ISSN 2518-170X (Online)
ISSN 2224-5278 (Print)

ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
ҰЛТТЫҚ ҒЫЛЫМ АКАДЕМИЯСЫ
Satbayev University

Х А Б А Р Л А Р Ы

ИЗВЕСТИЯ

НАЦИОНАЛЬНОЙ АКАДЕМИИ
НАУК РЕСПУБЛИКИ
КАЗАХСТАН
Satbayev University

N E W S

OF THE ACADEMY OF SCIENCES
OF THE REPUBLIC OF
KAZAKHSTAN
Satbayev University

SERIES

OF GEOLOGY AND TECHNICAL SCIENCES

1 (457)

JANUARY – FEBRUARY 2023

THE JOURNAL WAS FOUNDED IN 1940

PUBLISHED 6 TIMES A YEAR

ALMATY, NAS RK

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«ҚР ҰҒА Хабарлары. Геология және техникалық ғылымдар сериясы».
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

Меншіктеуші: «Қазақстан Республикасының Ұлттық ғылым академиясы» РҚБ (Алматы қ.).

Қазақстан Республикасының Ақпарат және қоғамдық даму министрлігінің Ақпарат комитетінде 29.07.2020 ж. берілген **№ KZ39VPY00025420** мерзімдік басылым тіркеуіне қойылу туралы куәлік.

Тақырыптық бағыты: *геология, мұнай және газды өңдеудің химиялық технологиялары, мұнай химиясы, металдарды алу және олардың қосындыларының технологиясы.*

Мерзімділігі: жылына 6 рет.

Тиражы: 300 дана.

Редакцияның мекен-жайы: 050010, Алматы қ., Шевченко көш., 28, 219 бөл., тел.: 272-13-19

http://www.geolog-technical.kz/index.php/en/

Типографияның мекен-жайы: «Аруна» ЖК, Алматы қ., Мұратбаев көш., 75.

«Известия НАН РК. Серия геологии и технических наук».
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

Собственник: Республиканское общественное объединение «Национальная академия наук Республики Казахстан» (г. Алматы).

Свидетельство о постановке на учет периодического печатного издания в Комитете информации Министерства информации и общественного развития Республики Казахстан **№ KZ39VPY00025420,** выданное 29.07.2020 г.

Тематическая направленность: *геология, химические технологии переработки нефти и газа, нефтехимия, технологии извлечения металлов и их соеденений.*

Периодичность: 6 раз в год.

Тираж: 300 экземпляров.

Адрес редакции: 050010, г. Алматы, ул. Шевченко, 28, оф. 219, тел.: 272-13-19

http://www.geolog-technical.kz/index.php/en/

Адрес типографии: ИП «Аруна», г. Алматы, ул. Муратбаева, 75.

News of the National Academy of Sciences of the Republic of Kazakhstan. Series of geology and technology sciences.
ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)
Owner: RPA «National Academy of Sciences of the Republic of Kazakhstan» (Almaty).
The certificate of registration of a periodical printed publication in the Committee of information of the Ministry of Information and Social Development of the Republic of Kazakhstan **No. KZ39VPY00025420,** issued 29.07.2020.
Thematic scope: *geology, chemical technologies for oil and gas processing, petrochemistry, technologies for extracting metals and their connections.*
Periodicity: 6 times a year.
Circulation: 300 copies.
Editorial address: 28, Shevchenko str., of. 219, Almaty, 050010, tel. 272-13-19
http://www.geolog-technical.kz/index.php/en/

Address of printing house: ST «Aruna», 75, Muratbayev str, Almaty.

