, растительность, Кызылординская область.

Introduction

The desert part of the Syrdarya river valley, covering a vast territory located within the West-North Turan subprovince of the North Turan subprovince of the North Turan province of the Iran-Turan subregion of the Sahara-Gobi desert area in accordance with the modern botanical and geographical zoning [1]. The considerable length of the river causes its crossing of different types of desert landscapes, including the entire subzone of medium (perennial saltwort) deserts, stretching from south-east to north-west. At the same time, in the delta area, near the Small Aral, the vegetation cover is influenced by the northern desert subzone, where wormwood-type plant communities dominate.

In accordance with the modern scheme of soil zoning of Kazakhstan, the study area belongs to the subzone of typical deserts, characterised by grey-brown, light-brown and associated soils [2-4]. The Syrdarya river valley in this region is a complex natural complex, where soil-forming processes take place in conditions of both zonal and intrazonal character. Within the river valley and delta intrazonal soils are formed on layered mottled alluvial sediments developing under conditions of additional groundwater moistening. These soils are characterised by a high degree of salinity, presence of carbonates and water-soluble salts of different chemical composition [5-7].

A special place is occupied by alluvial-meadow and riparian soils formed in the floodplain and delta part of the Syr Darya. They serve as a basis for meadows and riparian forests, and areas with the most fertile soils are actively used for rice cultivation. Along with this, solonchaks, takyr and takyr-like soils, formed in various hydrothermal conditions, are widespread in the territory. Along the right bank of the river, west of Kyzylorda city, as well as in the adjacent areas of Northern Kyzylkum along the left bank of the Syr Darya, aeolian sands prevail [8-10].

It should be noted that there is a considerable diversity of hydrological conditions in the valley, determined both by the water content of the river and the degree of distance of the floodplain areas from the channel. This affects the depth of groundwater table and, consequently, the type of soils. In the areas of irrigated agriculture, on the sites of ancient deltas and in the zones of artificial watering hydromorphic soils of swamp-meadow series prevail, which when drying up transform into meadow-meadow, deserted soils. Such diversity of natural conditions makes the region an important object for complex ecological and geobotanical studies. The floristic diversity of the desert part of the Syrdarya

river valley reflects the complex nature of its formation due to the action of many interrelated natural and anthropogenic factors [11-15]. The composition of the flora of this territory includes both species inherent in intrazonal floodplain vegetation and a wide range of representatives of placustrine communities, in particular, psammophytic flora of Kyzylkum, penetrating into the valley from the south through sand massifs formed here in the course of long-term natural processes [16]. Human activity also has a significant impact on the formation of the floristic appearance of the region – high density of settlements, intensive land use and various forms of interference in the natural environment significantly transform the vegetation cover, giving the flora additional complexity and mosaic.

Materials and methods

Classical botanical methods, including route-reconnaissance, ecological-systematic, ecological-geographical and phytocenotic approaches, were applied during the study [17]. These methods allowed a comprehensive characterisation of the flora and vegetation of the study area.

Collection of herbarium material was carried out according to the classical method of A.K. Skvortsov [18], which ensured the accuracy of species identification and reliability of the obtained data. Determination of plant species was carried out according to floristic summaries: «Flora of Kazakhstan» [19], «Illustrated flora of Kazakhstan» [19], «Illustrated identifier...», «Identifier of plants of Central Asia» [20, 21].

The taxonomy of species was brought in accordance with the Internet resource Plantarium [22]. The available materials of herbarium collections were also studied: Herbarium (AA) of the Institute of Botany and Phytointroduction (Almaty, Kazakhstan), Herbarium (MW) of the Lomonosov Moscow State University (Moscow, Russia; https://plant.depo.msu.ru/), as well as scientific papers devoted to the study of the flora of the Syr Darya River valley [23-25].

Results and discussion

As a result of field studies conducted in 2021-2023 covering the arid part of the Syrdarya river valley and adjacent territories, the presence of a set of factors that have a negative impact on the state of the vegetation cover of the region was established. Among the most significant anthropogenic impacts due to the area coverage of degraded lands, intensive grazing and ploughing of soil massifs for crops, in particular rice, prevail.

In this regard, grazing farm animals is the dominant form of landscape use in the Syrdarya valley. In the surveyed areas, especially near rural settlements (Figure 1A, B), a high level of vegetation disturbance was recorded. In such areas, vegetation is degraded to remnants of rare shrubs and single individuals of weedy and toxic plant species, including *Pseudosophora alopecuroides*, *Peganum harmala*, *Zygophyllum fabago* and *Karelinia caspia*.

