

ТЕОРЕТИЧЕСКИЕ И ПРАКТИЧЕСКИЕ АСПЕКТЫ ПРЕДУПРЕЖДЕНИЯ, ЛИКВИДАЦИИ ЧРЕЗВЫЧАЙНЫХ СИТУАЦИЙ И ГРАЖДАНСКОЙ ОБОРОНЫ

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HYDRODYNAMIC ACCIDENTS: CAUSES OF OCCURRENCE AND POTENTIAL HAZARDS FOR THE MINGACHEVIR RESERVOIR DAM

Abstract. Hydrodynamic accidents are emergency events caused by the failure of hydraulic structures, leading to flooding and inundation of extensive areas as well as large-scale socio-economic consequences. This article provides a systematic analysis of the factors contributing to the occurrence of hydrodynamic accidents, particularly disasters resulting from the failure of reservoir dams. Based on real events that have occurred worldwide, the consequences of such accidents and their underlying causes are examined in detail. The possible causes of similar potential hydrodynamic accidents in the context of our country are analyzed. As the object of the study, the potential failure of the Mingachevir reservoir dam due to possible hazards is assessed. The research results indicate that the interaction of technical, natural, and anthropogenic factors significantly increases the scale and impact intensity of hydrodynamic accidents.

Keywords: hydrodynamic accident, inundation, hydraulic structures, emergency situation, reservoir, flood, dam failure, Mingachevir reservoir dam.

In recent decades, due to the growing demand for water, many countries have increased activities related to the construction of hydraulic structures and the storage of water resources. Although such activities play an important role in water resources management, the intensification of extreme hydrological events has, in some cases, caused hydrodynamic accidents to become a globally relevant problem. Hydrodynamic accidents mainly occur as a result of sudden or progressive failure of dams, reservoirs, and other hydraulic structures. As a consequence, a large volume of water is released and begins to move uncontrollably within a short period of time, leading to severe consequences. Such emergency events pose serious threats to human life and activities, critical infrastructure facilities, as well as the environment.

International experience shows that the consequences of hydrodynamic accidents may manifest not only at the local level but also on a regional scale. Therefore, the study of the mechanisms underlying the occurrence of such accidents and the scientific assessment of their hazard levels are of great importance for effective emergency management [1].

The occurrence of hydrodynamic accidents is not associated with a single cause but results from the combined influence of various factors. Technical and structural deficiencies are considered among the main risk factors. Inaccurate assessment of hydraulic loads during the design of hydraulic structures, failure to account for the long-term durability of construction materials, and the lack of timely technical inspections significantly increase the probability of accidents. In particular, sudden failures caused by internal erosion processes within the dam body may occur.

Natural factors can also contribute to the occurrence of hydrodynamic accidents. Intense and prolonged precipitation, emergency events such as floods and flash floods in river basins, as well as seismic impacts during earthquakes, can generate excessive loads on hydraulic structures. In many cases, excessively high-water levels in reservoirs reduce the discharge capacity of spillway structures, ultimately leading to a deterioration of dam safety.

Anthropogenic and management-related factors may further exacerbate the scale of hydrodynamic accidents in the event of a failure of hydraulic structures. During climatic extremes, the opening of spillway gates to protect dam structures may increase flooding and losses in downstream areas. At the same time, improper selection of reservoir operating regimes, the absence of emergency preparedness plans, and the ineffective functioning of early warning systems result in greater losses when accidents occur. Global experience demonstrates that the human factor can play a decisive role in preventing or mitigating the consequences of such accidents [2].

Although failures of reservoir dams occur relatively rarely, it is expected that their probability will increase in the modern era due to the intensification of climate change. As a result, this influence may lead to more frequent and more intense flood events [3]. The collapse of the 14 de Julho Dam in Brazil is a clear example demonstrating the significant impact of climate change on dam safety [4].

As noted earlier, there are various factors contributing to dam failures. One of these factors is the aging of dams. As hydraulic structures age, sediments gradually accumulate over time, which affects water flow and reservoir storage capacity, thereby reducing the operational efficiency of the structure during periods of intense precipitation. In addition, aging dams become structurally weakened and require frequent technical maintenance, which in many cases is not adequately provided [5].