NEWS of the National Academy of Sciences of the Republic of Kazakhstan
SERIES OF GEOLOGY AND TECHNICAL SCIENCES
ISSN 2224-5278
Volume 1, Number 457 (2023), 189-201
https://doi.org/10.32014/2023.2518-170X.269

UDC 68.31.26

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ECOLOGICAL AND MELIORATIVE SUBSTANTIATION OF GRAY-EARTH-MEADOW SALINE SOILS OF ZHAMBYL REGION

Abstract. The main topic and object of research are gray-earth-meadow saline irrigated lands of the Zhambyl region, which, due to high natural salinity, are characterized by unsatisfactory ecological and reclamation conditions. The main purpose of the research is the ecological and meliorative substantiation of the water-salt regime of saline soils in irrigation systems of the Zhambyl region. The paper considers the reclamation and ecological justification of the water-salt regimes of saline soils, which, to restore their fertility and improve the ecological and meliorative state of irrigated lands, need to carry out comprehensive reclamation. Based on the conducted studies of soil and ecological-reclamation conditions of gray-meadow soils characterized by a high degree of salinity and insufficient moisture supply, the rationale for regulating the water and salt regime of the root layer, taking into account the distribution of precipitation, the supply of irrigation and drainage water to improve soil formation processes, was carried out. The obtained research results made it possible to develop methods for determining the reserves of surface and groundwater salts, and evaporation from the groundwater surface by the studied objects, which can be used to develop technologies for restoring and normalizing the soil-ecological state of irrigated lands to increase the productivity of agricultural land.

Key words: Evaporation, salt transfer, hydrochemistry, washing norms, ecological coefficients.

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ЖАМБЫЛ ОБЛЫСЫНДАҒЫ СОРТАҢДАНҒАН СҰР-ШАЛҒЫНДЫҚ ТОПЫРАҚТАРДЫ ЭКОЛОГИЯЛЫҚ- МЕЛИОРАТИВТІК НЕГІЗДЕУ

Аннотация. Негізгі тақырыбы мен зерттеу объектісі – Жамбыл облысының сұр-шалғынды сортаңды суармалы жерлері табиғи тұздылығы жоғары болғандықтан экологиялық-мелиоративтік жағдайы қанағаттанарлықсыз болып сипатталады. Зерттеудің негізгі мақсаты – Жамбыл облысының суландыру жүйелеріндегі сортаң топырақтардың су-тұз режимін экологиялық-мелиоративтік негіздеу. Жұмыста олардың құнарлылығын қалпына келтіру және суармалы жерлердің экологиялық-мелиоративтік жағдайын жақсарту үшін кешенді мелиорацияны қажет ететін сортаң топырақтардың су-тұзды режимдерінің мелиоративтік-экологиялық негіздемесі қарастырылған. Тұзданудың жоғары дәрежесімен және жеткіліксіз ылғалмен қамтамасыз етілмеуімен сипатталатын шалғынды-топырақтардың топырақ-экологиялық-мелиоративтік жағдайларын жүргізілген зерттеулердің негізінде түбірлік қабаттың су-тұз режимін реттеуге негіздеме жасалды. атмосфералық жауын-шашынның таралуын, топырақ түзуші процестерді жақсарту үшін суару және дренаждық суларды жеткізуді есепке алу. Зерттеудің алынған нәтижелері зерттелетін объектілер үшін жер үсті және жер асты суларының тұздарының қорын, жер асты суларының бетінен булануды анықтау әдістерін жасауға мүмкіндік берді, оларды қалпына келтіру және қалыпқа келтіру технологияларын әзірлеу үшін пайдалануға болады. ауыл шаруашылығы жерлерінің өнімділігін арттыру үшін суармалы жерлердің топырақ-экологиялық жағдайы.

Түйінді сөздер: булану, тұз алмасу, гидрохимия, шаю жылдамдығы, экологиялық коэффициенттер.

