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## **ASSESSMENT OF LAND DEGRADATION PROCESSES IN ATYRAU REGION**

**Annotation.** The assessment of land degradation processes in the Atyrau region has revealed the restoration of previously degraded lands. From 1991 to 2023, the Atyrau region has demonstrated an improvement in its ecological balance, which can be attributed to a reduction in the anthropogenic load on previously degraded lands. The underlying causes of land restoration in the region have been identified, and the principal comparative indicators are presented. The extent of land degradation restoration in the Atyrau region is demonstrated.

**Key words:** anthropogenic load; cattle slaughter; ecological balance; degradation; desertification; Atyrau region.

### *Introduction*

One of the most pressing issues of our time is the problem of desertification. The United Nations Convention defines "desertification" as the degradation of land in arid, semi-arid, and dry sub-humid regions due to a range of factors, including climate change and human activities. The practice of agriculture has a significant impact on the ecological balance of a considerable proportion of the planet's land surface. The limited natural land and resource potential for production purposes in agriculture gives rise to the necessity of expanding and developing steppe and forest areas. This, in turn, has the effect of disturbing the natural balance, increasing degradation processes and reducing soil fertility. The aspiration to enhance the agro-ecological quality of land is predicated on the utilisation of technogenic technologies, which have the potential to result in the degradation of land resources, the contamination of the atmosphere, water sources and forest areas. The processes of water erosion and soil deflation lead to an increase in desertification, which in turn results in a reduction in agricultural production and a decline in the quality of the land. Land degradation and desertification represent a global phenomenon of our time, affecting the majority of countries worldwide. In the present era, international organisations are directing considerable attention towards the implementation of measures designed to combat this perilous phenomenon. The active and often unreasonable human economic activity in arid regions, which occupy approximately 30% of the total land area, has created a significant risk of disturbing the ecological balance.



### *Research area*

Since 1960, the territory of Kazakhstan has been subject to desertification. Previously, the areas most susceptible to desertification were primarily arid and sub-arid regions, including semi-desert and desert zones, as well as areas undergoing intensive economic exploitation. At the present time, the border of desertification has shifted northwards to encompass the primary seeding region of Kazakhstan, extending into the forest-steppe and steppe zones. The Atyrau region is regarded as one of the most severely degraded areas in Kazakhstan. In Kazakhstan, estimates from specialists dealing with desertification problems within the UNCCD suggest that by 1996, 179.9 million hectares of desertified lands, representing 60% of the country's territory, had been identified. By 2014, official sources indicated that approximately 66% of Kazakhstan's lands were affected by desertification, with the Atyrau region experiencing a rate of not less than 60-70%.

Atyrau oblast is situated in the westernmost region of the Republic of Kazakhstan. The oblast is bordered to the west by the Astrakhan oblast of Russia, to the north by the West-Kazakhstan oblast, to the north-east and east by the Aktobe oblast, to the south-east and south by the Mangistau oblasts of the Republic of Kazakhstan, and to the south-west by the Caspian Sea. The region is distinguished by a remarkable diversity of natural conditions, resulting from its considerable length from north to south and from west to east, as well as from the disparate circumstances of its formation and development across its various sections.

The territory of the oblast is located within 46-49° north latitude, 47-56°30 east longitude, its length is 150-320 from north to south and slightly more 460 - 550 kilometres from west to east. It is divided into seven administrative districts: Kurmangazinskiy, Isatayskiy, Inderskiy, Kzylkoginskiy, Makhambetskiy, Makatskiy, Zhylyoi. The regional centre is the city of Atyrau. It is connected by the railway of state importance with the cities of Astrakhan, Aktobe, Aktau. The oblast has a network of highways of republican, oblast and district importance, connecting district centres, urban-type settlements among themselves and with the oblast centre.

