Zhakupova Zh., Yakovlev A., Sarkynov E.

METHOD OF CALCULATION AND DETERMINATION OF TECHNOLOGICAL AND TECHNICAL PARAMETERS PACKER HYDRAULIC DEVICE WITH AN EJECTOR BY SUBMERSIBLE MOTOR

Annotation

Developed method of calculation to determine the technological and technical parameters of the packer hydraulics with an ejector to the submersible motor for technology pipeless water lifting from wells , the main criteria for which to calculate the accepted theoretical background obtained by theoretical investigations of the processes in the water lifting technologies and packer device : seal, fixing , protivoskruchivanii and ejection.

Keywords: The methodology of calculation, the rationale, process variable, technical parameter, pipeless water lifting technology, hydraulic packer unit, ejector, submersible motor, section flowing process, underground water, wells, pumping stations, water supply, land reclamation.

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Zhanymkhan K., Mustafayev Zh.S., Kozykeeva A.T.

Kazakh national agrarian university

ASSESSMENT OF NATURAL-TECHNOGENIC LOADS ON THE BASIS OF GEOMORPHOLOGICAL ANALYSIS OF CATCHMENT BASIN TERRITORIES OF RIVER KARATAL

Abstract

On the basis of systematization and information of system analysis of multiyear statistical data of Almaty region and assessment of natural-technogenic loads on the basis of geomorphologic analysis of the catchment basin territories of river Karatal are made by RSE “Kazhydromet”.

Key words: system, systematization, basin, catchment, nature, assessment, loads, geomorphology, schematization, intensity, river, density, industry.

Introduction

Today, the development of the national economy in the basin of the river Karatal-characterized by progressive involvement and development of the resource potential of the natural landscape, the current rate of using which have greatly increased the anthropogenic impact on the natural environment. The significant influences on the formation of the ecological environment of natural landscapes provide the agriculture and water resources, as well as in industrial facilities associated with the processing and mining. In this case the economic activity of man on the one hand the catchment basins give some positive effect, on the other hand, is inevitably accompanied by a complex of negative ecological implications, complicating environmental situation in the various ranks of natural systems. Such negative natural and technogenic process of human activity is a result of lack of knowledge about the patterns of interaction between nature and anthropogenic factors, about the processes developing in the natural environment on the complex arrangement of catchments, which is one of the obstacles to the creation of ecologically sustainable and cost-effective systems of catchments functioning.

The scientific interest to the assessment of the ecological state of catchment rivers and problems of their complex arrangement are recently aroused relatively [1; 2; 3], which is explained by an increase in the current conditions of anthropogenic loads on the watershed, the need to the

assessment of the impact of loads of catchments on the ecological sustainability and the occurrence of the problem ensuring sustainable functioning of watersheds.

Materials and methods

Research object - the catchment basin of river Karatal with a length of 390 km, an area of 19.1 thousand square kilometers, which is formed at the confluence of three rivers called Tekely-Aryk, Chadzha and Cora, the origins of which are located at a height of 3200-3900 m are chosen. The basic part of 160 km is mountain area, from Zhungar Alatau and below confluence of river Kara and Chizhe the wide intermountain plains are entered. Other inflows are Kara, Terekty, Laba, Balykty, Mokur and the most abounding in water Koksu. After the confluence of the river Koksu the Karatal flows through sandy desert of Southern Balkhash region. At a distance of 40 km from the mouth of the river delta area is 860 km^2. According to many years of observations the average consumption of water in the river Karatal in an alignment of Ushtobe consist of 66.7 m^3 / s, or 2.1 km^3 / year [4].

An integrative assessment methodology of natural and anthropogenic loads of catchment basin of river Karatal, given the multidimensionality the problem, the totality of the existing methodological approaches in the systems of nature management are accepted, where the catchments are presented by schematized catenary, consisting of conjugate facies with different altitude relative position, that is the geosystem and catenary approaches are selected by priorities [5].

Two groups of indicators are considered by assessment of anthropogenic loads: direct (directly) and indirect (indirectly) exposure on water bodies and watercourses. [6]

The indirect and areal exposure on water bodies are appeared in the form of anthropogenic loads on the drainage basin associated with salinity territory, economic activities of the residents and the industrial and agricultural specialization of the economy. Indicators of these factors are used for zoning (ranking) the basin territory of river Karatal by the degree of anthropogenic loads.

