this into account, secondary salinization was observed on rice fields due to poor work of collector-drainage systems.

Taking into account all these problems, that the work done in the article is very relevant and more effective.

Key words: salinity, irrigated agriculture, modeling, groundwater table, adaptive potential, ecosystems, strip cropping.

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REVIEW OF DEGRADED LANDS IN THE REPUBLIC OF KAZAKHSTAN

Abstract

Human industrial activity, mining, urbanization and underdeveloped technical infrastructure have influenced the soil cover all over the world for centuries. The article discusses the current problems of agricultural land degradation.

Emissions and wastes of industrial enterprises (metallurgy, mechanical engineering, power engineering, mining), agrochemicals (mineral and organic fertilizers, pesticides, herbicides) are the main pollutants of the atmosphere and hydrosphere, soils and plants with harmful substances in amounts exceeding sanitary and hygienic standards (MPC, ODK, DOC, etc.). Great ecological damage is also caused by motor transport, dumps and others. The importance of this problem for the production and processing of agricultural products is that the accumulation of heavy metals in cultivated crops can cause contamination of food. Therefore, protection of the environment and food chain from heavy metal contamination is an urgent environmental problem.

Keywords: *agricultural land, anthropogenic activity, disturbed land, ecological assessment, wind erosion, industrial waste, recultivation.*

Introduction

Everyone knows that the Republic of Kazakhstan ranks 9th in the world in terms of the area of its territory. The territory of our country is characterized by deserts, semi-deserts and steppes, which causes vulnerability of lands to degradation processes. Another factor influencing the aggravation of problems is anthropogenic activity throughout the country.

To date, 180 million hectares of the country's territory are subject to desertification, representing 66% of the land. Wind erosion affects 45 million hectares of land, water erosion affects 19.2 million hectares. If we add technogenic desertification caused by industrial activity, the whole problem looks quite serious.

One of the most urgent problems of our time is the problem of land degradation, or desertification. It has long been known that areas degraded by mining, industrial activities, waste storage, etc. can pose a danger to human health, flora and fauna. For this reason, they require special attention and monitoring. [1,2,3,4]

Since heavy metals enter the organism of humans and herbivorous animals mainly with plant food, and the enrichment of the latter occurs mainly from soil, soil-agrochemical studies in technogenically contaminated territories become important in places where the population feeds for many years mainly on plant products. Soils are one of the first links in the biogeochemical food chain and the initial stage of heavy metal migration in the system: soil - plant - animal - food product - human. Therefore, in ecological studies the ability of soils to inactivate mobile forms of heavy metals

and methods and techniques of regulation and control of the flow of toxicants from soil to plants is given special attention. In the era of scientific and technological progress, the negative anthropogenic impact on the environment is becoming more and more intensive and large-scale. Among the biosphere pollutants heavy metals represent a special danger because of their high ecotoxicity, cumulativity, synergism and combined action with other agents of different nature. Pollution of biosphere objects (air, water, soil) with heavy metals is the reason of their accumulation in food raw materials of plant and animal origin, in amounts sometimes exceeding sanitary and hygienic norms. [5]

The peculiarities of the environmental situation in certain regions of Kazakhstan and emerging environmental problems are conditioned by local natural conditions and the nature of the impact of industry, transportation, municipal and agricultural sectors on them.

According to the studies of Kazakhstani scientists Kerimova U.K., Tireuov K.M., Pentaev T.P. [6], land continues to be withdrawn from the balance of economic turnover every year, the level of soil fertility is falling everywhere and it is no longer a deterrent to production.

Irrational use of resources and poor management have led to a reduction in productive land, a decrease in fertility, a decrease in agricultural production and, consequently, environmental degradation. [7]

Irrational use of resources, poor management has led to a reduction in productive land, decreased fertility, reduced agricultural production and subsequently to environmental degradation.

Materials and methods.

The data for the article were based on statistical data of stock materials on land degradation and desertification in the Republic of Kazakhstan from the Agency for Statistics, the Committee on Land Resources Management, the Ministry of Agriculture of the Republic of Kazakhstan, as well as monographs, books, scientific publications of scientists. These problems are given great attention not only by the government of the country, but also by researchers.

The study is based on the principles of system approach, results of research of specialists in the field of assessment of cadastral value of land taking into account anthropogenic pollution.