### *Materials*

The research was informed by a range of statistical data and materials on desertification issues in the Atyrau region of the Republic of Kazakhstan, sourced from the Institute of Geography, Department of Statistics, Committee on Land Resources Management, Ministry of Agriculture, Ecology and Geology of the Republic of Kazakhstan. Additionally, the study drew upon monographs, books and scientific publications by leading experts in the field. The issue of desertification and land degradation in Kazakhstan has been the subject of considerable attention from both governmental and scientific and research bodies. In order to address this issue, the government of Kazakhstan has enacted a series of legislative measures, as well as national programmes and action strategies, with the aim of combating desertification. Furthermore, the issue of desertification and land degradation was highlighted by the President of the Republic of Kazakhstan, K. Q. Tokayev, during the General Debate of the 74th session of the United Nations General Assembly, as well as in his address to the people of Kazakhstan on 1 September 2020.



### Research methods

The study of the problem of desertification and land degradation in the Atyrau region of Kazakhstan was based on comparative geographical, cartographic methods, as well as methods of spatial, economic and statistical analysis.

### Results and discussion

Since its inception in 1994 and subsequent ratification in 1997, the Convention to Combat Desertification has guided Kazakhstan's efforts to combat desertification and its relationship with poverty reduction. The country has demonstrated its commitment to this convention by adopting an integrated approach to planning and implementing activities aimed at combating desertification and its associated challenges. This approach encompasses the promotion of awareness and participation of local communities, the facilitation of information exchange, the transfer, acquisition, and adaptation of technologies to combat desertification. As of 1 November 2023, the Atyrau region's land fund is predominantly composed of reserve lands (7406.6 thousand hectares, representing 63.0% of the total area) and agricultural lands (3209.0 thousand hectares, accounting for 27.3% of the total land area) (Figure 1).

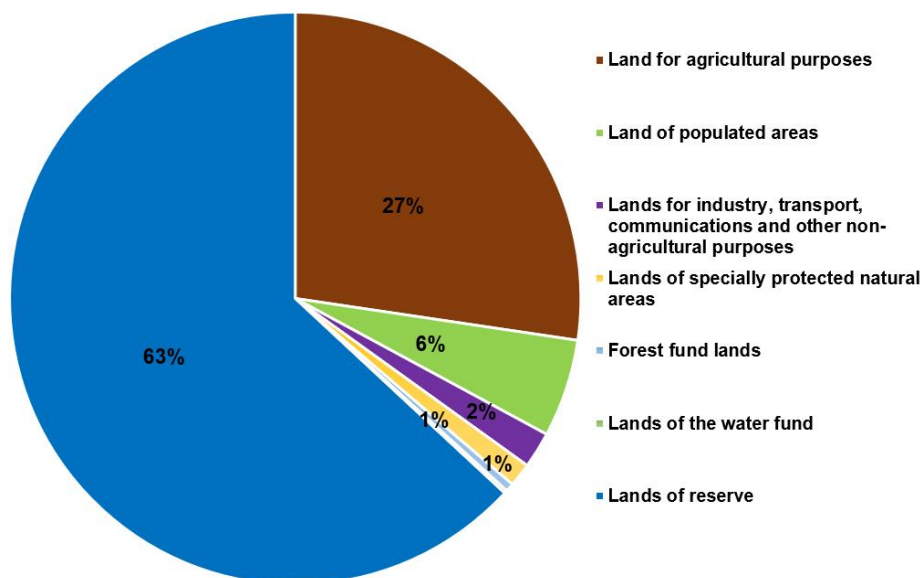


Figure 1 - Structure of the land fund of Atyrau region of the Republic of Kazakhstan, as of 1 November 2023

In the course of the reform of agricultural enterprises between 1991 and 2005, the area of agricultural land in the republic underwent a reduction of 136.2 million hectares. Subsequently, the area of land in this category in the Atyrau region exhibited an annual increase, with a total increase from 2005 to 2023 of 821.0 thousand hectares (Figure 2).

