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Integrated assessment of the geoecological situations of the Nura river basin

Extensive farming in the basin of the Nura river led to widespread degradation of soils of agricultural lands and a significant decrease in their potential fertility. One of the main ones is the activation of soil erosion in anthropogenically transformed geosystems by flushing and deflation processes or complete erosion of soils by linear erosion. A significant part of agricultural land in the Nura River basin is represented by soils that are estimated as erosion-deflation. In this connection, the authors analyze the current component indicators of the geoecological situation in the Nura basin, which allows us to systematize the criteria for its assessment in dependence on the severity of environmental degradation. Based on the analysis of the quality of surface water and the theoretical regularities of the region, the authors identify geoecological areas for the given territory.

Keywords: destabilization, anthropogenic pollution, geo-ecological situation, degradation, soil erosion, anthropogenically transformed geosystems, ecotone structure, tense situation, critical situation, transport and settlement impact, transformation of geosystems, anthropogenic disturbance, deflation, artificial landscape, soil diffusion.

Cartography of the geoecological situation is always complicated not by the sufficient development of the system of ecological monitoring and by the availability of fragmentary data on the state of specific territories. For example, according to this regional city hall, the group with particularly unfavorable environmental conditions for the person included 20 % of the populated territory of the region. The entire other part of the territory is characterized as having normal ecological conditions. According to our data, up to 65 % of the territory of the region is characterized by a high degree of inferior geoecological situation. It is established that the study area is characterized by a mismatch between the organization of the natural and economic infrastructure to the requirements of the scientifically-grounded system of rational land use, and the specific features of local geosystems. There are many examples of inconsistency of the organization of agrogeosystems to the contours of natural complexes, which is accompanied by the destabilization of the geoecological stability of the natural framework of the territory and the development of a number of negative physical and geographic processes (exacerbation of the earthquake, erosion, desiccation, desertification, seizure) [1]. Extensive farming in the Nura River basin has led to widespread depletion of soils of agricultural lands and a significant decrease in their potential fertility. One of the main ones is the activation of soil erosion in anthropogenically transformed geosystems by flushing and deflation processes or complete erosion of soils by linear erosion. A significant part of agricultural land is represented by soils that are assessed as exerosion-deflation. More than 45 % of the soils are poorly and mildly non-humid in the hill areas, the degradation of the humus layer as a result of deflation is 3–6 cm for 10 years. The intensification of erosion processes is caused by a decrease in the protective functions of natural vegetation and the erosion resistance of soils subjected to long-term economic impacts.

A significant amount of information on the state of agricultural land and the development of erosion was obtained during the analysis of satellite images from Landaft satellite in 2008. A feature of the manifestation of a cosmic image of erosion processes is the variability of brightness characteristics in different areas of the image, which arises as a result of reaching the surface of deeper horizons Soil, diffusion of arable and subsoil layers, as well as enhancement of the biomass of vegetation on erosion sites, which is associated with the erosion of fertile soil In places of movement of water streams. In the process of deciphering the localities subjected to linear erosion, an important role was played by the characteristic form of imaging. Investigations and analysis of the basic regularities of deciphering the quality of lands by space images have shown that it is clearly defined on the basis of the change in the photon, texture, shape and size of the soil. In areas subject to water erosion, a consequent change in the image pattern is observed, which in turn allows us to subdivide geosystems into categories of erosion free, potentially erosion-hazardous and eroded. The ratio of the following areas was taken into following ones while mapping geoecological situation and determining the degree of severity of its destabilization on the territory of each geoecological area: a) industrial-technological industrial zone with fragments of elementary, transformed natural subsystem; b) an industrial-

technological agricultural zone with fragments of an elementary, transboundary, almost completely controlled and controlled natural subsystem; C) Areas of ecotone structures.

Industrial-technological industrial and agricultural areas with fragments of elemental, transboundary, almost completely controlled and man-controlled natural subsystem are characterized by the following: the transformation of technogenic relief, technologically organized and dispersed technology, the altered hydrological and hydrochemical regime, the availability of agrarian landscapes and artificial forest plantations. The regions of the ecotone structures are divided into two categories: a) the territories immediately adjacent to the production and technology zone with elements of auxiliary, associated and other industries — watering, the location of the settlements, the objects of the territory's infrastructure; The land of industrial and agricultural use is separated by an open structure of highly transformed and degreed geosystems. The organization of which is largely controlled by technological processes and is characterized by strong fluctuations; b) zone of diffuse, indirect influence of economic activity, geosystemic organization of which is controlled mainly by modified natural factors; From the geoecological standpoint it is characterized by the presence of hearths with an unevenly and medium narcissistic soil and vegetation cover and indirect influence on the other components of natural geosystems [2].