As one moves away from residential settlements towards more remote areas, a gradual change in vegetation composition is observed: at the first stage, the proportion of weed species increases, but as one moves further away, their abundance tends to decrease. This distribution reflects the gradient of anthropogenic load and the degree of vegetation recovery depending on the distance from the sources of destructive impact.

Figure 1 – Landscape use near rural settlements
A–Start of the cattle route (100-150 m from the edge of the settlement),
B–Continuation of the cattle route (500-700 m) from the edge of the settlement)

Rice cultivation in the study region is geographically conditioned by biological peculiarities of rice crop, which require abundant and stable water supply. In this regard, its cultivation is concentrated exclusively within the Syrdarya river valley. However, long-term extensive use of agricultural land without observing agrotechnical norms, especially crop rotation rules, has led to a significant deterioration of soil conditions. The most pronounced negative consequence of this approach was secondary salinisation of soil horizons, which, in turn, caused a decrease in land productivity and their subsequent exclusion from agricultural turnover.

Assessment of the current state of unused land within the study area indicates a significant spread of degradation processes. According to statistical data of 2001, under the influence of cumulative negative factors, including mismanagement of land (21,159 ha), secondary salinisation (19,320 ha) and waterlogging (22,296 ha), 62,775 ha were taken out of agricultural turnover, which constituted 21.83% of the total area of irrigated land. To date, including arid areas of the Syrdarya river valley, the area of abandoned and fallow lands in Kyzylorda province is 54,008 ha, which is equivalent to 18.78% of the total irrigated land fund (287,525 ha).

Field surveys and results of geobotanical monitoring confirm that a significant share of previously actively used land for rice cultivation is currently in fallow condition. The main reasons for this state are intensive processes of secondary salinisation, as well as limited and unstable water supply, preventing sustainable agrotechnical use of these territories.

The following agricultural lands are indicative examples of degraded plots:

- plot 3, 6th check, 3rd crop rotation (coordinates: N 45°48′739″, E 61°52′488″; absolute height – 51 m, farm ‘Syr-Marzhany’ LLP), which has been in fallow condition for more than 10 years. The main degradation factor – pronounced secondary salinisation of soil profile;

- plot No.1, 5th crop rotation, located on the left bank terrace of the Syrdarya river (coordinates: N 45°34′356″, E 61°50′313″; altitude – 76 m, ‘Syr-Marzhany’ LLP), not used for farmland since the termination of irrigation more than 6 years ago. The main limiting factor is the high hypsometric position, which prevents the provision of a stable water regime.

These examples illustrate the systemic nature of degradation of reclamation lands in the Syrdarya river valley, caused both by unfavourable natural and climatic conditions and the lack of effective management in the sphere of agrarian policy, especially about the regulation of water resources and sustainable land use.

Among additional factors influencing the state of vegetation within the study area, anthropogenic and transport impacts are of particular importance.

Technogenic interference is of a local-planar nature and is associated with the construction and operation of economic, industrial and infrastructural facilities, including hydraulic structures aimed at regulating the flow of the Syrdarya River and the construction of irrigation canals. Such activities lead to the transformation of natural landscapes and disturbance of the hydrological regime of ecosystems.

Transport impacts, primarily road degradation, represent linear and localised forms of disturbance. In zones of constant transport pressure, complete or partial destruction of vegetation cover is recorded, accompanied by mechanical damage to the soil horizon and accelerated erosion.

Additional destabilising factors affecting the structure and stability of vegetation cover in the arid zone of the Syrdarya valley include: Cutting of tree and shrub vegetation used to be a significant factor in the destruction of phytocenoses. However, in recent years, due to the implementation of gasification programmes for settlements, its impact has significantly decreased and does not pose such a threat as it did 10-15 years ago. Pyrogenic impacts (natural and anthropogenic fires) have a local-area character and lead to complete degradation of vegetation cover in the affected areas, disrupting succession processes and ecosystem stability. Recreational pressure, especially near settlements and along motorway arteries, contributes to soil compaction, displacement of native species and formation of disturbed communities dominated by weedy flora. Bank erosion as a result of the unstable hydrological regime of the Syrdarya River also has a negative impact on coastal ecosystems, leading to mechanical destruction of the soil profile and loss of vegetation cover in erosion-prone areas (Figure 2 A, B).

Based on the generalisation of materials obtained in the course of research work conducted both under the current project and in the course of implementation of previous grants – ‘Monitoring of vegetation composition of livestock rangelands: scientific approach to sustainable use of desert pastures of Kazakhstan (on the example of Kyzylorda oblast)’ (2015-2017) and ‘Monitoring studies of restoration of natural vegetation on abandoned rice fields in Kyzylorda oblast’.