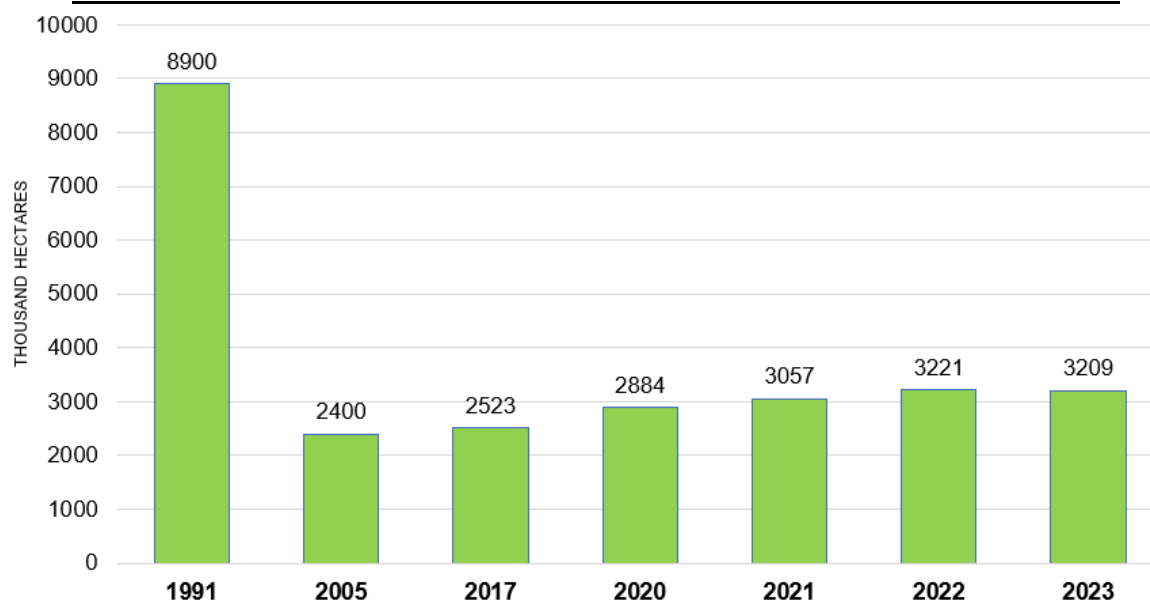


Figure 2 – Dynamics of agricultural land area in Atyrau region

Concurrently, as a consequence of the non-use of certain tracts of land for agricultural purposes and their unclaimed status within the Atyrau region, such lands were reclassified as reserve lands. The specific weight of reserve lands within the overall land fund of the Atyrau region is 58.4%.

In the Republic, up to 26.5% of pasture areas have been subjected to varying degrees of degradation for a period exceeding ten years. Nevertheless, these pastures remain in use, necessitating their exclusion from the turnover process. The general tendency towards deterioration of pastures persists, but there are also examples of successful strategies for reducing degradation. These include the return of a number of distant pasture areas to turnover and the dispersal of livestock from settlements.

Currently, a state programme has been initiated with the objective of restoring watering wells on distant pastures. This initiative involves the shared participation of land users and is designed to facilitate the organisation of pasture turnover, thereby mitigating the impacts on biodiversity. The degradation of pasture territories serves to exacerbate the effects of ongoing desertification processes, which are themselves accelerated by the observed climate change. The latter phenomenon results in warmer winters, a more uneven distribution of precipitation throughout the year, and drier summers.

The cartometric method of assessment of restoration of degraded pasture ecosystems was conducted in accordance with the methodology proposed by Professor R.A. Mirzadinov. The results of long-term field observations revealed that the daily radius of cattle driven away from a watering station or cowshed (sheep barn) does not exceed five kilometres. A radius of up to five kilometres around degradation centres encompasses 7,850 hectares under constant grazing influence. The number of



degradation hotspots is counted on the Google Earth map, and former and current cattle camps are identified.

The number of degradation hotspots was counted on the Google Earth map, and 406 former and current cattle camps were identified (Figure 3). Of these, 200 are situated on sandy massifs and 206 are located on solonchak plains, which are devoid of degradation.