As, the main (basic) were used: the density of the population in the catchment area, the density of industrial production (volume produced in the region of industrial production in the thousands of dollars per 1 km^2) and agricultural development including plowed (%) and the animal breeding pressures (number of conditional heads per 1 km^2).

The used indicators are grouped by type of anthropogenic influences: demographic, industrial and agricultural. The agriculture load is received as the arithmetic mean of scores intensities of agricultural (plowed) and animal breeding pressures. The total anthropogenic loads are defined as the arithmetic mean of scores of demographic, industrial and agricultural pressures which is based on the methods of A.G.Isachenko (Table 1) [7].

Table 1 - The scale of the main indicators for the zoning by the degree of anthropogenic loads

Intensity of loads, scores	Indicators			
	Population density, people/ km^2	Density of industrial production, thousand.dollars./ km^2	Plowing,%	Cattle pressures, cond. heads / km^2
Insignificant or missing (1)	0,00	0,00	0,00	0,00
Very Low (2)	<0.10	<0.35	<0.10	<0.10
Low (3)	0,20-1,00	0,36-3,50	0,20-1,00	0,20-1,00
Reduced (4)	1,10-1,50	3,60-35,00	1,10-5,00	1,10-2,00

Average (5)	5,10-10,00	36,00-105,00	5,10-15,00	2,10-3,00
Increased (6)	1,10-25,00	106,00-140,00	15,10-40,0	3,10-6,00
High (7)	25,10-50,0	141,0-170,0	40,1-60,0	6,10-10,0
Very high (8)	>50.0	>170.00	>60.0	>10.00

Geomorphological analysis of catchment basin of river Karatal

The catenary approach is the basis of geomorphological schematic caten at substantiation the need for meliorations of catchment basin of River Karatal that is the watershed represented by set catenae by the number equal to the physical and geographical areas on the drainage basin. The geomorphologic catenae scheme consists of four facies with different altitude interposition, that is, the eluvial facies is loftiness in the watershed line, transeluvial slope is up to the inflection point, transaccumulative represents the slope after the inflection point and the subaqueous is lowland floodplain terraces. The transeluvial and transaccumulative facies form the transitive slope facies and the subaqueous facies is adjacent to the drain. This schematization differentiate facies on the type of water supply that is, it considers the size and shape of the relief and represents the catenae as an elementary catchment with its characteristic features [9].

The geomorphologic schematization of a catchment basin of river Karatal was performed on the basis of methodological approach of A.I. Golovanov [10] and due to the the lithological basis and positions which are characterized by heterogeneity in the hydrological regime, in peculiarities of formation of soil and vegetation cover within the ecosystem of its tributaries which depend on the climatic conditions of the region [9].

In the catchment basin areas of river Karatal mountain, foothill, piedmont plains and plains landscape zones are allocated, which differ in the sum of biological active temperatures ($\sum t,^{o} C$) atmospheric precipitation(O_c),vaporability (E_o) and photosynthetic active radiation (R) (Table 2):

Table 2- Physical-geographical regionalization of Basin Karatal river

Meteostation	H, м	Natural-climatic region on the catchment facies of the rivers	Indicators of physical and geographical regionalization			
			O_c, mm	$\sum t^{o} C$	E_o, mm	R,kJ/cm^2
Landscape of mountain class or eluvial facies ($B_э$)						
Kugaly	1365	mountain	350	2250	675	149.0
Kos-Agash		mountain	345	2300	690	150.8
Landscape of foothill subclass or transeluvial facies ($B_{mэ}$)						
Saryozek	948	foothill	270	3000	900	175.9
Taldykorgan	602	foothill	230	3100	930	179.5
Landscapes of piedmont plains subclass of or transaccumulative facies (B_{ma})						
Ushtobe	428	foothill-plains	212	3180	954	182.4
Landscapes of plains class or subaqueous facies (B_{ca})						
Naimensuyek	349	plains	195	3200	960	183.0

1. Mountain region of Zhungar Alatau (eluvial facies), where the hydrothermal coefficient (HTC) <0.70 with the sum of the air temperature is above10^{o} degrees less 2800^{o}C.

2. Very arid, foothill zone (transeluvial facies) with hydrothermal coefficient (HTC) - 0.50-0.70 and the sum of temperatures are above 10 ° equal 2800-3200^{o}C.

3. Dry temperate zone (transaccumilative facies), where hydrothermal coefficient (HTC) - 0.30-0.50 with the amount of air temperature is above 10 ° equal 3200-3500ºC.