Figure 2 – Bank scour as a result of the hydrological regime of the river
A – Burnt trunks of turanga trees, B – Tributary of the main channel of the Syrdarya river with coastal woody vegetation

Species composition of lands used for pastures

The updated list includes 90 species of vascular plants regularly occurring on degraded pastures located in the arid zone of the Syrdarya valley. This list reflects the diversity of life forms and taxonomic breadth of the flora formed under the influence of pasture degradation and related environmental changes*:* Alliaceae: *Allium sabulosum;* Apiaceae: *Ferula capsica;* Asclepiadaceae: *Cynanchum sibiricum;* Asparagaceae: *Asparagus brachyphyllus;* Asteraceae: *Acroptilon repens, Artemisia terrae-albae, Cancrinia* sp.*, Cousinia microcarpa, Hyalea* sp.*, Karelinia caspica, Kochia iranica, Koelpinia linearis, Lactuca tatarica, Scorsonera* sp.*, Senecio jacobaea* (в соответствии с рисунком 3А)*, Taraxacum officinale, Xanthium strumarium;* Boraginaceae: *Arnebia decumbens, Lappula patula, Lappula semiglabra, Lappula spinocarpus, Nonnea caspica;* Brassicaceae: *Arabidopsis* sp.*, Descurainie sophia, Isatis* sp.*, Lepidium obtusum, Leptaleum filifolium, Meniocus linifolius, Srtigozella brevipes, Strigosella circinata, Tauscheria desertorum, Tetracme recurvata;* Caryophyllaceae: *Acanthophyllum pungens, Silene nana;* Chenopodiaceae: *Atreplex tatarica, Bassia eriophora, Bassia prostrata, Ceratocarpus arenarius, Ceratocephala falcata, Ceratocephala testiculata, Climacoptera lanata, Climocaptera brachiata, Corispermum declinatum, Halostachys belangeriana, Haloxylon aphyllum, Kraschenninnikovia ceratoides, Kraschenninnikovia ewersmanniana, Petrosimonia sibirica, Salsola arbuscula, Salsola arbusculiformis, Salsola nitraria, Salsola orientalis, Salsola tragus, Suaeda linifolia;* Convolvulaceae: *Convolvulus arvense;* Cyperaceae: *Carex pachystylis, Carex physodes;* Euphorbiaceae: *Euphorbia* sp.*;* Fabaceae: *Alchage kirgisorum, Alhagi pseudoalhagi, Ammodendron bifolium, Pseudosophora alopecuroides* (в соответствии с рисунком 3В), *Glycyrrhiza uralensis, Halimodendron halodendron;* Fumariaceae: *Fumaria officinalis;*Geraniaceae: *Erodium oxyrhynchum;* Hypecoaceae: *Hypecoum parviflorum;*

Lamiaceae: *Lallemantia royleana, Salvia* sp.*;*Papaveraceae: *Roemeria refracta*; Peganaceae: *Peganum harmala;* Scrophulariaceae: *Veronica* sp.*;*Plumbaginaceae: *Limonium otolepis;* Poaceae: *Aeluropus litteralis, Anisantha tectorum, Bromus squarrosus, Eremopurum Poacynum, Eremopyrum orientalis, Eremopyrum triticeum, Leymus multicaulis, Phragmites australis;* Polygonaceae: *Calligonum aphyllum;* Ranunculaceae: *Clematis orientalis, Delphinium leptocarpum;* Rosaceae: *Rosa persica;* Scrophulariaceae: *Dodartia orientalis;* Solanaceae: *Hyoscyamus niger, Hyoscyamus pusilla, Lycium turkomanicum;* Tamaricaceae: *Tamarix elongate;* Zygophyllaceae: *Zygophyllum fabago* (в соответствии с рисунком 3С).

Considering that the composite list includes species growing on different edaphic types of territories disturbed as a result of grazing, the general structure of the family spectrum reflects the hierarchy of the leading taxa characteristic of the flora of the desert part of the Syrdarya river valley (in accordance with Figure 4).

The graph illustrates changes in the species composition of vegetation on degraded lands depending on the degree of their disturbance is presented in Figure 5.