Aging dams are typically characterized by design solutions that do not meet modern engineering requirements. In particular, approximately one-third of dam accidents worldwide are associated with spillway structures designed using outdated formulas that do not account for the long-term effects of intense weather conditions [6]. Furthermore, snow and glacier melt are considered another form of flooding that can lead to overtopping of dams; this phenomenon was also observed during the Kyzyl-Agash dam disaster in Kazakhstan [7-9]. The Situ Gintung Dam in Indonesia was recorded as having failed as a result of internal erosion processes [10-12].

The Taum Sauk Pumped Storage Power Plant, located in Reynolds County, Missouri, USA, was constructed between 1960 and 1963. The facility consists of a lower reservoir and an upper reservoir. On December 14, 2005, a series of deficiencies introduced during the design and construction phases, errors in the programming of monitoring and control equipment, and human factors led to the catastrophic failure of the upper reservoir. During the failure, although one of the two pumps was shut down, the other continued to operate, and shortly thereafter water began to overtop the parapet wall and spill. Malfunctioning

sensors that were improperly programmed and/or incorrectly installed failed to indicate in time that the reservoir had reached its full capacity [13-15].

Following the Tohoku earthquake of March 11, 2011, with a magnitude of 9.0, the Japanese authorities inspected more than 400 reservoir dams. According to official reports, nearly all of these dams withstood the ground shaking, maintained reservoir integrity, and continued operation with only minor to moderate damage. The notable exception was the Fujinuma Dam. Prior to the earthquake, the Fujinuma Dam retained a small reservoir known as Fujinuma Ike, which was used for irrigation and recreational purposes and had a maximum storage capacity of approximately 1.5 million cubic meters. This earthfill dam, located in the southern part of Fukushima Prefecture, failed shortly after the earthquake. As a result of the dam failure, the entire volume of water stored in the reservoir was released uncontrollably, and the flow was directed toward a small downstream village. The resulting flood completely destroyed 19 houses, caused severe damage to other buildings, washed away a bridge, blocked roads with debris, and led to the loss of eight human lives [16-18].

In 2018, the failure of the Xe Pian–Xe Namnoy Dam in southern Laos generated a powerful flood wave, resulting in more than 70 fatalities and leaving thousands of people homeless. Although it is clearly established that the disaster was caused by geological and engineering problems, the gradual degradation process of the dam and the potential hazards posed by other dams in the area have not yet been fully clarified [19]. The primary cause of the accident was the development of erosion due to the proximity of groundwater to the surface in vegetated foundation areas, which led over time to localized collapses and the formation of voids. When erosion and softening of the foundation reached a critical level, the static stability of the dam was compromised, resulting in a deep circular slide at the highest section of the dam. Finally, when the thin upstream section of the dam crest ruptured, a water wave overtopped the dam, causing an uncontrolled and catastrophic release of water. As a result of this accident, the central section of Saddle Dam D and its foundation were completely washed away [20, 21].

On May 19, 2020, during several days of intense rainfall, the earthen embankment section of the Edenville Dam failed. This failure subsequently led to the collapse of the downstream Sanford Dam, as well as damage to two additional dams. As a result of these accidents, material losses amounted to approximately 100 million US dollars, and during the COVID-19 pandemic period, about 11,000 people were evacuated, while approximately 2,500 structures sustained severe damage [22, 23].

On April 5, 2024, flooding along the Ural River in Russia resulted in the failure of the Orsk Dam. In the city of Orsk, flooding intensified following the breach of the dam, leading to the evacuation of thousands of residents, 15 fatalities, and injuries to at least six people. The estimated economic damage amounted to approximately 1.2 billion rubles. The accident was caused by a dangerous rise in water levels due to ice melting in the Ural River [24, 25].

On August 25, 2024, the Arba'at Dam, located in Sudan's Red Sea State, approximately 38 km northwest of Port Sudan, suffered severe damage as a result of heavy rainfall. According to analyses, a breach occurred in the dam, leading to the complete drainage of the reservoir. As a result of the accident, significant damage to people and property was reported in approximately 20 downstream villages. Based on the analyzed data, up to 50,000 people living in the western part of the dam area were severely affected by this event. In addition, the Arba'at Dam is considered a strategically important hydraulic structure for Port Sudan, as it represents one of the city's main sources of drinking water.

