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The influence of climatic conditions of Central Kazakhstan on the state and development of the hydrographic network of the Region

The climate of Kazakhstan has changed significantly during the Quaternary period. This affected the periodic flooding or desiccation of the territory, traces of which have been preserved in the relief to this day. Focus on climate change in the historical era (2000–3000 years) it caused various opinions and disputes. According to some researchers, over the past 2000–3000 years, the climate has become more humid than in the preceding postglacial period. Although small intra-century cycles of fluctuations in lake levels indicate periodic humidification of the climate, the general course of the centuries-old cycle is now directed towards decreasing humidity. Consequently, the drying of the territory of Kazakhstan will reach a maximum in 2600–2700, after which the climate will change towards humidification. The increase in moisture levels from 1952-1953 was reflected in the rise in lake levels, increased river flows, and the onset of glaciers, which is the result of an intrasecular rhythm of moisture variability against the background of large, centuries-old rhythms. Research shows that in Kazakhstan, during the Quaternary, there was an alternation of pluvial and xerothermal epochs, but the type of modern relief-forming processes is more consistent with xerothermal epochs. This is evidenced by a reduction in runoff along the valleys, a partial transition of concentrated runoff to a flat one, a reduction in the water area of lakes, the presence of abandoned irrigation ditch systems far from the modern water channel, and the death of tributaries of the right bank of the Yertys River at the level of the modern floodplain. At the present stage, climate aridization has affected the hydrographic network of Central Kazakhstan.

Keywords: Central Kazakhstan, Ishim, Selety, hydrographic, Nura, Budenovskoye, Samarkandskoye reservoir.

Introduction

Geographical location, the variety of relief and climatic conditions of Kazakhstan have caused an uneven distribution of surface waters in its territory. Character of the hydrographic system, regime and flow of the rivers depend essentially on the latitudinal zonation of climate and landscapes. On the most part of the territory evaporation equals to the amount of precipitation. Therefore, there is a shortage of moisture in the soil and aridity roughs in the form of landscapes everywhere. Due to the shortage of moisture, especially sharply expressed in the desert and semi-desert areas, surface runoff is small, river system is sparse, and the rivers are shallow. Many rivers form independent basins of a closed flow and finish in small closed lakes, lost in the sands or its own deposits. Central Kazakhstan applies to the areas with poor hydrographic system. Surface runoff of the Central Kazakhstan is represented by rivers Yesil, Selety, Shiderty, Sarysu, Nura (Fig. 1, 2). Modern state of the rivers is aggravated by environmental destabilization of the region.

Materials and methods

Flow of Nura river is regulated by 25 water reservoirs. Total volume of water bodies is about 1 km^3, the total usable capacity — 450 million m^3 (Table 1).

Table 1

Water reservoirs of the Nura river basin [1]

№	The name of the reservoir	The volume of the reservoir, million m^3		Surface area, km^2
		total	effective	
1	Budenovskoye	12,6	12,3	5,1
2	Aschysuyskoye	20,0	18,0	6,8
3	Botakara	30,6	28,8	15,9
4	Tuzdinskoye	10,0	9,0	5,9
5	Kokpektinskoye	1,5	1,4	0,4

Continuation of Table 1

№	The name of the reservoir	The volume of the reservoir, million m^3		Surface area, km^2
		total	effective	
6	Samarkandskoye	254,0	87,5	72,0
7	Komunarskoye	1,2	1,1	0,4
8	Shokayskoye	5,0	4,6	1,3
9	Oshagandinskoye	5,1	5,0	1,6
10	Koybas	1,7	1,4	0,8
11	Tikhonovskoye	1,5	1,4	0,5
12	Akbastauskoye	2,34	2,3	0,8
13	Tumatay	1,02	1,0	0,7
14	Krasnopolenskoye	4,5	3,5	2,1
15	Burminskoye	2,3	2,1	0,7
16	Zhartasskoye	10,5	10,0	5,0
17	Sherubaynurinskoye	274,0	180,0	38,2
18	Toparskoye	3,2	3,1	1,1
19	Fyodorovskoye	83,0	12,8	4,3
20	Chkalovskoye	6,4	5,5	2,0
21	Saranskoye	11,0	8,0	5,4
22	Intumaksoye	190,0	18,0	42,0
23	Samarskoye	14,1	14,0	3,9
24	Komsomolskoye	1,1	1,0	0,4
25	Sabyrkozhy	1,9	1,8	0,6