In the course of writing the article various methods were applied. Economic and statistical to analyze and assess the current state of agricultural land. A summary and grouping of materials from reports and reports 2019-2021 related to the current state of land management in the RK was carried out. And also abstractly - logical to identify sectoral and regional peculiarities. The study is based on the principles of system approach and technical and economic analysis on the results of research of specialists in the field of land use in foreign countries.

Results and discussion.

Deterioration of fertility is largely due to non-compliance with the scientifically based farming system, which involves the implementation of a number of agro-measures. It is worth recognizing that today not all agricultural producers pay due attention to the protection of the fertile layer of land. The indicator of proper operation of the enterprise is stable yields.

Natural sources (factors) of land degradation are: sharp continentality of climate, natural salt reserves in alluvial plains sediments, deflation, soil erosion and mudflows, salt and dust aerosols from the dried bottom of the Aral Sea, and others.

Eroded lands constitute one of the largest ameliorative groups by area, negatively affecting the qualitative condition of lands and their productivity. [8]

The total area is 4.9 million ha (20.2 %); strongly deflated, which includes strongly deflated soils with homogeneous contours, complexes with their predominance, complexes of medium deflated soils with strongly deflated from 30 to 50 %, as well as all sands. The total area is 17.1 million ha (70.7 %).

There are 24.2 million ha or 11.3% of agricultural lands subjected to wind erosion (deflated) in the republic (Table 1).

The main areas of agricultural lands subject to wind erosion are located in Almaty region - about 5 million hectares, Atyrau and Turkestan regions - 3.1 million hectares each, Kyzylorda region - 2.8 million hectares, Zhambyl and Aktobe regions - more than 2.0 million hectares each. [9]

The largest share of eroded agricultural lands (more than 30% of their total area) is located in Almaty, Atyrau and Turkestan regions. The smallest share of eroded lands (up to 5%) in the composition of agricultural lands is in Akmola, Karaganda, Kostanay and North-Kazakhstan regions (Fig. 1).

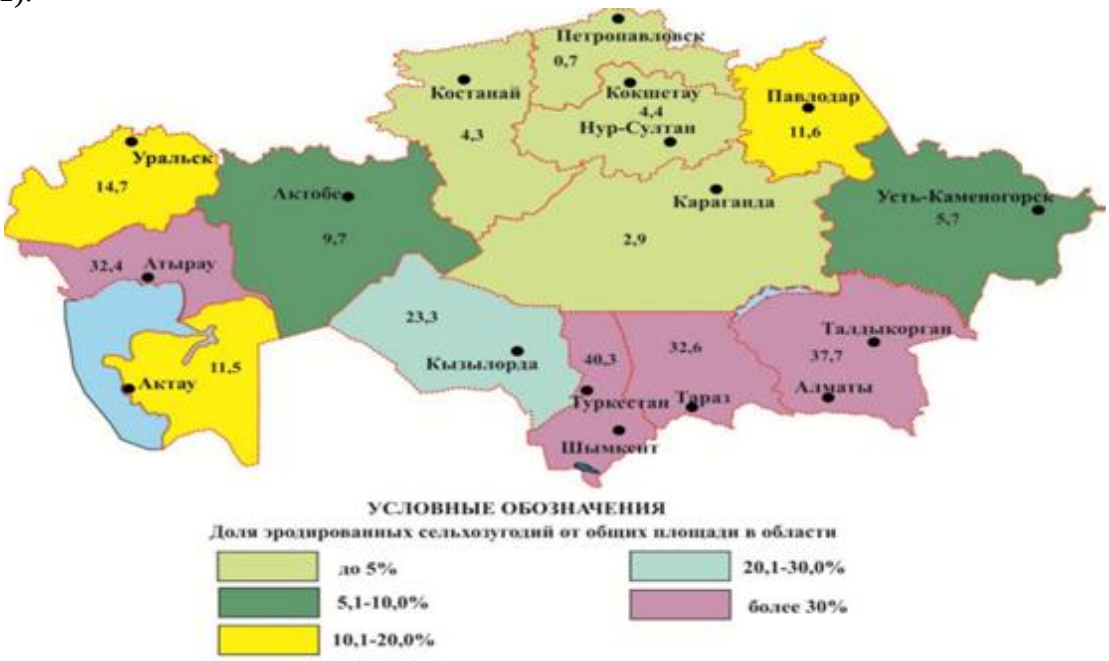

Figure 1 - Erodibility of agricultural land (2022)

The country has accumulated about 31.6 billion tons of industrial waste. About 1 billion tons are generated annually. These are mainly technogenic mineral formations (TMF), including overburden and ash and slag (70% of the total volume), waste from manufacturing industry (10% of the total volume) and other activities (20%), according to the data for 2021 of the Committee for Environmental Regulation Control of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan. [10]

Industrial sources: liquid and solid emissions from industrial enterprises and the oil and gas sector, transport emissions and radiation and chemical contamination, waste from the military and space complex, emissions of greenhouse and ozone-depleting gases, waste in areas of mining, oil and gas extraction and construction of linear and point developments not accompanied by reclamation measures.