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ЭКОЛОГО-МЕЛИОРАТИВНОЕ ОБОСНОВАНИЕ СЕРОЗЕМНО-ЛУГОВЫХ ЗАСОЛЕННЫХ ПОЧВ ЖАМБЫЛСКОЙ ОБЛАСТИ

Аннотация. Главной темой и объектом исследований являются сероземно-луговые засоленные орошаемые земли Жамбылской области, которые вследствие высокой природной засоленности характеризуются неудовлетворительным эколого-мелиоративным состоянием. Основная цель исследований заключается в эколого-мелиоративном обосновании водно-солевого режима засоленных почв на оросительных системах Жамбылской области. В работе рассмотрено мелиоративно-экологическое обоснование водно-солевого режимов засоленных почв, которые для восстановления их плодородия и улучшения эколого-мелиоративного состояния орошаемых земель нуждаются в проведении комплесных мелиораций. На основе проведенных исследований почвенных и эколого-мелиоративных условий сероземно-луговых почв, характеризующихся высокой степенью засоленности и недостаточной влагообеспеченностью, выполнено обоснование регулирования водного и солевого режима корнеобитаемого слоя с учетом распределения атмосферных осадков, подачи оросительных и дренажных вод для улучшения почвообразовательных процессов. Полученные результаты исследований позволили разработать методы определения запасов солей поверхностных и грунтовых вод, испарения с поверхности грунтовых вод по исследуемым обьектам, которые могут быть использованы для разработки технологий по восстановлению и нормализации почвенно-экологического состояния орошаемых земель для повышения продуктивности сельскохозяйственных угодий.

Ключевые слова: испаряемость, перенос солей, гидрохимия, промывные нормы, экологические коэффициенты.

Introduction. The effectiveness of the reclamation use of sierozem-meadow soils in the Zhambyl region of Kazakhstan is associated with serious changes in soil-forming and natural processes on irrigated and adjacent lands, which do not allow for obtaining guaranteed crop yields. At present, a significant part of the irrigated lands in this region is in an unsatisfactory ecological and reclamation state due to the high degree of salinization of the soil cover, aeration zone, groundwater, poor natural drainage, and irrational use of water and land resources and the lack of strategic and tactical solutions for the development of reclamation in Zhambyl region.

To manage the reclamation regime on irrigated lands, a complex of reclamation measures is needed to ensure high yields of crops of good quality at the lowest cost of water, labor, and material resources per unit of production and to maintain a stable favorable reclamation state of irrigated lands and adjacent territories. To find out the reasons for the unfavorable reclamation state of lands and a reasonable choice of measures to improve it, a systematic approach is required for reclamation and operational indicators. These include the ratio of the values of evaporation and drainage flow to water intake and water supply, the values of the system efficiency, coefficients for the use of water resources, water consumption of agricultural crops, and others. The main criteria that characterize the reclamation state of irrigated lands and integrally reflect the course of the reclamation process in the irrigated area are the regime of levels and mineralization of groundwater, the degree, and type of soil salinity, and crop yields (Adilbektegi and et al, 2019).

One of the criteria that increase the level of agricultural technology is the agrotechnical system of tillage. It should be at a particularly high level, as it is the main condition for obtaining high yields of irrigated crops and serves as one of the main means of increasing the fertility and quality of irrigated lands, the expedient and efficient use of water supplied for irrigation.

In the system of processing saline soils, deep (by 0.25 ... 0.35 m) autumn plowing is of particular importance, which helps to increase the water permeability of the soil and disrupt the capillary connection of the upper arable soil layer, since the delay leads to a sharp drying of the upper soil horizons, their strong compaction, restoration of capillary pathways for groundwater rise and, ultimately, salt accumulation. However, plowing saline soils during the spring period is not allowed (Averyanov, 1978).

When regulating the water regime of the soil, the thickness of the moistened soil layer is important, which is not constant during the growing season and increases as the root system of plants develop in depth. In this regard, the calculated moistened layer under sugar beet, alfalfa, and spring crops in May and the first half of June on thick gray soils should be taken no more than 0.5 ... 0.6 m (Bresler and et al, 1987). On powerful gray soils and meadow soils with deep groundwater, it is limited to a layer below which soil moisture is maintained at the level of its lowest moisture capacity by capillary recharge from groundwater and is taken equal to when groundwater occurs 2 ... 3m - 0.8. ..1.0 m, at 1...2 m - 0.7...0.8 m (Deng and et all, 2015).