Figure 3 – Plants found in degraded pastures
(A– *Senecio jacobaea*, B– *Pseudosophora alopecuroides*, C– *Zygophyllum fabago*)

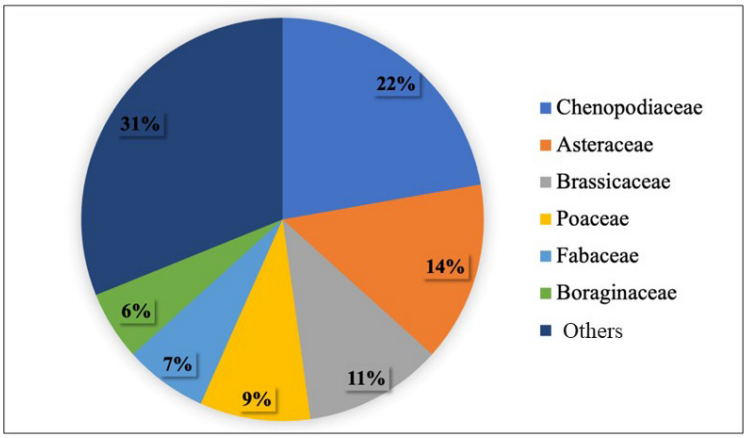

Figure 4 – Distribution of species by families

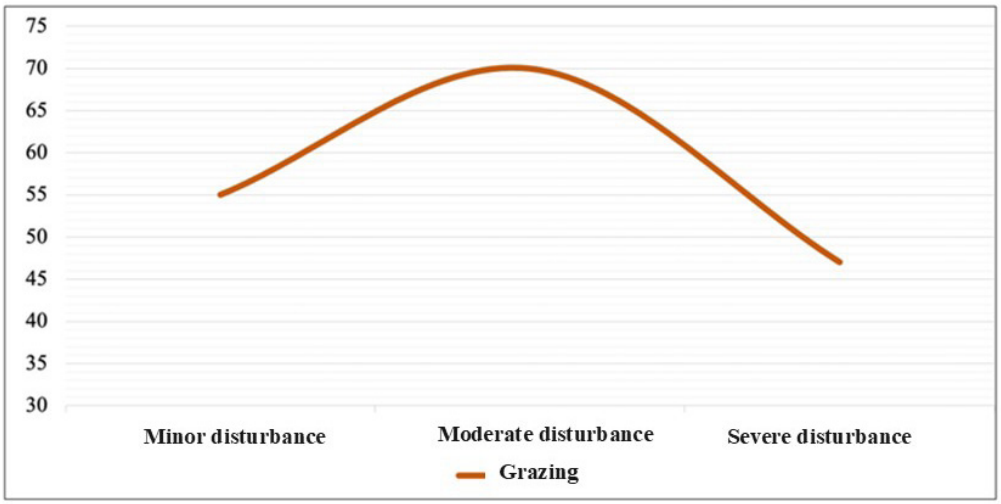

Figure 5 – Changes in vegetation species composition of pastures about the degree of site disturbance

Within the framework of the grant project «Monitoring studies of revegetation of abandoned rice fields in Kyzylorda oblast: prospects for their use» (2018-2020), a list of characteristic species of the flora of fallow lands in the region was compiled. The above list included 81 species belonging to 63 genera and 27 families. The taxonomic structure indicates the dominance of the families Chenopodiaceae (22 species), Asteraceae (13 species), Fabaceae (9 species) and Poaceae (5 species), which reflects the typical spectrum of desert and semi-desert flora of the region.

In the framework of the current stage of the study, the work on the study of vegetation of fallow lands was continued and expanded by surveying abandoned rice and melon lands in other administrative districts of Kyzylorda oblast. This made it possible to supplement and update the existing list of species characteristic of fallow lands of former agricultural lands and to identify regional features of their floristic composition.

On 22 May 2023, 6 km south of Zhanakorgan towards Shieli (coordinates: N 43˚59′56″; E 67˚12′32″; absolute altitude – 70 m), a geobotanical description of the site of an old deposit, which is more than 30 years old, was carried out. In the surveyed area, a secondary phytocoenosis community of licorice-briar type has formed, dominated by Rosa persica Michx. ex Juss. and Glycyrrhiza glabra L., and Halimodendron halodendron (Pall.) Voss is also present. The community contains 27 vascular plant species, and the total projective cover is 60-65%, indicating a fairly high degree of revegetation.

In contrast to the floristic composition of perennial deposits of rice fields of the Kazalinsk massif, only one species of the Chenopodiaceae family – *Ceratocarpus utriculosus* Bluket ex Krylov – was recorded at this site. The greatest species diversity is represented by the family Brassicaceae, including 8 species, including *Tauscheria lasiocarpa*, *Chorispora tenella*, *Camelina* sp., *Cardaria* sp., *Descurainia sophia*, *Diptichocarpus strictus*, *Litwinowia tenuissima*, and *Goldbachia* sp. The families Poaceae (*Aeluropus littoralis*, *Eremopyrum bonaepartis*, *Eragrostis minor*) and Ranunculaceae (*Ceratocephala, Consolida*, *Ranunculus*) are represented by three species each. Other families have 1-2 species, which reflects the specificity of phytocenotic diversity at the site with a long fallow period and slightly saline soils.