The situation with industrial wastes, including technogenic mineral formations (hereinafter - TMF) remains extremely unsatisfactory. By the present time in the republic there are 775 objects of TMO, in which about 34 billion tons are accumulated, and there is a tendency of their annual growth. [11]

The development of the mining industry has intensified the process of land contamination with toxic substances. In Kazakhstan, according to the Ministry of Environmental Protection, as of January 2010, there are more than 43 billion tons of waste, of which about 600 million tons are toxic. This figure increases annually by 700 million tons of industrial waste, of which about 250 million tons are toxic. Significant amounts of persistent organic pollutants - chromium and heavy metals such as lead, cadmium and zinc - have accumulated on the territory of the country. About one and a half thousand tons of industrial and municipal waste per inhabitant of the country, which exceeds the level of waste accumulation in European countries. The largest specific weight has waste from mining and processing complexes in Karaganda region - 29.4%, East Kazakhstan region - 25.7%, Kostanay region - 17% and Pavlodar region - 14.6%.

Only as a result of activity of non-ferrous metallurgy enterprises waste accumulated over 22 billion tons, including about 4 billion tons of mining waste, from toxic - over 1.1 billion tons of enrichment waste and 105 million tons of metallurgical processing waste.

According to the data of the Ministry of Environmental Protection of the Republic of Kazakhstan, oil and oil products pollution is observed on the area of more than 1.5 million hectares. The major share of soil and environment pollution falls on Atyrau region - 59 %, Aktobe region - 19 %, West Kazakhstan region - 13 % and Mangistau region - 9 %. The total area of oil pollution in Western Kazakhstan is 194 thousand hectares, and the volume of spilled oil - more than 5 million tons. Thus, studies in Atyrau region showed that the highest levels of soil pollution with oil products are found near the Makat field. In heavily oiled areas the maximum content of oil products reaches 172480 mg/kg with the maximum permissible concentration (MPC) of oil in Kazakhstan 100 mg/kg. High levels of soil contamination with oil products were found near Dossor, Komsomolskoye, Tanatar, Tentexor and Iskene fields. Here MAC varies from 24 to 138.

In Kostanay region by the end of 2021, the total area taken out of turnover as a result of pollution and land disturbance is 37,773.6 hectares, including about 27 thousand hectares by mining enterprises.

Table 1 - Recultivation of disturbed lands by oblasts for 2021

Name of areas	Number of enterprises and organizations	Was at the beginning of 2021		Disturbed land
		Disturbed	Developed disturbed lands	
Akmola region	448	20374,0	7288,0	387,2
Aktobe region	115	13745,8	660,7	-
Almaty region	413	7436,0	971,0	349,0
Atyrau region	90	2242,0	59,0	-
EKR	183	12821,	4891,1	46,9
Zhambyl region	134	6205,0	1983,0	-
WKR	23	4424,0	392,0	-
Karaganda region	306	45355,0	10679,0	736,0
Kyzylorda region	32	2,7	711,0	319,0
Kostanay region	751	38298,6	13848,5	1902,7
Mangystau region	158	70477,0	9415,0	-
Pavlodar regiob	195	12146,0	1232,0	-
NKR	265	3933,0	3701,0	-
Turkestan region	73	2378,0	-	-
Shymkent city	12	357,0	-	-
Almaty city	-	-	-	-
Astana city	5	168,5	-	-
All	**2888**	**233257,8**	**52130,3**	**3740,8**

Mining industry of the region is represented by large enterprises for iron ore mining and production of iron ore pellets - JSC "Sokolovsko-Sarbayskoye Mining and Processing Production Association" in Rudnyi town and Lisakovskiy GOK - Lisakovskiy GOK, the Lisakovskiy branch of LLP "Orken". Non-ferrous metallurgy enterprises include Krasnooktyabrsk bauxite ore management of "Aluminum of Kazakhstan" JSC, "Shaimerden" JSC of Kamystinsky district (zinc, nickel), "Komarovskoye mining enterprise" LLP of Zhitikara city, "Varvarinskoye" JSC of Taranovsky district (gold, copper) and others.