Material and research methods. The Zhambyl region in terms of natural and climatic terms is located in the desert zone of the temperate zone. This zone occupies the largest part of the flat territory of the republic, located south of the semi-deserts and piedmont sloping plains of mountain systems (Duan and et all, 2015). The zone as a whole is characterized by a very low amount of atmospheric precipitation, a large amount of evaporation, and significant daily and annual fluctuations in air and soil temperatures, which leads to a sharp continentality and aridity of the climate. The main characteristic feature of the desert climate is aridity, which directly defines the boundaries of the desert zone and creates the originality of its landscapes (Elimelech and et all, 2011). The annual amount of precipitation is not more than 250 mm, and in many areas, the amount varies from 100 to 200 mm.

Summer is characterized by very high temperatures. The average July temperature ranges from 23...250 in the north to 300 in the south of the zone (Kireycheva and et all, 2017). Summer weather is characterized by great stability, frequency of occurrence of atmospheric droughts, and large daily amplitudes of air and soil temperatures (Zhaparkulova and et all, 2021). The duration of the summer period is on average 150-170 days, during which only 20 ... 25% of the total negligible annual precipitation falls (Kulagin and et all 2019).

However, when irrigated, desert soils can produce high yields of a variety of crops. Agricultural plants grown on desert irrigated soils contain more trace elements and various useful salts than on lands in a humid climate (Howard and et all, 2009).

Field studies necessary for the development of methods for predicting the water-salt regime of reclaimed lands were carried out on experimental plots characterizing five groups of soils in the lower reaches of the Talas River, Kokozek LLP, Bayzak district, Zhambyl region, in terms of mechanical composition and filtration capacity. The total area of the experimental plot was 20 ha (Kulagin and et all 2019).

For ecological and reclamation substantiation of the water-salt regime of saline sierozem-brown soils, leaching against the background of horizontal drainage is envisaged. To assess the operation of the existing horizontal drainage and subsequent feasibility studies on the development of technology and the justification of land reclamation measures that ensure the optimal water-salt regime of the calculated layer (0 ... 1.0 m) of the soil, it is necessary to sequentially calculate the following (Kharchenko and et all, 1977):

– admissible depth of ground waters depending on the salinity of ground and irrigation waters, admissible increase in salinity of 0...1.0 m of the soil layer during the growing season, irrigation rate, and total evaporation.

To restore soil properties, an adaptive complex of reclamation measures is required, that is, a complex adapted to natural conditions and ensuring the functional stability of the soil cover. This complex is aimed at the formation of an optimal reclamation regime. At present, the main limits for regulating the components of the reclamation regime and measures have been developed to ensure the creation of an optimal reclamation regime on reclaimed lands, and a favorable environmental situation within the agro landscape (Mueller and et all, 2014).

Soil pollution during salinization occurs mainly as a result of anthropogenic human activities, with improper work on land improvement, and agrotechnical environmental measures. This occurs as a result of ignoring the laws governing the natural balance and evolution of soils, as well as hydrogeological, hydrochemical, and geochemical changes during environmental and reclamation work (Nippert and et all, 2010).

Based on the studied data on soil-ecological conditions for seorozem-meadow and dark chestnut carbonate, as well as insufficient moisture supply in the presence of high thermal resources, which requires the need to regulate the water regime of the root layer in the studied years in terms of the distribution of precipitation, the supply of surface and discharge sources according to the parameters of the ecosystem (Jamil and et all, 2011).

The main methods of regulating the hydrochemical regime are the impact on the level of groundwater by various measures (irrigation, washing, loosening of soil against the background of drainage). The formation of water-salt, thermal, and food regimes in the calculated soil layer is directly affected by water-physical and Physico-chemical processes. This is because as a result of irrigation and flushing with the use of drainage, the conditions for the formation of incoming and outgoing elements of the water-salt balance, salt reserves, infiltration rate, changes in the movement of moisture, evaporation, the outflow of groundwater and others change dramatically (Veselov and et all, 2004). The use of a complex of environmental and reclamation measures made it possible to displace leached toxic salts from the calculated salt.