Notable differences in the floristic composition of fallow lands located in different areas of the Syrdarya valley are due not only to the significant geographical distance between the sites, but also to the peculiarities of soil-edaphic conditions, primarily the degree of soil salinity. Thus, the above-analysed site near the town of Zhanakorgan, characterised by the dominance of representatives of the Brassicaceae family and the presence of species typical of slightly saline soils, geobotanically belongs to the Turkestan floristic region. This is explained by its relative proximity to the foothills of the Syrdarya Karatau and the absence of pronounced salinisation, in contrast to most of the surveyed areas belonging to the Kyzylorda floristic region, where saline and saline soils prevail.

It should be noted that in previous periods the main focus was on the study of vegetation of fallow rice fields in Kazaly district. However, under the current grant, geobotanical surveys were expanded to include new sites in other administrative districts of Kyzylorda region. Despite the limited scope of field surveys due to the broad focus of the project, the previously identified trends in the hierarchy of the leading families were confirmed, as presented in the summarised analysis (Figure 6).

Thus, a total of 77 species of higher vascular plants were identified during the grant, which surveyed abandoned rice fields of varying degrees and durations of fallow:– Asclepiadaceae: *Cynanchum sibiricum;* Asteraceae*: Artemisia terrae-albae, Acroptilon repens, Cirsium arvense, Inula britannica, Karelinia caspia, Lactuca tatarica, Saussurea salsa, Senecio jacobaea, Xanthium strumarium;*Boraginaceae*: Argusia sibirica;*Brassicaceae*: Descurainia sophia, Cardaria draba, Chorispora tenella, Lepidium obtusum, Strigosella circinata;* Capparaceae*: Capparis herbacea;* Chenopodiaceae*: Atriplex tatarica, Climacoptera aralensis, Climacoptera brachiata, Climacoptera lanata, Halocnemum strobilaceum, Halostachys belangeriana, Kalidium caspicum, Kalidium foliatum, Petrosimonia sibirica, Pyankovia brachiata, Suaeda altissima, Suaeda crassifolia, Suaeda linifolia, Suaeda microphylla, Atriplex sagittata, Kochia iranica, Climacoptera lanata, Kochia prostrate; Convolvulaceae: Convolvulus arvensis; Cyperaceae: Bolboschoenus maritimus, Bolboschoenus maritimus var. compactus;* Cuscutaceae: *Cuscuta campestris;* Elaeagnaceae: *Elaeagnus oxycarpa, Elaeagnus angustifolia;*Euphorbiaceae: *Euphorbia jaxartica;* Fabaceae: *Alhagi pseudalhagi, Glycyrrhiza glabra, Goebelia pachycarpa, Lotus corniculatus, Medicago sativa, Sphaerophysa salsula, Halimodendron halodendron, Melilotus albus*; Frankeniaceae: *Frankenia hirsuta;* Hypecoaceae: *Hypecoum parviflorum;* Iridaceae: *Iris tenuifolia;* Juncaceae: *Juncus jaxarticus;* Lythraceae: *Lythrum*

salicaria; Nitrariaceae: *Nitraria schoberi;* Plumbaginaceae: *Limonium otolepis;* Poaceae: *Aeluropus littoralis, Calamagrostis pseudophragmites, Crypsis aculeata, Eremopyrum bonaepartis, Eremopyrum orientale, Lasiagrostis splendens, Phragmites australis;* Polygonaceae: *Polygonum arenarium, Polygonum aviculare, Polygonum patulum;* Scrophulariaceae: *Dodartia orientalis*; Solanaceae: *Lycium dasystemum, Lycium ruthenicum;* Tamaricaceae: *Tamarix hispida, Tamarix ramosissima, Tamarix elongata;* Zygophyllaceae: *Zygophyllum fabago, Zygophyllum oxianum.* Variation of quantitative composition depending on the terms of fallow is shown in Figure 7.