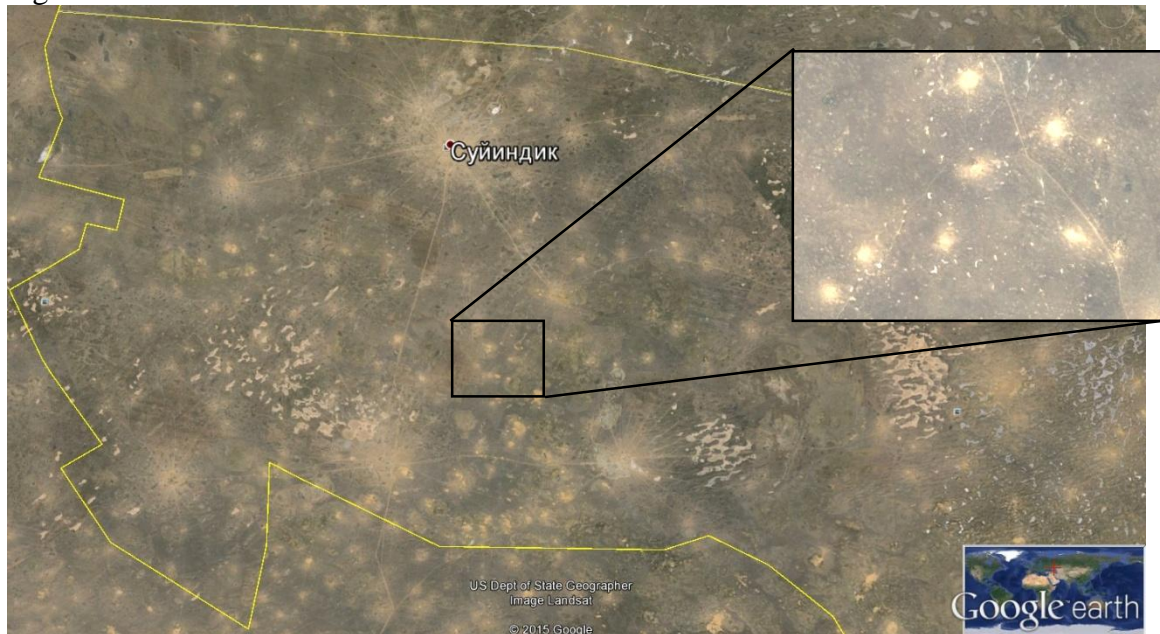


Figure 3 – Counting the number of degradation sites using the Google Earth electronic map

The degree of degradation of previously highly degraded areas, which now exhibit a medium degree of degradation, is calculated. The results of our research indicate that the identified distances of strong degradation extend from the centre up to 450 metres. However, for the purposes of calculation, we will adopt a distance of 500 metres. The medium degree of degradation rarely exceeds 700 metres from the centre; however, for the purposes of this calculation, we will take 900 metres (see Figure 4).

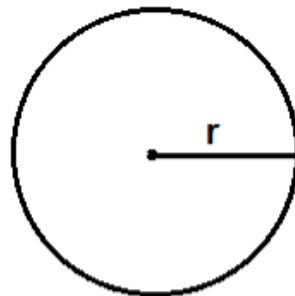


Figure 4 – Calculation of areas of degraded lands by concentric circles



Calculations are made according to the formula:

$$S = \pi R^2 \quad (1)$$

where, S - area of the degree of degradation, R - radius of the spread of the degree of degradation.

Using formula (1), we calculate the area of highly degraded lands up to 500 meters:

$$406 \text{ foci} \times 3,14 \times 0,5^2 = 318,71 \text{ km}^2 = 31871 \text{ ha}$$

Moderately degraded lands are distributed over an area of up to 900 meters:

$$406 \text{ foci} \times 3,14 \times 0,9^2 = 1032,62 \text{ км}^2 = 103262 \text{ ha}$$

In order to calculate the area of moderately degraded lands, it is necessary to subtract the area of highly degraded lands from the total area of 103,262 hectares:

$$103262 \text{ ha} - 31871 \text{ ha} = 71391 \text{ ha.}$$

Total residual degraded lands around former wintering grounds and wells:

$$31871 \text{ ha} + 71391 \text{ ha} = 103262 \text{ ha.}$$

In addition, there is still grazing and degradation of vegetation around the settlements. Briefly, the above concentric circles of degradation around one settlement can be summarised as follows:

1. In the centre a cattle rut up to 150 m in diameter.
2. Severely knocked down areas up to 900 m from 150 m.
3. Moderately disrupted areas up to 2000 m from 900 m
4. Weakly disturbed areas up to 3500 m from 2000 m.
5. Original, weakly degraded pasture up to 5000m from 3500m.