4. Very dry zone (superaqual facies), where hydrothermal coefficient (HTC), which characterizes the moisture and heat supply - 0.20-0.30, with the amount of air temperature is above 10 ° equal 3200-3500ºC.

Based on Table 1, the geomorphological schematization of catchment basin of river Karatal from the eluvial up subaqueous facies, where their height position gradually reduced, which gives the possibility to produce on the basis of their geomorphological schematization of landscape catchment catenae were developed (Table 3).

Table 3- Geomorphological schematization of landscape catenae of the catchment basin of River Karatal

Natural-climatic zones		Geomorphologic indicator (absolute height of the earth surface, m)	Administrative districts
Landscape classes	facies		
Mountain	Eluvial	<1400	Kerbulak Koksu
Foothill	Transeluvial	600-1400	Kerbulak Eseldin Koksu
Piedmont plain	Transaccumulative	450-600	Eseldin Karatal
Plains	Subaqueous	>450	Karatal

As it can be seen from Table 3, the given classification of catchment basin Karatal generally coincides with natural and climatic and landscape regionalization that is, the first classification is based on the relative values (for example, the degree of moisture), and the second is based on the absolute values (e.g. lie of the ground). By virtue of this there are small discrepancies between the classifications and it is necessary to determine with the basic classification [1; 2; 3; 4].

The soil cover of river basin Karatal features a large variety, is due to the climatic of heterogeneity of the territory and the mountain-plain relief.

The natural and climatic catchment indicators are characterized by: hydrothermal coefficient ($HTC = 10 \cdot O_c / \sum t$), moisturizing coefficient ($Ky = O_c / E_o$), moisture assessment ($K_O = O_C / 0.18 \sum t$), dryness index ($\overline{R} = R / LO_C$), bio-climatic productivity ($BCP = K_y (\sum t / 1000)$) (table 4).

Table 4 - Hydrological-climatic assessment of warmth and moisture provision of Basin Karatal River

Meteostation	H, м	Annual average over many years				
		$\overline{R}$	HTC	BCP	Cm	K_O
1	2	3	4	5	6	7
Mountain class of landscapes or eluvial facies ($B_Э$)						
Kugaly	1365	1.71	1.55	1.17	0.52	0.86
Kos-Agash	1300	1.75	1.50	1.15	0.50	0.83

1	2	3	4	5	6	7
The foothill subclass of landscapes or trans eluvial facies ($B_{mэ}$)						
Saryozek	948	2.50	0.9	0.90	0.30	0.50
Taldykurgan	602	3.12	0.7	0.78	0.25	0.43
Piedmont plains subclass of landscapes or trance cumulative facies (B_{ma})						
Ushtobe	428	3.44	0.7	0.70	0.22	0.37
Plains class of landscapes or subaqueous facies (B_{ca})						
Naimensuyek	349	3.75	0.6	0.64	0.20	0.34

As it can be seen from Table 4, the basin Karatal river has a high heat supply, as *HTC*=0.60-1.55 и $\overline{R}$ =1.71-3.75 is enough high. However, the moisture content of the basin is very low (K_y =0.20-0.52), that determines the features of formation and functioning of landscape systems.

The appropriate classification on natural and climatic indicators, uniting watersheds and their catenae in the same type of landscape group on the most significant indicators by heat moisture provision is more suitable for complex arrangement [5-6]. According to this classification it is necessary to perform the justification of melioration of agricultural land and optimization the infrastructure of catchment on their complex arrangement of basin Karatal River.

Results of Research

The four districts of Almaty region are located in the catchments basin of Karatal, they are: Eskeldin, Kerbulak, Koksu and Karatal with a total area 4669056 ha and population of 191 279 people (Table 5) [10].

Table 5- The total land area and distribution of agricultural land in the Basin of Karatal River

Administrative districts	Population	Total land area, ha	Agricultural lands, ha	including		
				tillage	haymaking	pastures
Eskeldin	50436	803730	580002	55968	16035	506276
Kerbulak	51894	1116575	922628	130549	19988	761351
Koksu	40286	697704	650657	31549	9308	599039
Karatal	48663	2051047	1792228	19964	14342	1753855
Total	191279	4669056	11723515	238030	59673	3620521

Taking into account the natural- climatic conditions of landscape systems in basins of Karatal River the main of agricultural crops for providing needs of the population are cultivated (Table 6) [10].