When studying the mechanism of salt transfer, proper regulation of water-salt and food regimes, it is necessary to determine the following values - the dissolution of salts, leaching of rocks, evaporation of soils and groundwater, convective diffusion, transfer of salts with filtration flow, ion-salt balance in the system solution - solid phase, displacement of pore solutions, etc (Ibrahimi and et all, 2014).

The main parameters of systematic horizontal drainage are the distances between drains, the position of the groundwater level (GWL) after drainage, the head between the drains, and the inflow of groundwater to the drain and collector. The inflow and outflow of water to the drain from both sides are determined by the formula.

$$Q_0 = 4kh^2 l / R \qquad (1)$$

where, Q – water flow to the drain, m^3; k filtration coefficient, m/day; h is the pressure of groundwater between drains, m; l - drain length, m; t is the duration of flushing, days; R is the distance between drains, m.

The flow of water to the drain per hectare per unit of time is determined by the following expression:

$$q_0 = \frac{Q_0}{t} \qquad (2)$$

where q_0 – module of drainage runoff at a given pressure of groundwater, m3/ha.

Then, with a known value of the actual speed of water movement Vf of the soil, drainage runoff and based on a system analysis of the water-physical and chemical properties of the study area and environmental coefficients characterizing the level of danger in the calculated soil layer, it is possible to determine the net leaching rates of saline soils using the following formula:

$$N_{nm} = \frac{Q_0 V_\phi}{q_0} \, .Э_к \, , \qquad (3)$$

where N_{nm} – water supply (net), m^3/ha; Vph – filtration rate in saturated layers, m/day. Ec-Environmental coefficient.

The physical substantiation of the proposed system of basic indicators in assessing the ecological state of the soil based on the violation of physical functions is determined. Primarily topics that the classical ideas about soil as a dispersed porous system with a developed structure and pore space are fundamental for assessing the physical state of the soil (Adilbektegi and et all, 2019).

1. Hydrothermal regime (Ruan and et all, 2008). Reflecting heat and moisture supply of territories. in a generalized form it is characterized by a "dryness index":

$$\overline{R} = Ro / L * Oc \quad (4)$$

where R_o – radiation balance of natural conditions, kcal/cm^2.

The advantage of this indicator over others (Ku. GTK. BKP) is obvious: firstly, it characterizes the conditions of heat and moisture supply of plants, those biological processes. Secondly, determines to a large extent the conditions for the formation of soil, hydrogeological and geochemical conditions and, thirdly, allows you to take into account the nature of the intensity of anthropogenic activities (irrigation regime, patterns of land use, etc.). [3-8,9-12]:

$$\overline{R}y = Ry / L * (Oc + Op), \quad (5)$$

where Ry – radiation balance when upgraded;

$$Ry = Ro(1 - A_1)/(1 - A). \quad (6)$$

where A_1 and A – albedo. depending on the structure of use and the degree of moisture of irrigated lands; O_r - irrigation norm - net (mm).

Results. Energy spent on soil formation (Table 1):

$$Q_n = R / e^{-\alpha \overline{R}} \quad (7)$$

where Q – energy. spent on soil formation. kcal/cm2. α is the coefficient. taking into account the condition of the soil surface.

Table 1. Determination of the cost of solar energy for soil formation

Agricultural crops	Σ t.^{o}C>10^{x}C	$R_{ФАР}$. kDj/sm^2	Irrigation norms. Or.mm	Precipitation Oc. mm;	Or+Os.mm	R=R/$_{OC}$	R=R/($_{OC+OP}$)	heat flow Q_{Ti} kDj/sm^2	Moisture Exchange (Auto).g_a	Moisture exchange (Hydro).g_r
Alfalfa	3000	158	750	210	960	3.0	0.66	37	0.52	0.48
Winter wheat	1320	102	350	160	510	2.6	0.80	17.5	0.45	0.40
Corn for grain	2800	151	420	240	660	2.52	0.92	56	0.40	0.34
Sugar beet	2900	153	710	220	930	2.82	0.67	35.5	0.51	0.46
Vegetables	2200	132	460	200	680	2.64	0.78	23.7	0.46	0.41