The settlements themselves have an area of at least 1 km in diameter, so let us calculate the area of the settlements using formula (1):

$$3,14 \times 1^2 = 3,14 \text{ km}^2 = 314 \text{ ha.}$$

$$\text{Slaughterhouse area: } 3,14 \times 1,15 = 4,15 \text{ km}^2 = 415 \text{ ha}$$

$$415 \text{ ha} - 314 \text{ ha} = 101 \text{ ha slaughterhouse.}$$

$$\text{Area of heavily damaged areas: } 3,14 \times 1,9^2 = 11,335 \text{ km}^2 = 1133,5 \text{ ha}$$

$$1133,5 - 415 = 718,5 \text{ ha strong degradation.}$$

$$\text{Area of averagely knocked down areas: } 3,14 \times 3^2 = 28,26 \text{ km}^2 = 2826 \text{ ha}$$



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$2826 - 1133,5 = 1692,5$  ha average degradation.

Due to the fact that weak degradation is not taken into account anywhere, we also neglect them.

According to statistical data, there are 128 settlements in Atyrau oblast, let us calculate the areas of slaughterhouses, strongly and moderately degraded areas around settlements and cities.

The area of skotosbooting:  $101 \text{ ha} \times 128 \text{ settlements} = 12928 \text{ ha}$ .

Area of severely disturbed areas:  $718.5 \text{ ha} \times 128 = 91968 \text{ ha}$ .

Area of moderately knocked down plots:  $1692.5 \times 128 = 216640 \text{ ha}$ .

Total slaughterhouse knockdown, heavily and moderately knocked down areas:

$12928 \text{ ha} + 91968 \text{ ha} + 216640 \text{ ha} = 321536 \text{ ha}$

The remaining degraded lands are summarised with the obtained degradation figures around the villages, resulting in a total of 424,798 hectares of degraded lands in the Atyrau region. This figure is comprised of 103,262 hectares and 321,536 hectares, respectively. As previously stated, a significant reduction in grazing activity has resulted in the restoration of these lands. Based on our estimates, the current extent of degraded pasturelands in the Atyrau region is below 424.8 thousand hectares..

#### *Conclusion*

The assessment of different periods of time, with varying degrees of degradation of ecosystems in the Atyrau region, including works carried out in the past decades, as well as geobotanical and cartographic materials from Kazgiprozem, has enabled us to identify with a high degree of accuracy the changes that have occurred in recent years.

The pasture ecosystems of the Atyrau region were subjected to the highest grazing loads until 1994, resulting in significant degradation and desertification. This was primarily due to the effects of overgrazing. Following the sharp decline in livestock numbers after 1993-1994, intensive restoration processes are currently underway on degraded pasture ecosystems.

The remaining degree of degradation is confined to the Naryn-Kum sands, encompassing a surface area of no more than 30%. The vegetation of the remaining territories of the Atyrau region has been restored to its original state. The calculation of residual vegetation degradation around 406 degradation hotspots in the Atyrau region revealed that 103,262 hectares of land were severely and moderately degraded. It was determined that the extent of degraded lands in the vicinity of settlements encompasses 321,536 hectares, comprising severely and moderately degraded areas. In total, the estimated extent of degraded land in the Atyrau region does not exceed 424.8 thousand hectares..

#### **REFERENCES**

[1] Makhambetov M.Zh., Mirzadinov R.A., Uteshkalieva A.M., Izimova R. Assessment condition of vegetation cover ecosystems the Atyrau region. 7th Sonference “European Applied Sciences: modern approaches in scientific researches”. Stuttgart, Germany. 2013 y., R.4-5



[2] Ustojchivoje upravlenie pastbishchnymi resursami dlya povysheniya blagosostoyaniya sel'skogo naseleniya i sohraneniya ekologicheskoy celostnostej. Proekt Pravitel'stva Respubliki Kazahstan, GEF, PROON. Almaty, 2010 g., 12 s. [in Russian].