Technical and natural technogenic elements (engineering structures of production and auxiliary purposes — buildings, transport systems, etc.), as well as artificial elements of the ecological carcass (swards, woody plants, etc.) are characterized by geometrically correct outlines of shapes (rectangular, linear, rounded) With relatively even, sharp, sharp borders. In the limits of residential complexes and production areas, they form a system of interconnected elements. By the limits of the production and technological zone, their distribution is mainly diffuse, with an increased density along the roads. Natural-resource and natural-ecological elements of the Nura River basin, represented by modified natural complexes, have not sharp, not rectilinear, but fuzzy diffuse boundaries and geometrically inappropriate forms of contours. They usually form an openwork net that is denser to the periphery or the boundaries of industrial sites in the Nura River basin or grouped in relation to certain elements of the landscape ecological fleet of the territory (along the valleys of the rivers Nura, Cherubainur, UlkenKundyszdy, Aschysu and coastal lines of reservoirs, etc.) [3].

One of the compiling assessments of the geoecological situation was data on the medical and environmental risks of drinking water use, related to the supply and the level of contamination of drinking water according to the following parameters: 1) the distribution of harmful substances (according to sanitary regulations and drinking water standards) according to safety class (I — extremely II — highly dangerous, III — dangerous, IV — moderately dangerous); 2) the nature of pollution. The combination of the above characteristics makes it possible to assess the degree of safety of the detected level of contamination of the source and the degree of its suitability for drinking water use.

Analysis of modern component indicators of geoecological situation in the Nura River basin made it possible to detect and systematize the criteria for its assessment, depending on the severity of environmental destabilization (Table 1).

Table 1

Criteria of evaluating of types of geoecological situation

Criteria	Type of geoecological situation		
	Relatively satisfactory (I)	Tense (II)	Critical (III)
1	2	3	4
Spatial criteria			
Areaofdegradedland, %:			
Not representing immediate threats to man (dumps, pits, degradation of agriculture, forest land)	Less than 5	5–20	More than 40
Representing the threat of destruction of buildings and structures (landslides, faults)	absent	Less than 5	More than 5
dumps of toxic rocks isolated from groundwater, with the possible transfer of particles through the air, runoff to surface water bodies	Less than 5	25–50	More than 50
Pit excavations and dumps of toxic rocks with the threat of groundwater contamination	Less than 1	5–10	10–20
Dividing of the territory by swarms, km / km^2	Less than 0.5	0,5–2,2	More than 2,2
Depth of erosion and water level of relative surface, sm	Lessthan 25	25–220	More than 220
Projective coverage of grazing vegetation,% of the zone	More than 80	20–80	Less than 20

Table 1 continuation

1	2	3	4
Presence of micro-objects with drinking water quality of the next hazard class	III	IV	VI
The difference of hydro objects with drinking water of the following character of pollution (according to toxic indicators of harmfulness)	Admissible	Moderate	High and extremely high
Dynamic criteria			
The rate of degassing of geosystems,% of space per year	Less than 0,1	2–5	More than 5
Speed increase in the area of downed pastures,% of land per year	Less than 4	4–16	More than 16
The rate of increase in the area of saline land,% of land per year	Less than 1	2–8	More than 8
Rate of increase in the area of eroded lands,% of the area per year	Less than 0.1	2–5	More than 5
The rate of increase in land area with favorable agglomerative conditions, 5 from the area of agricultural land per year	Less than 0,1	0,2–1,0	More than 1
Additional criteria			
Ratio of land plots of land of different degree of erosion, %			
strongly changed	Less than 10	30–55	more than 55
- Very changed	Less than 5	5–45	more than 45
Excess of groundwater level,% of background value	Allowable level	25–30	more than 50
Density,% coverage	Less than 6	6–80	more than 80
Conformity of the facility for the disposal of waste to environmental requirements	Territories intended for storage	Territories intended for storage partially meet the environmental requirements	Not equipped facilities do not meet the environmental requirements

The aforementioned evaluation criteria allowed to obtain an average total indicator of the degree of anthropogenic disruption of natural geosystems in%, based on the share of the PTC with its different values in the total area of the natural area, which made it possible to classify the territories to be classified as a certain type of destabilization of geoecological situation: I — relatively satisfactory 0–20 %); II — strained (41–60 %); III — critical (more than 60 %) (Table 2).