Consequently, the damage caused by the accident had a serious impact on the water supply of Port Sudan [26-28].

Table 1 – Selected emergency accidents related to reservoir dam failures during 2005–2025

№	Country	Reservoir dam name	Date of the accident	Storage capacity/Dam age classification	Year of operation start	Cause of failure (natural, technical, human, combined)	Specific cause of occurrence
1.	USA	Taum Sauk Upper Reservoir Dam (Missouri)	14.12.2005	Capacity: ~5 mln m ³ (upper dam); non-aging	1963	human	Lack of proper inspections Overtopping – Failure of level control, management error
2.	Indonesia	Situ Gintung Dam	27.03.2009	Capacity: ~2 mln m ³ ; aging	1933	technical	Heavy rains → overtopping, Poor maintenance, internal erosion, hidden cracks
3.	Kazakhstan	Kyzyl-Agash Dam	11.03.2010	Capacity: - Age: -	-	combined	Sudden dam breach due to poor management, structural and operational deficiencies and caused by torrential rains, early snowmelt
4.	Japan	Fujinuma Dam (Fukushima)	11.03.2011	Capacity: ~1,5 mln m ³ ; aging	1937-1949	natural	Earthquake effects (2011 Tohoku), Seismic instability
5.	Lao PDR	Xe-Pian Xe-Namnoy – Saddle Dam D	23.07.2018	Capacity: >5 mlrd m ³ ; non-aging	2017–2018	combined	Seepage and cracking, high water level → failure of the auxiliary dam
6.	USA	Edenville Dam (Michigan)	19.05.2020	Capacity: ~49 mln m ³ ; aging	1925	technical	Technical defects and extreme rainfall → overtopping and breaching
7.	Ukraine	Kaxovka HES dam	06.06.2023	Capacity: ~18 mlrd m ³ ; aging	1956	human	Explosion / military sabotage (wartime conditions)
8.	Russia	Orsk city dam (Ural river)	05.04.2024	Capacity: - non-aging	2010	human	Very high-water level → flood loading, operational problems
9.	Sudan	Arba'at Dam (Port Sudan)	24.08.2024	Capacity: - non-aging	app. 1990s	combined	Breach, heavy rains and structural deficiencies
10.	Brazil	14 de Julho	02.05.2024	Capacity: 55.18mln m ³ ; non-aging	2008	natural	Torrential rainfall

On June 6, 2023, during the Russia–Ukraine war, the Nova Kakhovka Dam, located in southern Ukraine, was destroyed by an explosion. As a result, a massive volume of water flowed uncontrollably downstream along the Dnieper (Dnipro) River, inundating dozens of settlements [29]. The dam's destruction directly affected more than 100,000 people and led to the flooding of over 620 square kilometers of land [30].

Hydrodynamic accidents occurring worldwide and their consequences vary in severity depending on their causes. Statistics on several hydrodynamic accidents that have occurred over the past 20 years are presented in Table 1. This table clearly demonstrates the level of danger posed by such emergency events.

The list of accidents presented in Table 1 can be further expanded, as such hydrodynamic accidents have occurred frequently worldwide and are likely to occur in the future as well.

Based on the analyses above, the dam failures that have occurred can be grouped in Figure 1 - the form of a diagram according to the age of the dam, the cause of failure, and the reservoir volume [1].