Budenovskoye and Aschysuyskoye reservoirs are located on tributaries of the Nura — river Aschysu; reservoir Botakara — on the river Otkelsyz; reservoir Tuzdinskoye — on the river Tuzdy; reservoir Kokpektinskoye — on the river Kokpekty. Budenovskoye reservoir is currently destroyed and can hold no more than 1 million m^3. Natural temperature and gas regime are preserved in the upper and lower reaches of Nura river. In the middle of the river near the Temirtau, including Samarkand reservoir, due to warm wastewater, thermal and gas regime is violated. The main sources of pollution of the Nura river are the enterprises of Karaganda-Temirtau industrial area. With the waters of the tributary Kokpekty come organic and suspended solids, ammonium, nitrates and nitrites. By the wastewaters of JSC “Mittal Steel Temirtau”, CJSC “Alash”, SDPS-1 JSC “KazRosEnergo” Samarkandskoye reservoir is polluted by oil products, phenols, ammonium ions, organic compounds, zinc, copper, lead. With waters of tributary Sherubainura into the river Nura come utility fecal waste and mine waters from Shakhtinsk and Karaganda [2]. Discharge of waste waters affects to the chemical composition of water in the area from Samarkandskoye to Intumakskoye reservoir:

- mineralization and content of the main ions increase by 4–6 times;
- maintenance of ammonium ions increase by 2-3 times;
- the concentration of mercury increases by 30–37 times;
- content of oil products increases by 2–5 times.

Figure 1. The river Yesil in the upper part [3]

For a comprehensive assessment of the water quality of the river Nura water pollution index (WPI) was calculated during the flood period. MPC of commercial fishing importance water bodies was used as a criterion for assessing the state of pollution of surface waters [4]. The excess of the MPC was noted on the ammonia nitrogen, nitrites, oil products, phenols, mercury, sulphates, potassium and sodium.

Table 2

Average concentration of mercury in the Nura river [4]

The name of the post	Raising		Peak		Abatement	
	WPI	Mercury, mg/dm^3	WPI	Mercury, mg/dm^3	WPI	Mercury, mg/dm^3
v. Sergiopolskoe	1,57	0,09	1,99	0,13	0,68	0,02
s. Tokarevka	1,29	0,14	1,28	0,09	0,63	0,01
Samarkandskoye reservoir, 7 km above the dam	1,84	0,21	1,88	0,43	0,60	0,00
Samarkandskoye reservoir, 0,5 km above the dam	1,41	0,11	1,55	0,11	0,61	0,09
Temirtau, 1 km above the combined discharge	2,69	0,03	1,18	0,03	0,71	0,015
Temirtau, 1 km below the combined discharge	9,55	4,46	1,29	0,20	2,14	0,75
Temirtau, 5,7 km below the combined discharge	8,85	3,97	2,99	1,36	2,28	0,67
village Rostovka	6,15	2,34	1,87	0,57	1,49	0,47
Headrace of Intumakskoye reservoir	2,72	0,13	1,47	0.21	0,79	0,07
Downstream of Intumakskoye reservoir	1,96	0,01	1,01	0,06	3,0	0,02
v. Zaharovka	1,76	0,01	0,63	0,01	0,80	0,0
s. Kievka	2,14	0,001	0,83	0,004	0,62	0,0
v. Shahterskoye	1,76	0,01	0,72	0,01	0,65	0.0
v. Ahmetaul	2,29	0,01	1,22	0,007	0,78	0,0
v. Romanovskoye	2,11	0,002	0,89	0,0005	0,75	0,0
s. Korgalzhin	1,52	0,001	0,88	0,004	0,60	0,0

Mercury contamination in the general level of pollution of the Nura river is: in the upper part of the river — 1,5 %; in the middle part — 76 %; in the lower part — 0,5 %. The mercury content was insignificant — 0,001-0,002 mg/dm^3 (Table 3). Concentration of major pollutants was below the maximum allowable. Starting from Samarkandskoye reservoir, there is an increase of content of sulphates, potassium and sodium ions.

Figure 2. Seleta river canyon [3]

On the posts near the village Rostovka and headrace of Intumakskoye reservoir level of contamination is reduced, but concentration of mercury remains within 3,6-3,4 MPC, respectively.

Table 3

The qualitative composition of water of the Nura river [4]

The name of observation posts	WPI	Quality class	Average concentration of mercury, mg/dm^3
v. Sergiopolskoe	0,62	2*	0,0001
s. Tokarevka	1,03	2-3	0,0002
Samarkandskoye reservoir, 7 km above the dam	0,86	2	0,0
Samarkandskoye reservoir, 0,5 km above the dam	0,71	2	0,0
Temirtau, 1 km above the combined discharge	0,78	2	0,0
Temirtau, 1 km below the combined discharge	1,26	3**	0,254
Temirtau, 5,7 km below the combined discharge	1,72	3	0,44
village Rostovka	1,57	3	0,36
Headrace of Intumakskoye reservoir	1,17	3	0,34
Downstream of Intumakskoye reservoir	1,07	3	0,08
v. Zaharovka	1,19	3	0,0
s. Kievka	1,18	3	0,0
v. Shahterskoye	1,45	3	0,0
v. Ahmetaul	1,12	3	0,0
v. Romanovskoye	1,15	3	0,0
s. Korgalzhin	1,22	3	0,0
* — clean water; ** — moderately polluted water.			