On the territory of the region there are 7 large mining enterprises, whose activities are associated with land disturbance: JSC "Aluminum of Kazakhstan" - KBRU (Lisakovsk), JSC "Aluminum of Kazakhstan" - TBRU (Arkalyk), JSC "Aluminum of Kazakhstan" - TBRU (Arkalyk), JSC "Aluminum of Kazakhstan" - TBRU (Arkalyk). Arkalyk), JSC "Kostanay Minerals" (Zhitikara), JSC "Varvarinskoye" (B. Mailin district), JSC "SSGPO" (Rudnyy), Lisakovsk branch of LLP "Orken", LLP "Komarovskoye Mining Enterprise" (Zhitikara).

According to the Bureau of National Statistics of RK, in Kostanay region the number of stationary sources of pollutant emissions in 2021 amounted to 18,976 units (Table 2). [12]

Table 2 - Number of stationary sources of pollutant emissions for 2019-2021, units.

Name	2019 г.	2020 г.	2021 г.
Stationary sources of emissions	17462	17929	18976

According to the Bureau of National Statistics of the Republic of Kazakhstan, the total volume of emissions in 2021 amounted to 137.9 thousand tons.

The share of the largest mining enterprise of Kostanay region - JSC "SSGPO" accounts for about 77% of emissions from the total volume of industrial emissions. In 2021 in comparison with 2020 in connection with the increase in production volumes there was an increase in actual emissions: JSC "SSGPO" - by 1%, JSC "Kostanay Minerals" - by 4%, SCP "Kostanay Heat and Power Company" (SCP "KTEK") - by 16%. At the same time, there are enterprises in the region, which reduced in 2021 the volume of production and emissions into the environment: JSC "Varvarinskoye" - by 29%, Lisakovskiy branch of LLP "Orken" - by 13%.

According to the results of research it is seen that the average soil pH is 7.19. This indicates that the soil environment is slightly alkaline. The average humus content is 3.77%. The average content of nitrogen (total) is 0.56%.

Table 3 - Content of gross forms of heavy metals and metalloids in soil cover, mg/kg

Element	Content, mg/kg			Background content, mg/kg
	Average	Minimum	Maximum	
Ni	17,1	5,1	28,1	6,2
Cu	32,5	10,8	58,0	12,1
As	3,2	1,1	8,9	1,2
Hg	1,1	1,1	4,8	4,1
Cd	0,4	0,07	0,6	0,07
Pb	7,6	6,0	9,7	9,6
Zn	85,7	27,0	138,5	29,0

When assessing trace element composition, the gross content of elements was analyzed. Exceedance relative to MPC (EPC) was revealed for all sampling sites for arsenic, single exceedances were noted for mercury, zinc, nickel and copper. Multiplicity of exceedances over MPC (EPC) for arsenic content reaches 4.6 times; for mercury - 2.2; for zinc - 2.5; for nickel - 1.4; for copper - 1.8 times.

Conclusion

Regionally, the largest amount of disturbed lands is located in three regions, in Mangystau region - 70.5 thousand hectares and 9.4 thousand hectares have been worked out, in Karaganda region - 45.9 thousand hectares and 10.7 thousand hectares respectively and in Kostanay region - 40.1 thousand hectares and 13.8 thousand hectares respectively. In total, there are 2888 enterprises and organizations in the republic that have disturbed lands on their territory. In the reporting year, 3.7 thousand hectares were disturbed in the republic, 15.9 thousand hectares of disturbed lands were reclaimed and 61.1 hectares of disturbed lands were reclaimed. The largest area of disturbed lands in Kostanay region is 1.9 thousand ha

Detected levels of As, Cd, Zn and Pb in long-term abandoned mining areas were well above national thresholds, indicating the impending need to fully investigate and assess the suitability of the land for further agricultural use. Changes in Pb, Zn and Cd content showed a very similar pattern. The vertical distribution profiles in each sampling zone show different patterns. Heavy metal content near the tailings pond generally increases significantly with increasing soil depth.

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ОБЗОР НАРУШЕННЫХ ЗЕМЕЛЬ РЕСПУБЛИКИ КАЗАХСТАН

Аннотация

Промышленная деятельность человека, добыча полезных ископаемых, урбанизация и неразвитость технической инфраструктуры на протяжении веков оказывали влияние на почвенный покров во всем мире. В статье рассматривается актуальные проблемы деградации сельскохозяйственных земель.