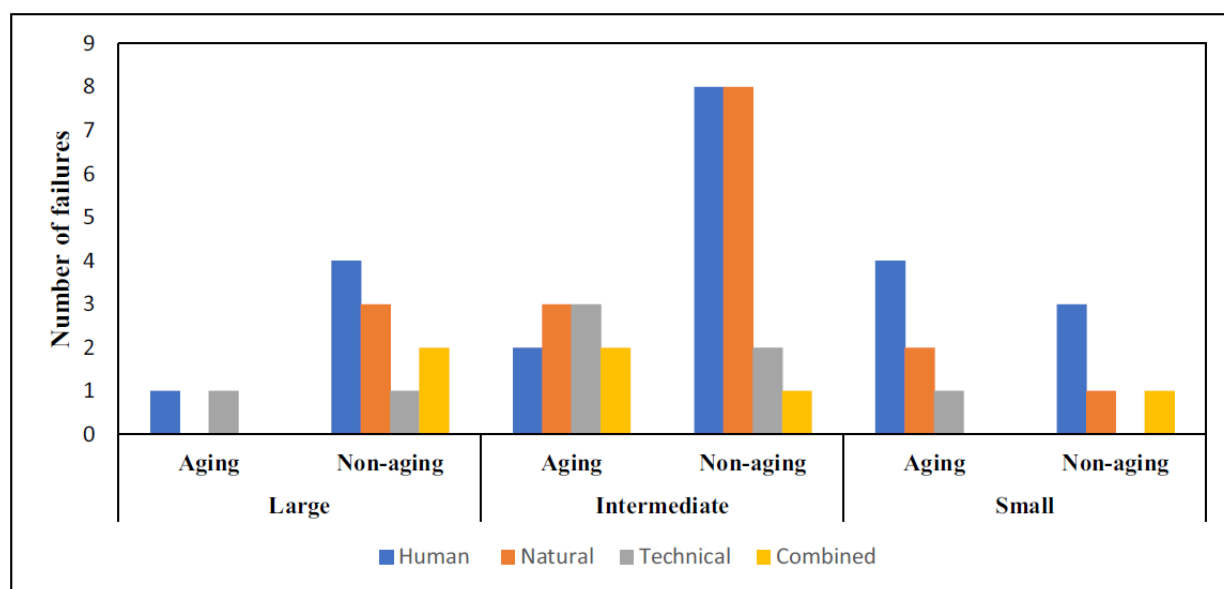


Figure 1 – Classification of hydrodynamic accidents that occurred in the 21st century

There are numerous reservoirs in our country as well. These reservoirs have been constructed for various purposes, including river regulation, water storage, electricity generation, and others. Within the study area—the Yevlakh–Neftchala zone of the Kura River basin—any potential accident that may occur at the dam of the Mingachevir Reservoir, which is considered the largest reservoir in the Caucasus and is capable of causing severe inundation consequences, could lead to an extremely dangerous emergency situation for the country. In particular, in the event of such an accident, all settlements located along the Kura River downstream from the Mingachevir Reservoir dam (especially those situated close to the river) could be exposed to flooding. Figure 2 presents a risk map of areas vulnerable to flooding and inundation. In the case of a possible dam failure, there is a high probability that the flood wave would propagate in this direction [31].

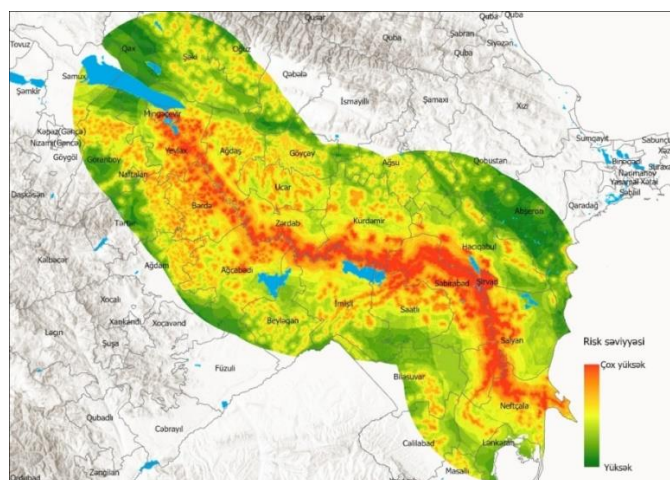


Figure 2 – Risk map of areas prone to flooding and inundation

The factors that may lead to such an accident should be derived from the global experience reviewed above. These experiences demonstrate that reservoir dams may fail due to natural, technical, and human factors, as well as intentional destruction by an enemy under wartime conditions.

Based on the results of the conducted analyses, all of the aforementioned potential factors can be considered relevant for Azerbaijan. The country's territory is frequently exposed to seismic activity, and in particular, the area where the Mingachevir Reservoir is located is classified as an 8-intensity seismic zone [32]. At the same time, during high-water periods (spring–summer months), increased precipitation and snowmelt further raise the likelihood of such hydrodynamic events.