Intensity of moisture exchange between soil and ground waters:

$$\bar{g} = g/(Oc + Op) = \exp(-1.5 * \bar{R}). \quad (8)$$

The main indicators and models for assessing the biological cycle on irrigated lands are for soil:

- hydrothermal regime radiation "dryness index"

$$R = R / L(Oc + Op + W + g). \quad (9)$$

including water (Oc. Op. W. g values) and thermal (R) regimes;

- energy. spent on soil formation (Q). which is directly related to the hydrothermal regime (R) and the nature of the use of irrigated lands (Or); change in the balance of humus; salt regime and balance of the root-inhabited soil layer based on balance and differential equations of salt movement and ion-exchange sorption of cations; change in the nutrient regime in soils based on the intrazonal distribution of the agrochemical properties of soils depending on the hydrothermal regime (R). for plants (Nippert and et all, 2010):

- The biological productivity of soils, which, at optimal values of the nutrient and salt regimes, is associated with the hydrothermal regime and the structure of the use of irrigated lands (Kharchenko and et all, 1977);

Currently when irrigation becomes massive a number of fundamentally new questions arise. Including ecological and biological character, in this case, one of the main tasks is the assessment of possible changes in the hydrothermal regime. The solution of which requires the development of the theory of modern soil:

-forming processes in new anthropogenic conditions. When one of the main conditions of the soil-forming process fundamentally changes (Kulagin and et all 2019).

- the mode of entry and the amount of moisture entering the soil surface and into the soil.

To assess the role of climate in soil formation, the most suitable indicator is the hydrothermal regime. Reflecting the ratio of heat and moisture in natural conditions:

$$\bar{R} = \frac{R}{LO_C} \quad \text{for automorphic conditions,} \quad (10)$$

$$\bar{R} = \frac{R}{L(O_C + E_z)} \quad \text{for hydromorphic conditions,} \quad (11)$$

where: $\bar{R}$ - indicator of the hydrothermal regime; R is the radiation balance. kJ/cm^2 per year; O_s - the amount of precipitation. cm; Eg - evaporation from the surface of groundwater. cm; L is the latent heat of vaporization. kJ/cm^3 per year.

The choice of this indicator is due to the fact. that it determines the balance of surface and soil waters and soil formation conditions. Under natural conditions, the main items in the balance of surface and ground waters are evaporation (E) and moisture exchange between soil and ground waters (g). Surface runoff at is absent.

Values of water exchange between soil and ground waters. as well as evaporation are determined depending on $\bar{R} > 2\bar{R}$:

$g_a = \exp(-\bar{R}),$ (12)

$g_г = g_a - \bar{R}(1-\bar{\Delta})^{1.5},$ (13)

E = 1 – g, (14)

where: g_a и $g_г$ – moisture exchange in automorphic and hydromorphic conditions. share of precipitation;

E – evaporation. share of precipitation; $\bar{\Delta} = \Delta/\Delta_0$;

Δ – depth of groundwater, m;

Δ_0 - groundwater depth. at which evaporation from their surface is 0. m. The results of solar energy consumption for soil formation are given in Table 3.

An analysis of the available data shows. that salinization of arid soils under natural conditions is observed under the following conditions:

$$g \leq \frac{1}{\Delta} ln \frac{C_2}{C_1}$$ (15)

where: C1 - allowable mineralization of the soil solution. g/l; C2 - mineralization of groundwater (under hydromorphic conditions) or mineralization of soil solution at the depth of seasonal soil wetting (under automorphic conditions) g/l.

The permissible depth of groundwater levels on lands prone to salinization, in the presence of mineralized groundwater and irrigation water, depends on the combined action of factors, which include: the type of soil salinity, the type, and mineralization of groundwater and irrigation water, the permissible increase in salinity of the top meter soil layer for the growing season (Wichelns and et all, 2015).