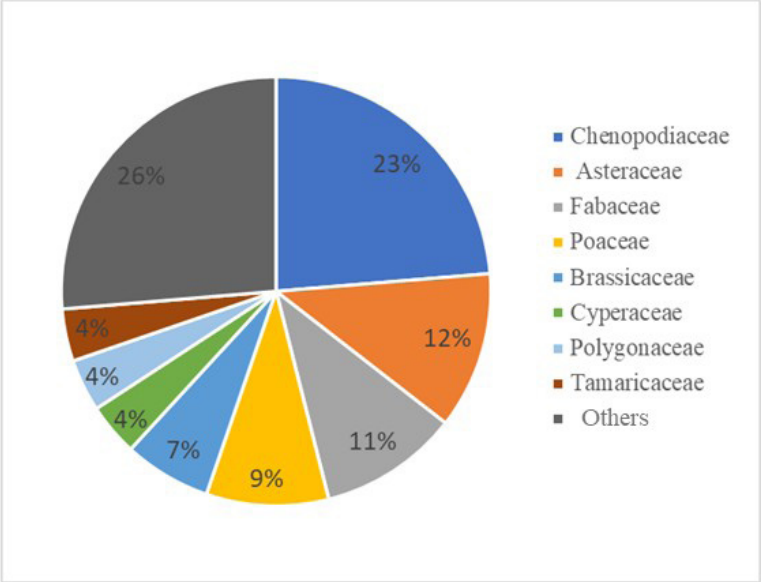

Figure 6 – Taxonomic composition of vegetation families of the studied rice deposits (2021-2023)

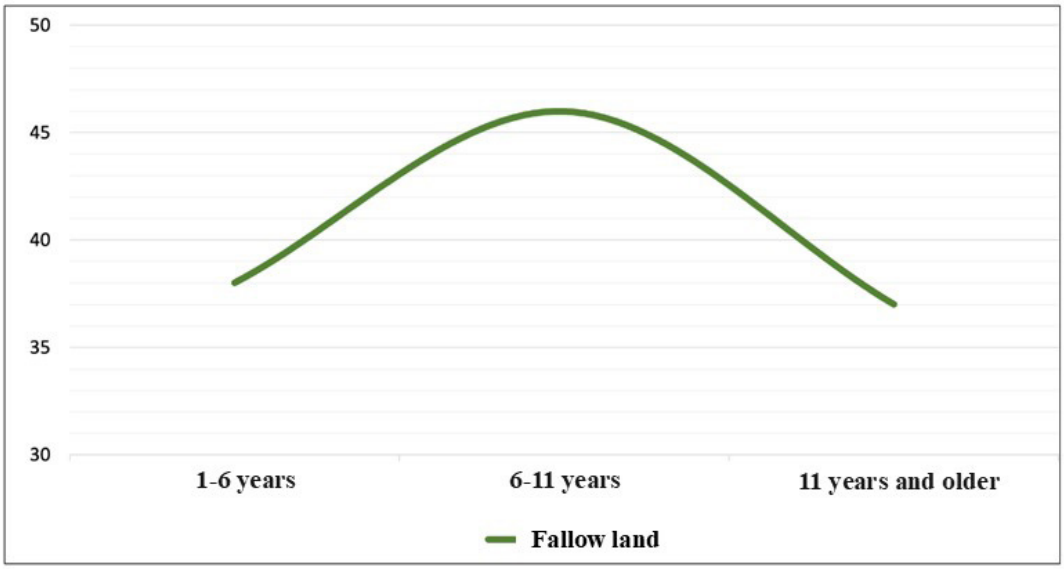

Figure 7 – Dynamics of vegetation species composition of abandoned rice fields depending on fallow dates

Thus, the dynamics of vegetation species composition on rice paddies depending on the duration of their non-use demonstrates parabolic dependence, which allows us to consider this regularity as a potential basis for the construction of predictive models and scales for assessing the state of vegetation at specific sites.

Since during the project implementation the data on rice deposits were mainly clarified and supplemented based on previously obtained results, the main focus of the present stage of research work was on studying the floristic composition of abandoned cucurbits. The table presents the species composition of vegetation of cucurbits located in the desert part of the Syrdarya river valley, established during the field surveys in 2021-2023.

Analysis of the obtained data showed that the floristic composition of the vegetation of abandoned melon lands includes 47 species belonging to 20 botanical families. The highest species diversity (Figure 8) was observed in the Chenopodiaceae family (19%), followed by Brassicaceae and Fabaceae (10% each), Asteraceae (8%) and Poaceae (6%). The remaining families are represented by 2-3% of the total number of species. In terms of life forms, perennial plants predominate – 45% (21 species), while the share of annuals is 32% (15 species), which reflects the characteristic features of phytocenoses of disturbed desert agro-landscapes. In general, the taxonomic structure of the leading families of cucurbits is like the family spectrum of the flora of the floodplain zone of the Syrdarya River. In both cases, the Chenopodiaceae family retains the leading position, but there are differences in the hierarchy of other taxa. Thus, in the studied deposits, Brassicaceae and Fabaceae occupy the second and third places by the number of species, which is explained by the abundance of weed forms, whereas in floodplain communities they correspond to Asteraceae and Poaceae, typical for most arid regions of Kazakhstan.