As it can be seen from Table 6, the main areas of agricultural land are occupied by wheat and barley with a total area of 118,600 hectares; from them about 101000 ha of rainfed lands are located on foothill areas of Eskeldin and Kerbulak district of Almaty regions. The irrigated land area is dominated by soybean areas, which are about 19,100 hectares and vegetables with a total area of 9700 hectares in Karatal River Basin. In this case, one of the water-intensive crops, the rice aregrown on territory o Karatal district with an area of 4100 hectares, which shows a certain balance structure of agricultural land Basin of Karatal River.

Table 6 - Sowing area and structure of agricultural crops cultivated in the Basin of Karatal River

Crops	Administrative districts located in the basin of Karatal River, ha				
	Eskeldin	Kerbulak	Koksu	Karatal	Basin of Karatal River
Wheat	12000	28400	7600	3700	51700
Barley	13500	47100	5200	1100	66900
Corn for grain	800	300	300	700	2100
Rice	-	-	-	4100	4100
Sunflower	900	100	300	200	1500
Soybean	10400	-	7700	1000	19100
Sugar beet	1000	-	2700	400	4100
Potatoes	2200	2400	900	1100	6600
Vegetables	900	500	800	1500	3700
Total	40890	78800	25500	13800	158990

However, the productivity of agricultural crops is relatively low, which requires which requires the necessity to improve the cultivation technology of agricultural crops (Table 7). [10]

Table 7 - Productivity of agricultural crops in the Basin of Karatal River

Crops	Administrative districts located in the basin of Karatal Rive,r ha				
	Eskeldin	Kerbulak	Koksu	Karatal	Basin of Karatal river
Wheat	24.0	17.8	24.7	17.0	20.875
Barley	23.1	18.3	23.7	15.3	20.100
Corn for grain	57.4	37.0	60.8	52.0	51.800
Rice	-	-	-	38.5	38.500
Sunflower	11.2	12.3	13.0	17.3	13.450
Soybean	19.2	-	21.3	13.2	17.900
Sugar beet	329.4	-	267.1	267.1	237.866
Vegetables	164.4	193.6	193.0	187.0	184.500
Vegetables	184.2	241.2	318.0	285.0	257.10

The wide development of animal husbandry which has certain natural resources, e.i. in these regions there are hayfields and pastures that provide their livelihoods were taken in the Basin of Karatal River (Table 8) [10].

As it can be seen from Table 8, the livestock load is generally distributed unequally on the territories of regions which are the despite rather occupied large of total area and including rangeland the smallest number of animals are observed in Karatal district.

Table 8 - Livestock animals in the Basin of Karatal River

Types of animals	Administrative districts located in the Basin of Karatal River, by animal heads				
	Eskeldin	Kerbulak	Koksu	Karatal	Basin of River Karatal
Cattle	26700	22800	30800	44600	124900
Cows	13800	21600	11800	12000	59200

Pigs	4600	1200	4200	9100	19100
Sheep and goats	112500	200000	128900	81500	522900
Horses	7100	13500	8600	6600	35800
Total	164700	259100	184300	153800	761900

In connection with the existing of nature management systems with the primary development ore mining, which basically form the volume of industrial production in the Karatal River basin (Table 9) [10].

Table 9 - The volume of industrial and agricultural production by main activities in Basin of Karatal River

Indicators	Administrative districts located in the Basin of Karatal River, mln. tenge				
	Eskeldin	Kerbulak	Koksu	Karatal	Basin of Karatal river
Gross agricultural production	11893.1	14099.3	9249.2	10265.0	45506.6
- plant growing	7362.8	8039.3	5549.7	6667.5	27619.3
- livestock	4608.4	6073.2	3703.2	3706.6	18091.4
Mining industry	15.5	656.7	23.7	34.8	730.7
Manufacturing industries	4455.9	407.4	3510.8	1708.9	10083.0
Products Manufacture	4387.8	6.2	3061.7	1394.8	8850.5
Total	32723.5	29282.1	25098.3	23777.6	110881.5

On the basis of the data presented in Tables 5-9 the calculations were conducted in the Karatal River basin, which allowed revealing the following differentiation of natural and anthropogenic loads (Table 10).