Calculations made to assess the main characteristics and indicators of the ecological and reclamation state of soils in the Talas irrigation array of the Zhambyl region are shown in Table 2.

Table 2. Permissible groundwater depth

Soil composition	Soil layer. m	Soil density, γ.t/m^3	Salt content. $S_н$. %	Mineralization of irrigation water. M_{pol} .g/l	Mineralization of ground water. $M_{гр}$ .g/l	Irrigation rate. O_{gr} gross m^3/ha	Total evaporation for vegetation. $I_{0.}$ m^3/ha	Height of capillary rise. H_k .m.	Permissible groundwater depth lewel. S_{add} .m
Light loam	0.5	1.30	0.35	0.7	2	5000	2000	2	0.23
Medium loam	1	1.45	0.5	3	4	6000	1500	2.5	0.68
Loamy	1	1.47	0.8	4	5	8000	1500	3	1.28
Clay	1	1.53	1.0	5	6	9000	1500	3.2	2.24

Establishing the ability of soils to retain water available to plants depends on certain properties of the soil. Any additional water in the form of precipitation or irrigation. groundwater level rise (GWL) exceeding this value is excessive and can disrupt the hydrological balance of soils. Depending on the permeability of soils, relief, lithology, and hydrography, excess water can infiltrate into groundwater, turn into waterlogging of the area, which will affect the natural landscape, the environment, ecological and economic activities, as well as soil fertility, that is, it is a factor pollution (Kulagin and et all 2019). Analyzing the obtained calculations given in tabular form show the quantitative assessment of the environmental situation of the studied objects: the level of danger (very dangerous-EC=0.70-0.80).

Ecological assessment of the study of the site according to the degree of salinity of soils for various irrigation tenologies, the indicators are given in tabular form (Table 2).

Table 3. Ecological assessment of the study of the site according to the degree of salinity

Indicators	Experimental area irrigation technology			
	By furrows	By stripes	By loosening	Calculation formulas
	highly saline	highly saline	highly saline	
Area, ω_{nt}, ha	46	44	48	By measurement
Porosity, in shares	0.46	0.47	0.46	P=(1- γ/ d).100%, (16)
Initial mineralization, C0, g/l	5	6	7	By experience
Soil density, γ, t/m^3	1.46	1.44	1.46	By experience
Initial salinity, S0, %	1.4	1.7	1.9	Accounting
Total salt reserves, Sb, t/ha	204	245	277	$S_{об}$=100. H. γ . S_0 (17)
Displaced salts, Sw, t/ha	163	201	249	$S_в$= $S_{об}$.(0.5-0.8), (18)
Remaining salts, Sos, t/ha.	41	44	28	S_{oc}= $S_{об}$- $S_в$, (19)
Groundwater level (GWL), h_{gw}, m	3	3	3	
Water volume up to GWL, W_{gw}, m^3/ha	13800	14100	13800	W_{gw}=10^4.П .h_{gwl}, (20)
Water flow to the drain, Q_0, m^3	16.8	22.9	35.3	Q_0=4.K.h^2.L.t/R ,(21)
Water inflow to the drain, q_0, m^3/day	0.3	0.43	0.77	q_0= Q_0/ t, (22)
Flushing rate, net, N_{nt}, m^3/ha	7000	7456	6877	$N_{нт}$= Q_0.ϑ/ q_0 , (23)
Flushing rate, gross, N_{br}, m^3/ha	8400	8947	8252	$N_{бр}$ = $N_{нт}$.(1.15-1.20) , (24)
Salt reserves in GW, Sgw, kg/ha	69000	84600	96600	$S_{угв}$= $W_{угв}$. C_0, (25)
Permissible mineralization in soil solution Cd, g/l	4.95	5.58	5.65	$C_д$=$S_{угв}$+S_{oc}/ $W_{угв}$ +$N_{бр}$, (26)
Water inflow from channels Q, m^3/s	0.1	0.1	0.1	Accounting
Washing time, t, days	56	53	46	t=N_{nt}.ω_{nt}/86400.η.Q, (27)
The share of the volume of transit waters discharged into the river during the flushing process Vt	0,82	0,82	0,82	$V_т$= N_{nt}*ω_{nt}/86400* Q.t,(28)
Precipitation of the leaching period P, m^3/ha	427	420	100	weather station
The lowest moisture capacity of the soil, βmc,%	22	24	22	By analysis
Moisture saturation in the dissolved layer, Wн, m^3/ha	3212	3456	3212	$W_н$=100. H. γ. $\beta_{нв}$, (29)