[3] Petrov K.M. Estestvennyye processy vosstanovleniya opustoshennyh zemel'. – Sankt-Peterburg. – 1996. [in Russian].

[4] Sel'skoe, lesnoe i rybnoe hozyajstvo Kazahstana za 1991-2023 gody. Statisticheskie sborniki. Agentstvo RK po statistike. Almaty-Astana, 1992-2024. 1987 s. [in Russian].

[5] Mirzadinov R.A., Usen K., Torgaev A.A., Bajsartova A.E. Ocenka processov opustynivaniya v Kazahstane. Problemy osvoeniya pustyn', 2009, № 1-2, s. 14-17. [in Russian].

[6] Mahambetov, M.Zh. Ocenka processov vosstanovleniya degradirovannyh ekosistem Atyrauskoj oblasti / Dissertaciya na soiskanie uchenoj stepeni doktora filosofii (PhD) po special'nosti 6D060800-Ekologiya. Almaty, 2016. – S.152. [in Russian].

[7] Svodnye analiticheskie otchety o sostoyanii i ispol'zovanii zemel' Respubliki Kazahstan za 2015-2023 gody. Astana, 2016-2024 gg. S. 2287 [in Russian].

[8] Abdieva Z.B., Dyusenova G.B., Botabekova G.T. Vliyanie antropogennyh faktorov na prirodnye ekosistemy i problema opustynivaniya / degradacii zemel': Materialy Respublikanskoj nauchno-teoreticheskoy konferencii «Sejfullinskie chteniya – 9: novyj vektor razvitiya vysshego obrazovaniya i nauki» posvyashchennaya dnyu Pervogo Prezidenta Respubliki Kazahstan – 2013. – №1(2) – S.104 -105 [in Russian].

[9] Makkar, H. Animal Nutrition: Beyond Boundaries of Feed and Feeding; Food and Agriculture Organization: Rome, Italy, 2016. [Google Scholar]

[10] Feyisa, T., Dejen, M. Assessment of major livestock feed resources and feeding systems in Bench-Maji zone; South Western part of Ethiopia / Online Journal of Animal and Feed Research. Volume 7, Issue 6: 145-153; Nov 25, 2017

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### **ОЦЕНКА ПРОЦЕССОВ ДЕГРАДАЦИИ ЗЕМЕЛЬ АТЫРАУСКОЙ ОБЛАСТИ**

**Аннотация.** При оценке процессов деградации земель по Атырауской области выявлены восстановление ранее деградированных земель. С 1991 по 2023 годы в Атырауской области наблюдается улучшение экологического баланса, что можно объяснить снижением антропогенной нагрузки на ранее деградированные земли. Выявлены глубинные причины восстановления земель в регионе и приведены основные сравнительные показатели. Показана степень восстановления деградированных земель в Атырауской области.

**Ключевые слова:** антропогенная нагрузка; убой скота; экологическое равновесие; деградация; опустынивание; Атырауская область.





**Махамбетов М.Ж., Изимова Р.И.**  
**АТЫРАУ ОБЛЫСЫ ЖЕРЛЕРІНІҢ ДЕГРАДАЦИЯЛАНУ ПРОЦЕСТЕРІН**  
**БАҒАЛАУ**

**Аңдатпа.** Атырау облысындағы жердің тозу процестерін бағалау бұрын бұзылған жерлерді қалпына келтіруді анықтады. 1991 жылдан 2023 жылға дейін Атырау облысы өзінің экологиялық тепе-теңдігінің жақсарғанын көрсетті, мұны бұрын бұзылған жерлерге антропогендік жүктеменің төмендеуімен байланыстыруға болады. Өңірдегі жерді қалпына келтірудің негізгі себептері анықталып, негізгі салыстырмалы көрсеткіштер берілген. Атырау облысындағы жердің тозуын қалпына келтіру деңгейі көрсетілген.

**Кілтті сөздер:** антропогендік жүктеме; мал сою; экологиялық тепе-теңдік; деградация; шөлейттену; Атырау облысы.