In addition, the military-political risk factor should also be regarded as relevant for Azerbaijan. Experience gained during the Second Karabakh War indicates that rockets deliberately launched by the enemy fell in areas surrounding the Mingachevir Hydropower Plant (Figure 3). Due to the protection provided by air defense forces and the neutralization of the rockets in midair, no actual damage was recorded. Nevertheless, in such circumstances, the potential risk of damage to reservoir dams cannot be entirely ruled out [33].



Figure 3 – Missiles launched by the Armenian armed forces in October 2020

Conclusion. The conducted analyses show that reducing the risk of real hydrodynamic accidents worldwide requires the implementation of scientifically grounded monitoring systems, the improvement of early warning mechanisms, timely dissemination of information to the population, effective management measures, and the availability of risk maps by zones. Considering the large number of hydraulic structures in our country, improving the measures mentioned above will help minimize losses in the event of such emergencies.

Furthermore, when assessing the probability of such an accident occurring at the dam of the Mingachevir Reservoir – the largest reservoir in the Caucasus – and its potential consequences if it were to occur, a catastrophic emergency scenario emerges. In addition, during hazard level assessment, the integrated analysis of hydraulic and hydrological parameters is of great importance. Risk assessment enables the identification of risk zones, the prediction of possible losses, and the planning of preventive measures aimed at preventing such events and mitigating their severity.

References

1. Reem Nasser, Dimitris Tzioutzios, Yiliu Liu. Statistical Analysis of Global Dam Accidents in the 21st Century: A Focus on Common Features and Causes. *Water Resources Management* – 2025, 39:6493–6516, <https://doi.org/10.1007/s11269-025-04259-7>
2. Anna Kalinina, Matteo Spada, Peter Burgherr. Application of a Bayesian hierarchical modeling for risk assessment of accidents at hydropower dams. *Safety Science* 110 – 2018, 164–177, <https://doi.org/10.1016/j.ssci.2018.08.006>
3. Andrea Maranzoni, Marco D’Oria, Carmine Rizzo. Probabilistic mapping of life loss due to dam-break flooding. *Natural Hazards* – 2023, 20:2433–2460, <https://doi.org/10.1007/s11069-023-06285-3>
4. South Asia Network on Dams, Rivers and People (SANDRP) – 2024. <https://sandrp.in/2024/05/06/may-2024-brazil-dam-collapse-leads-to-death-destruction/>
5. Paulina Concha Larrauri, Upmanu Lall, M. Amin Hariri-Ardebili. Needs for Portfolio Risk Assessment of Aging Dams in the United States. *Journal of Water Resources Planning and Management* 149:04022083. - 2022, DOI: 10.1061/JWRMD5.WRENG-5673
6. Aristotelis Koskinas, Aristoteles Tegos, Penelope Tsira, Panayiotis Dimitriadis, Theano Iliopoulou, Panos Papanicolaou, Demetris Koutsoyiannis, Tracey Williamson (2019) Insights into the Oroville Dam 2017 Spillway Incident. *Geosciences* 2019, 9(1), 37; <https://doi.org/10.3390/geosciences9010037>
7. Reliefweb – 2010. Available at: <https://reliefweb.int/report/kazakhstan/kazak-authorities-probe-flood-tragedy>
8. Azertac – 2010. Available at: https://azertag.az/en/xeber/kazakhstan_president_demands_answers_over_deadly_flooding-589242
9. Asia-Plus New Agency – 2010. 35 villagers die in Kazakhstan flood. Available at: <https://www.asiaplustj.info/en/news/centralasia/20100315/35-villagers-die-kazakhstan-flood>
10. R.A. Nabilah, Dwita Sutjiningsih, Evi Anggraheni, S.Murniningsih. Dam break analysis of Situ Gintung Dam collapse reconstruction. *IOP Conference Series Earth and Environmental Science* – 2020, DOI: 10.1088/1755-1315/599/1/012064
11. Joko Sujono. Hydrological Analysis of the Situ Gintung Dam Failure. *JDR* – 2012, Vol.7 No.5 pp. 590-594, doi: 10.20965/jdr.2012.p0590, <https://www.fujipress.jp/jdr/dr/dsstr000700050590/>