Выбросы и отходы промышленных предприятий (металлургии, машиностроения, энергетики, горнорудной промышленности), агрохимикаты (минеральные и органические удобрения, пестициды, гербициды) являются основными загрязнителями атмосферы и гидросферы, почв и растений вредными веществами в количествах, превышающих санитарно-гигиенические нормативы (ПДК, ОДК, ДОК и т.д.). Большой экологический ущерб наносят также автотранспорт, свалки и прочие. Важность данной проблемы для производства и переработки сельскохозяйственной продукции заключается в том, что накопление тяжелых металлов в возделываемых культурах может стать причиной контаминации продуктов питания. Поэтому защита окружающей среды и пищевой цепи от загрязнения тяжелыми металлами является актуальной экологической проблемой.

Ключевые слова: сельскохозяйственные земли, антропогенная деятельность, нарушенные земли, экологическая оценка, ветровая эрозия, промышленные отходы, рекультивация.

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ҚАЗАҚСТАН РЕСПУБЛИКАСЫНЫҢ БҰЗЫЛҒАН ЖЕРЛЕРІН ТАЛДАУ

Аңдатпа

Адамның өндірістік қызметі, тау-кен өндірісі, урбанизация және техникалық инфрақұрылымның дамымауы ғасырлар бойы бүкіл әлемде жер жамылғысына әсер етті. Мақалада ауылшаруашылық жерлерінің деградациясының өзекті мәселелері қарастырылады.

Өнеркәсіптік кәсіпорындардың (металлургия, машина жасау, энергетика, тау-кен өнеркәсібі) шығарындылары мен қалдықтары, агрохимикаттар (минералды және органикалық тыңайтқыштар, пестицидтер, гербицидтер) атмосфера мен гидросфераның, топырақ пен өсімдіктердің негізгі ластаушылары санитариялық-гигиеналық нормативтерден (ШРК, ШРК, ДОК және т.б.) асатын мөлшерде зиянды заттар болып табылады. Автокөліктер, полигондар және басқалар да үлкен экологиялық зиян келтіреді. Ауыл шаруашылығы өнімдерін өндіру және қайта өңдеу үшін бұл проблеманың маңыздылығы-өңделген дақылдарда ауыр металдардың жиналуы азық-түліктің ластануына әкелуі мүмкін. Сондықтан қоршаған ортаны және азық-түлік тізбегін ауыр металдардың ластануынан қорғау өзекті экологиялық проблема болып табылады.

Кілт сөздер: ауылшаруашылық жерлері, антропогендік әрекеттер, бұзылған жерлер, экологиялық бағалау, жел эрозиясы, өнеркәсіптік қалдықтар, рекультивация.

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ПРИНЦИПЫ УСТОЙЧИВОГО ЗЕМЛЕПОЛЬЗОВАНИЯ СЕЛЬСКОХОЗЯЙСТВЕННЫХ ЗЕМЕЛЬ ТУРКЕСТАНСКОЙ ОБЛАСТИ

Аннотация

Целью данной статьи является детальное изучение понятий устойчивого землепользования на примере сельскохозяйственных земель Туркестанской области, проанализирован терминологический аппарат и рассмотрены принципы устойчивого землепользования. В статье анализируются факторы, влияющие на устойчивость землепользования, а также проведен анализ изменения площадей сельскохозяйственных земель с 1991 по 2021 годы, установлено, что резко сократилась их площадь, и значительно выросли площади земель запаса. Соблюдение принципов устойчивого землепользования является ключевым фактором роста конкурентоспособности сельского хозяйства. При исследовании данного вопроса использован системно-аналитический метод, позволяющий раскрыть суть устойчивого землепользования как сложной абстрактно-материальной системы, а также метод статистического анализа для наглядного представления динамики основных показателей сельского хозяйства региона и состояния сельскохозяйственного землепользования. Данная статья имеет междисциплинарный характер написана на стыке аграрной экономики и землеустройства, так как в результатах прослеживается, что эффективность устойчивого землепользования приводит к увеличению сельскохозяйственной продуктивности. Результаты – проанализированы основные концепции и принципы устойчивого землепользования, - проведен анализ динамики использования сельскохозяйственных земель Туркестанской области, а также раскрыта роль государственной поддержки в вопросах устойчивого развития АПК. Авторы приходят к выводу, осуществление устойчивого землепользования с учетом экологических факторов путем комплексного решения проблем рационального использования земель возможно через оптимизацию землепользования.