Relatively satisfactory geoecological situation is characteristic for the following regions: KaraSor lake seasonal-grazing, Karkaraly-Kent small-grass poppy-agricultural. Local transformation of natural geosystems, permissible contamination of surface and groundwaters, transgression of vegetation cover, and narrow-scale land degradation are noted [4, 5].

Table 2

Criteria for assessing the type of geoecological situation

Geoecological area	Degree of anthropogenic disruption of natural geosystems, %	Type of ecological situation
Teniz-Korgalzhinsky lake-ravniny with agricultural loading	45	Tense
Ladyshko-Sredne-Nurinsky ravninniy with significant industrial-residential and hydrotechnical impact	45–65	Tense
Karaganda small-mouthed with settlement-transport and hydrotechnical influence	90 %	Critical
Károsory lake seasonal-grazing	10–15	Relatively satisfactory
Karkalaly-Kent small-grass poppy-agricultural	5–15	Relatively satisfactory

An intensive geoecological situation has developed in the following areas — Teniz-Korgalzhynskoe lake-ravninniy with agricultural loading, Ladychesko-Sredne-Nurinsky ravninniy with significant industrial-residential and hydrotechnical impact. Small-scale transformation of natural geosystems, moderate pollution

of water, extensive transformation of vegetation cover, shallow manifestation of processes of land degradation are noted.

Critical geoecological situation characterizes the following region: Karagandinskiy melkosopochny with residential-transport and hydrotechnical impact. Here, the destruction of individual components of the natural resource potential occurs, which can lead to their complete disappearance, which requires timely intervention to eliminate the negative processes and phenomena in these territories.

Analysis of the main stage and the direction of the transformation of the basin, the modern assessment of geoecological situations, allows two provisions of the future development of the country to be put forward. For the first position, the anthropogenic loads are characteristic, which for the historical period have turned the natural steppe communities into a continuous artificial landscape. When taking urgent measures for the protection of nature, the landscapes can be partially restored. The second provision, to develop a scheme for the geoecological decay of the Nura basin as the basis for measures to address environmental problems.

References

1 Мальковский И.М. Антропогенная нарушенность речных бассейнов гидроэкологической ситуации / И.М. Мальковский, Л.С. Толеубаева // Нац. атлас РК окружающей среды и экологии. — Алматы, 2006. — Т. 3. — С. 35.

2 Мальковский И.М. Геоэкологические критерии устойчивости систем водообеспечения / И.М. Мальковский, Л.С. Толеубаева // Современные проблемы гидроэкологии внутриконтинентальных бессточных бассейнов Центральной Азии: докл. междунар. науч.-практ. конф. — Алматы, 2003. — С. 214–219.

3 Фондовые материалы Карагандинского областного территориального управления лесного и охотничьего хозяйства. — Караганда, 2009. — 26 с.

4 Акпамбетова К.М. Современные рельефообразующие процессы бассейна реки Нуры (Центральный Казахстан) / К.М. Акпамбетова, Г.М. Жангожина // Отечественная геоморфология: прошлое, настоящее, будущее: сб. тр. XXX пленума геоморфологической комиссии РАН. — СПб.: СПбГУ, 2008. — С. 184–185.

5 Жангожина Г.М. Геоэкологическая оценка земельных ресурсов бассейна р. Нуры / Г.М. Жангожина // Поиск. — 2010. — № 4. — С. 154–156.