Table 10- Indicators of anthropogenic loads in the drainage basin of the river Karatal

Indicators	Administrative districts located in the Basin of Karatal River, mln. tenge				
	Eskeldin	Kerbulak	Koksu	Karatal	Basin of Karatal
1	2	3	4	5	6
Total area, km^2	80373	111657.5	69770.4	205104.7	466905.6
Population, people	50436	51894	40286	48663	191279
Population density, people/km^2	0.530	0.460	0.577	0.237	0.410
Area of irrigated land, ha	40890	78800	25500	13800	158990
Plowing,%	0.050	0.070	0.036	0.007	0.034
Cattle load, cond. by heads / km^2	2.050	2.320	2.542	0.750	1.532
The density of industrial production, thous.dollars / km^2	1.192	0.767	1.064	0.342	0.703

Available water resources, km^3	0.381	0.363	1.166	0.380	2.29
Specific water availability per person, thous.m^3/people	7.566	6.395	23.943	7.308	11.972

On the basis of a systematic of data analysis shown in Table 10 by the level of total anthropogenic loads on the territory of basin Karatal river the two intensity groups from low (3 points) to medium (5 points) are allocated.

The low anthropogenic loads (4 points) is observed on the territory of Karatal district of Almaty region, where the population density is equal to 0.237 people / km^2, the density of industrial production is 0.342 thousand dollar / km^2. The territory is characterized by the lowest for the considered basin with agricultural development with a plowing level of 0.007%, and the livestock loads approximately 0.750 conditional heads / km^2.

The everage anthropogenic loads (5 points) are characterized for the largest group, which included Eskeldin, Kerbulak and Koksu Districts, where the population density is 0.460-0.577 people/km^2, the density of industrial production varies from 0.767-1.192 thousand dollars / km^2, plowing level is from 0.005 to 0.034%, livestock loads are from 2.050 to 2. conditional heads / km^2.

Generally, by geoecological load as in the result of anthropogenic activities of Basin of Karatal River is not so high that is the Basin River belongs to the region with no high technogenic loads.

In general, the Basin of Karatal River has a high water supply, but it is characterized by a high degree of pollution, both at the local and regional level in connection with the development of mining and manufacturing industries. The total anthropogenic loads on the territory of the River Basin Karatal increases downstream, reaching the highest values in the mouths of Lake Balkhash.

Conclusion and recommendations

The performed ecological-economic zoning of the territories based on the assessment of anthropogenic loads in the result of anthropogenic activities can serve as a basis for the development of a number of activities aimed at solving the water problems in the Karatal River Basin on the basis of geomorphologic analysis of formation of Geostock.

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Жанымхан К., Мустафаев Ж.С., Қозыкеева А.Т.

ОЦЕНКА ПРИРОДНО-ТЕХНОГЕННОЙ НАГРУЗКИ НА ОСНОВЕ ГЕОМОРФОЛОГИЧЕСКОГО АНАЛИЗА ВОДОСБОРНОЙ ТЕРРИТОРИИ БАССЕЙНА РЕКИ КАРАТАЛ

Аннотация

На основе систематизации и системного анализа информационных многолетних статистических материалов Алматинской области и РГП «Казгидромет» произведена оценка природно-техногенной нагрузки на основе геоморфологического анализа водосборной территории бассейна реки Каратал.

Ключевые слова: система, систематизация, бассейн, водосбор, природа, оценка, нагрузка, геоморфология, схематизация, интенсивность, река, плотность, промышленность.

Жанымхан Қ., Мұстафаев Ж.С., Қозыкеева Ә.Т.

ҚАРАТАЛ ӨЗЕНІ АЛАБЫНДАҒЫ СУЖИНАҒЫШ АУМАҒЫН ГЕОМОРФОЛОГИЯЛЫҚ ТАЛДАУДЫҢ НЕГІЗІНДЕ ТАБИҒИ-ТЕХНОГЕНДІК ЖҮКТЕМЕНІ БАҒАЛАУ

Аңдатпа

Алматы облысы және РМК «Қазгидромет» ақпараттық көпжылдық статистикалық мәліметтерді жүйелеу және жүйелік талдау арқылы Қаратал өзені алабындағы сужинағыш аумағын геоморфологиялық талдаудың негізінде табиғи-техногендік жүктемесі бағаланды.

Кілт сөздер: жүйе, жүйелеу, алаб, сужинағыш алаң, табиғат, бағалау, нагрузка, геоморфология, сұлбалау, қарқындылық, өзен, тығыздық, өндіріс.