Table 1 – Species composition of abandoned gourds in the desert part of the Syrdarya river valley

№	Species	Life form	Economic significance
1	2	3	4
1. **Asclepiadaceae**			
1	*Cynanchum sibiricum* Willd.	Perennial	Weedy
2. **Asteraceae**			
2	*Acroptilon repens* (L.) DC.	Perennial	Weedy, poisonous
3	*Artemisia terrae-albae* Krasch.	Small subshrub	Forage
4	*Karelinia caspia* (Pall.) Less	Perennial	Medicinal
5	*Lactuca tatarica* (L.) C.A. Mey.	Perennial	Weedy
3. **Boraginaceae**			
6	*Arnebia decumbens* (Vent.) Coss. & Kralik	Annual	
7	*Nonea caspica* (Willd.) G. Don	Annual	
4. **Brassicaceae**			
8	*Cardaria pubescens* (C.A. Mey.) Jarm.	Perennial	Weedy
9	*Chorispora tenella* (Pall.) DC.	Annual	Weedy
10	*Lepidium obtusum* Basiner	Perennial	
11	*Strigosella circinata* (Bunge) Botsch.	Annual	
12	*Strigosella trichocarpa* (Boiss.et Buhse) Botsch.	Annual	Weedy
5. **Capparaceae**			
13	*Capparis herbacea* Willd.	Subshrub	Edible
6. **Chenopodiaceae**			
14	*Atriplex sagittata* Borkh.	Annual	
15	*Climacoptera brachiata* (Pall.) Botsh.	Annual	Forage
16	*Climacoptera lanata* (Pall.) Botsch.	Annual	
17	*Kalidium caspicum* (L.) Ung.-Sternb.	Shrub	Forage
18	*Bassia odontoptera* (Schrenk) Freitag & G. Kadereit	Annual	

Continuation table

№	Species	Life form	Economic significance
1	2	3	4
19	*Petrosimonia sibirica* (Pall.) Bunge	Annual	Forage
20	*Salsola nitraria* Pall.	Annual	
21	*Salsola tragus* L.	Annual	Forage
22	*Suaeda microphylla* Pall.	Subshrub	
7. **Convolvulaceae**			
23	*Convolvulus arvensis* L.	Perennial	Weedy
8. **Cuscutaceae**			
24	*Cuscuta lupuliformis* Krock.	Annual	
9. **Euphorbiaceae**			
25	*Euphorbia jaxartica* (Prokh.) Krylov	Perennial	Medicinal
10. **Fabaceae**			
26	*Alhagi kirghisorum* Schrenk	Subshrub	Medicinal
27	*Alhagi pseudoalchagi* (Bieb.) Fisch.	Subshrub	Medicinal
28	*Glycyrrhiza uralensis* Fisch. ex DC.	Perennial	
29	*Halimodendron halodendron* (Pall.) Voss	Shrub	
30	*Pseudosophora alopecuroides* (L.) Sweet	Perennial	Weedy
11. **Fumariaceae**			
31	*Fumaria officinalis* L.	Perennial	
12. **Peganaceae**			
32	*Peganum harmala* L.	Perennial	Medicinal
13. **Plumbaginaceae**			
33	*Limonium otolepis* (Schrenk) O. Kuntze	Perennial	Tannin
14. **Poaceae**			
34	*Aeluropus littoralis* (Gouan) Parl.	Perennial	Forage
35	*Phragmites australis* (Cav.) Trin. ex Steud.	Perennial	Technical
36	*Eremopyrum bonaepartis* (Spreng.) Nevski	Annual	
15. **Polygonaceae**			
37	*Polygonum pseudoarenarium* Klokov	Perennial	
38	*Polygonum patulum* M. Bieb.	Perennial	
39	*Polygonum aviculare* L	Perennial	Weedy
16. **Ranunculaceae**			
40	*Clematis orientalis* L.	Shrub	
41	*Ceratocephala falcata* (L.) Cramer	Annual	
17. **Scrophulariaceae**			
42	*Dodartia orientalis* L.	Perennial	
18. **Solanaceae**			
43	*Lycium depressum* Stocks	Shrub	
19. **Tamaricaceae**			
44	*Tamarix elongata* Ledeb.	Shrub	Ornamental
45	*Tamarix ramosissima* Ledeb.	Shrub	Ornamental
20. **Zygophyllaceae**			
46	*Zygophyllum fabago* L.	Perennial	Medicinal, poisonous
47	*Zygophyllum oxycarpum* Popov	Perennial	