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Нұра өзені алабының геоэкологиялық жағдайын кешенді бағалау

Нұра өзені алабында ауылшаруашылықтың күрт дамуы егістік жерлердің топырақтарының тозуға ұшырауына, олардың құнарлылығының азаюына әкеліп соғуда. Топырақтың осындай белсенді пайдалануының нәтижесінде антропогендік қайта қалыптасқан геожүйелерде шайылу және дефляция үрдістері немесе топырақ эрозиясының сызықты түрінің дамуына әсерін тигізеді. Нұра өзені алабындағы ауылшаруашылыққа жарамды жерлерінде топырақтар эрозиялық-дефляциялық түрге бағаланады. Осыған байланысты авторлар Нұра өзені алабының геоэкологиялық жағдайын қазіргі кездегі компоненттер тармағы бойынша талдап, оның экологиялық өзгеріске ұшырауының критерийлерін бөліп көрсетеді. Жер беті суларының сапасын анықтау арқылы және зерттеліп отырған аймақтың теориялық заңдылықтарын ескере отырып, авторлар осы аумақты геоэкологиялық аудандарға бөліп қарастыруды ұсынады.

Кілт сөздер: өзгеру, антропогендік ластану, геоэкологиялық ахуал, топырақтың бұзылуы, топырақтың шайылуы, антропогендік-қайта қалыптасқан геожүйелер, экотондық құрылым, шиеленіскен жағдай, сыни жағдай, селитебтік-көліктік әсер ету, геожүйенің түрленуі, антропогендік бұзылушылық, желге үрлену, жасанды ландшафт, топырақ диффузиясы.

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Комплексная оценка геоэкологической ситуации бассейна реки Нуры

Экстенсивное ведение земледелия в бассейне р. Нуры привело к повсеместной деградации почв пахотных угодий и значительному снижению их потенциального плодородия. Одной из основных причин является активизация разрушения почв антропогенно-преобразованных геосистем процессами смыва и дефляции или полное уничтожение почв линейной эрозией. Значительную часть сельскохозяйственных угодий в бассейне р. Нуры представляют почвы, которые оцениваются как эрозионно-дефляционные. В связи с этим авторы анализируют современные покомпонентные показатели геоэкологической ситуации в бассейне р. Нуры, что позволяет систематизировать критерии ее оценки в

зависимости от остроты экологической дестабилизации. На основе анализа качества воды поверхностных вод и по теоретическим закономерностям исследуемого региона выявлены геоэкологические районы для данной территории.

Ключевые слова: дестабилизация, антропогенное загрязнение, геоэкологическая ситуация, деградация, эрозия почв, антропогенно-преобразованные геосистемы, экотонная структура, напряженная ситуация, критическая ситуация, селитебно-транспортное воздействие, трансформация геосистем, антропогенная нарушенность, дефляция, искусственный ландшафт, диффузия почв.

References

1 Malkovskii, I.M., & Toleubaeva, L.S. (2006). Antropogennaia narushennost rechnykh basseinov hidroekolohicheskoi situatsii [Anthropogenic disruption of river basins of hydroecological situation]. *Nats. atlas RK okruzhaiushchei sredy i ekologii — Nat. atlas RK of environment and ecology,* Almaty, Vol. 3 [in Russian].

2 Malkovskii, I.M., & Toleubaeva, L.S. (2003). Heoekolohicheskie kriterii ustoichivosti sistem vodoobespecheniia [Geoecological criteria for the stability of water supply systems]. Proceedings from Current problems of hydroecology in the intracontinent drainage basins of Central Asia: *Mezhdunarodnaia nauchno-prakticheskaia konferentsiia — International scientific-practical conference*. (pp. 214–219). Almaty [in Russian].

3 *Fondovye materialy Karagandinskogo oblastnogo territorial'nogo upravlenija lesnogo i ohotnich'ego hozjajstva. [Funded materials of the Kargandy regional territorial management of forestry and hunting farms]*. (2009). Karaganda [in Russian].

4 Akpambetova, K.M., & Zhangozhina, G.M. (2008). Sovremennye relefoobrazuiushchie protsessy basseina reki Nury (Tsentralnyi Kazakhstan) [Modern relief-shaping processes of the basin of the Nura River (Central Kazakhstan)]. Proceedings from Domestic geomorphology: past, present, future: *XXX plenum heomorfologicheskoi komissii RAN — XXX plenum of the geomorphological commission of the RAN.* (pp. 184–185). Sankt-Petepsburg: SpbGU [in Russian].

5 Zhangozhina, G.M. (2010). Heoekolohicheskaia otsenka zemelnykh resursov basseina r. Nury [Geoecological evaluation of land resources of the river Nura]. *Poisk — Search, 4, 154–156* [in Russian].