Conclusion

Discharge of large volumes of waste waters, waste mine waters contributed to entrance to river system huge masses of solid material, which influenced on process of modern alluvial sedimentation in large parts of river Nura. New type of alluvial deposits distributed in the river — technogenic silts [5]. Power of silts is different, the first few kilometers they are fully lined the riverbed, and with increasing distance from the city encountered as lenses and stains. Pollution of the river causes the danger of losing water sources and, above all, drinking. Variety of projects to purify the river Nura from technogenic silts are offered, but they all suffer from lack of complex geoecological approach to solving this problem, the factors of interconnection and interdependence of natural ingredients fails to take into account, geographical forecast of further development in the basin of the Nura river is not given. The solution of this problem acquires special importance in connection with the problem of water supply of the young capital of Kazakhstan — Astana.

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Лорант Денез Давид, К.М. Акпамбетова

Орталық Қазақстанның климаттық жағдайларының өңірдің гидрографиялық желісінің жай күйі мен дамуына әсері

Төрттік дәуірде Қазақстанның климаты көптеген өзгерістерге ұшырады. Олар мезгіл-мезгіл су басуға немесе аумақтың кебуіне әкелді, оның іздері бүгінгі күнге дейін жер бедерінде сақталған. Тарихи дәуірдегі (2000-3000 жылдар) климаттың өзгеру бағыты әртүрлі пікірлер мен даулар туғызды. Кейбір зерттеушілердің пікірінше, соңғы 2000-3000 жыл ішінде климат оның алдындағы мұздан кейінгі кезеңге қарағанда ылғалдырақ болды. Көл деңгейінің ширек ғасыр аралық ауытқулары климаттың мезгілдік ылғалдануын білдірсе де, көпғасырлық циклдің жалпы бағыты қазіргі уақытта ылғалдылықтың төмендеуіне бағытталған. Демек, Қазақстан аумағының кебуі 2600-2700 жылдары ең жоғары шегіне жетеді, содан кейін климат ылғалдана бастайды. 1952–53 жылдардан бастап ылғалдылықтың жоғарылауы көл деңгейінің көтерілуіне, өзен ағындарының ұлғаюына және мұздықтардың пайда болуына әкелді, бұл ірі көпғасырлық ырғақтардың бедерінде ылғалдылықтың өзгеруі ғасыр ішілік ырғақтың нәтижесі. Зерттеулер көрсеткендей, Қазақстан аумағында төрттік дәуірде плювиальды және ксеротермиялық кезеңдердің кезектесуі орын алған, бірақ қазіргі заманғы рельеф түзуші процестердің түрі ксеротермиялық дәуірлерге көбірек сәйкес келеді. Бұған аңғарлар бойындағы ағынды сулардың азаюы, шоғырланған ағынның жазық ағынға қарай ішінара ауысуы, көлдердің акваториясының кемуі, суы бар заманауи арнадан қашықтағы қараусыз қалған арық жүйелерінің болуы, сондай-ақ Ертіс өзенінің оң жағалауындағы салалардың қазіргі су тасқыны деңгейінде қурап қалуы дәлел бола алады. Қазіргі кезеңде климаттың құрғақтануы Орталық Қазақстанның гидрографиялық желісіне де әсерін тигізді.

Кілт сөздер: Орталық Қазақстан, Есіл, Сілеті, гидрография, Нұра, Буденовское, Самарқанд су қоймасы.

Лорант Денез Давид, К.М. Акпамбетова

Влияние климатических условий Центрального Казахстана на состояние и развитие гидрографической сети региона

В течение четвертичного периода климат Казахстана подвергался многочисленным изменениям. Они приводили к периодическому обводнению или иссушению территории, следы которого сохранились в рельефе до сих пор. Направленность в изменении климата в историческую эпоху (2000–3000 лет) вызывала различные мнения и споры. С точки зрения некоторых исследователей, за последние 2000–3000 лет климат стал более влажным, нежели в предшествующей ему послеледниковый период. Хотя мелкие внутривековые циклы колебаний уровней озер свидетельствуют о периодическом увлажнении климата, общий ход многовекового цикла направлен на данный момент в сторону уменьшения влажности. Следовательно, высыхание территории Казахстана достигнет максимума в 2600–2700 годах, после чего начнется увлажнение климата. Повышение влажности с 1952–1953 годов отразилось в подъеме уровня озер, повышении расходов рек и наступании ледников, что является результатом внутривекового ритма изменчивости увлажненности на фоне крупных многовековых ритмов. Как показывают исследования, на территории Казахстана в четвертичный период происходило чередование плювиальных и ксеротермических эпох, но тип современных рельефообразующих процессов больше соответствует ксеротермическим эпохам. Об этом свидетельствуют сокращение стока по долинам, частичный переход сосредоточенного стока в плоскостной, сокращение акватории озер, наличие брошенных арычных систем вдали от современного русла с водой, а также отмирание притоков правобережья реки Ертыс на уровне современной поймы. На современном этапе аридизация климата отразилась и на гидрографической сети Центрального Казахстана.

Ключевые слова: Центральный Казахстан, Есиль, Селеты, гидрография, Нура, Буденовское, Самаркандское водохранилище.

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