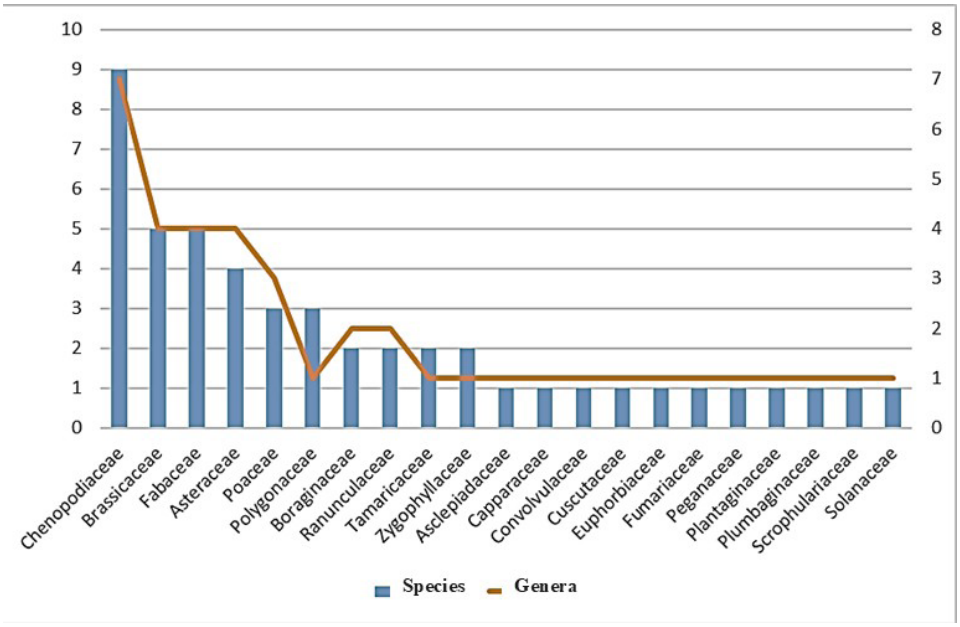

Figure 8 – Family spectrum of abandoned gourds in the desert part of the Syrdarya river valley

In the surveyed melon fields, 26 plant species with economic value were identified. Among them, weedy forms (9 species), as well as fodder and medicinal plants – 6 species each, respectively – predominate. Ornamental species are represented by two taxa, the other groups of useful plants include 1-2 species each.

In total, the anthropophilic component of the flora found in fallow areas of former rice checks and melon fields comprises 89 species, which indicates a high degree of transformation of the vegetation cover under the influence of agricultural use and subsequent self-restoration.

Conclusion

The vegetation cover of the desert part of the Syrdarya valley has undergone significant transformation under the influence of a complex of anthropogenic factors. The most destructive impact is caused by: uncontrolled grazing, intensive agricultural development (primarily rice cultivation), anthropogenic construction, transport loads and pyrogenic processes. These factors contribute to the degradation of biodiversity and replacement of natural communities by synanthropic and weedy species. Species diversity decreases with increasing disturbance, especially in the vicinity of settlements and livestock routes. The most characteristic indicators of severe degradation are as follows — *Pseudosophora alopecuroides*, *Zygophyllum fabago*, *Peganum harmala*, *Karelinia caspia*. These species are displace fodder, medicinal and native plants, which worsens the ecological and economic quality of lands.

Field and geobotanical surveys in 2015-2023 revealed consistent differences in flora composition on pastures and fallow farmland (including rice and melon). Chenopodiaceae, Asteraceae and Fabaceae dominate on pastures, while the presence of Brassicaceae and Poaceae is increasing in some cases on old fallow lands. Plots with many years of non-cultivation show tendencies to restore natural phytocenoses, especially in areas with reduced salinity. Indicator species of succession include: *Halimodendron halodendron*, *Glycyrrhiza glabra*, *Rosa persica* (in typical communities), as well as *Ceratocarpus utriculosus* и *Descurainia sophia* in the early stages. The family spectrum of flora of pasture and fallow ecosystems corresponds to the typical hierarchy of arid territories of South Kazakhstan, where Chenopodiaceae retain the leading position. However, in zones with lower salinity and proximity to foothills, the role of Brassicaceae and Poaceae is increasing, which indicates the importance of taking into account soil and orographic factors in ecological assessment.

Graphical modelling of the dynamics of species composition depending on the period of fallow showed a parabolic dependence, allowing the use of such regularities for predicting the natural recovery of vegetation and optimising the timing of phytomelioration interventions.

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Authors' contributions

Vesselova P.V., Kudabayeva P.V. – field work, con-ducting the research, approval of the final version of the article, Abdildanov D. Sh., Ussen S. – field work, statistical data processing, conducting the research.

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