Filtration rate in saturated layers, ϑ, m/day	0.0125	0.014	0.015	ϑ=h.γ. $\beta_{нв}$ / 100.n. t, (30)
Evaporation during flushing, E_0, m^3/ha	1300	1300	1100	E_0=0.0018(25+ t)^2. (100-a), (31)
The share of the volume of wash water coming from the CDS:	0.35	0.35	0.32	$q_к=(N_{nt}+ P - W_н- E_0) / N_{br}$, (32)
Salinity chemistry: chloride-sulfate (x-s)	x-c	x-c	x-c	
Environmental factor:	0.76	0.80	0.77	$Э_к$= 1-exp (- $C_д$.$V_т$.q_k), (33)
Environmental hazard level	Very dangerous	Very dangerous	Very dangerous	

Changes in the water-salt regime of the soil under the influence of reclamation treatments led to a change in the composition of absorbed bases, in particular, exchangeable sodium. Against the non-moldboard background, the changes were not significant (0.8%), more significant changes were observed in plantation plowing (7.1%) (Ruan and et all, 2008). However, it should be noted that an extremely unfavorable picture developed in the first year of development due to the removal of the lower horizons enriched in sodium to the soil surface. But over time, the negative phenomenon has sharply decreased.

Conclusions and discussion. The need to study the groundwater regime under irrigation and flushing conditions is related to the position of these waters relative to the earth's surface, which contributes to the formation of saline soils (Kharchenko and et all, 1977). Based on many years of field research on the study of soil and ecological conditions of sierozem-meadow saline soils for the effective use of water resources in irrigated zones, methods have been developed to improve the ecological and reclamation conditions against the background of deep loosening, and methods have been recommended for determining the reserves of salts from evaporation from the surface of groundwater.

The research was carried out on sierozem-meadow soils, where there is an effusion type of water regime, which is created on lands where the annual evaporation significantly exceeds the annual amount of precipitation and there is a close occurrence of the groundwater level (Kulagin and et all 2019). Therefore, groundwater rises to the surface and partially evaporates. If the groundwater is saline, then salinization of the soil layer inevitably occurs with the salts contained in the groundwater. In the course of the studies, the reserves of salts in the soil and the amount of evaporation from the surface of groundwater were determined depending on the depth of groundwater. In this case, the water-physical properties of the soil group and, accordingly, the salt content and mineralization of groundwater were taken into account.

The studies carried out and the results obtained are the scientific basis for the environmental regulation of sierozem-meadow soils with chloride-sulfate salinity for the conditions of the Talas irrigation massif, which allow, on the principles of mathematical modeling, to provide the required parameters of the reclamation regime of soils and increase the environmental sustainability of agro landscapes in the Zhambyl region.

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ISSN 2518-170X (Online),
ISSN 2224-5278 (Print)

Заместитель директор отдела издания научных журналов НАН РК *Р. Жәлиқызы*
Редакторы: *М.С. Ахметова, Д.С. Аленов*
Верстка на компьютере *Г.Д.Жадыранова*

Подписано в печать 18.02.2023.
Формат 70x$90^{1}/_{16}$. Бумага офсетная. Печать – ризограф.
20,0 п.л. Тираж 300. Заказ 1.

Национальная академия наук РК
050010, Алматы, ул. Шевченко, 28, т. 272-13-19