12. Reliefweb WHO emergency situation report no. 2: Collapsed dam of Situ Gintung, Tangerang, Banten Province, Republic of Indonesia - 30 Mar 2009. Available at: <https://reliefweb.int/report/indonesia/who-emergency-situation-report-no-2-collapsed-dam-situ-gintung-tangerang-banten>
13. J. David Rogers, Conor M. Watkins, Jaewon Chung. The 2005 upper Taum Sauk Dam failure: A case history. *Environmental & Engineering Geoscience*, Vol. XVI, No. 3, August 2010, pp. 257–289. DOI: 10.2113/gsegeosci.16.3.257
14. Practical Engineering – 2024. The Wild Story of the Taum Sauk Dam Failure <https://practical.engineering/blog/2024/10/15/the-wild-story-of-the-taum-sauk-dam-failure>
15. Abree A. Peterson, Karen E. DeMatteo, Roger J. Michaelides, Stanton Braude, Alan R. Templeton. Time Series Analysis of Vegetation Recovery After the Taum Sauk Dam Failure. *Remote Sens.* 2025, 17(9), 1605; <https://doi.org/10.3390/rs17091605>
16. Leslie F. Harder, Jr., Keith I. Kelson, Tadahiro Kishida, and Robert Kayen. Preliminary Observations of the Fujinuma Dam Failure Following the March 11, 2011 Tohoku Offshore Earthquake, Japan. *Geotechnical Extreme Events Reconnaissance (GEER)* https://damfailures.org/sites/default/files/wp-pdf/QR5_Preliminary-Observations-of-Fujinuma-Dam-Failure_06-06-11.pdf
17. Daniel Pradel, Joseph Wartman, and Binod Tiwari. Failure of Fujinuma dam during the 2011 Tohoku Earthquake. *Joint Conference Proceedings 9th International Conference on Urban Earthquake Engineering/ 4th Asia Conference on Earthquake Engineering* March 6-8, 2012, Tokyo Institute of Technology, Tokyo, Japan. DOI: 10.1061/9780784412787.156
18. Bhuddarak Charatpangoon, Junji Kiyono, Aiko Furukawa, Chayanon Hansapinyo. Dynamic analysis of earth dam damaged by the 2011 Off the Pacific Coast of Tohoku Earthquake. *Soil Dynamics and Earthquake Engineering* Volume 64, - September 2014, Pages 50-62. Available at: <https://www.sciencedirect.com/science/article/abs/pii/S0267726114001006>
19. Ahmed F. Chraibi, Anton J. Schleiss, and Jean-Pierre Tournier. Failure of Saddle Dam, Xe-Pian Xe-Namnoy Project: Executive Summary. *Springer Series in Geomechanics and Geoengineering* – 2020, DOI: 10.1007/978-3-030-46351-9_2
20. Lei Xie, Wenbin Xu, Xiaoli Ding. Recursory motion and deformation mechanism of the 2018 Xe Pian-Xe Namnoy dam Collapse, Laos: Insights from satellite radar interferometry. *International Journal of Applied Earth Observation and Geoinformation* Volume 109, May 2022, 102797. <https://doi.org/10.1016/j.jag.2022.102797>
21. International Rivers – 2018. The Xe Pian-Xe Namnoy Dam Disaster: Situation Update Two Years On. Available at: https://www.internationalrivers.org/wp-content/uploads/sites/86/2020/08/ir-factsheet-2_year_xe_pian_dam_collapse_1_0.pdf
22. Department of Environment, Great Lakes, and Energy – 2020/ Edenville/Sanford dams' failure. Available at: <https://www.michigan.gov/egle/about/organization/water-resources/dam-safety/edenville-sanford>
23. Daniel Pradel, Adam Lobbstaël, Colin N. Brooks, Richard Dobson, Nicholas Marion, Thomas Oommen, Alan J. Esser, P.E., Adda Athanasopoulos-Zekkos, Dimitrios Zekkos, Marin Clark, Kirk Townsend, Nathan Niemi, Nik Midttun, Madeline Hille. The May 19, 2020, Failure of Edenville Dam near Midland, Michigan. *Geo-Extreme* – 2021, <https://doi.org/10.1061/9780784483688.026>
24. BBC – 2024. Available at: <https://www.bbc.com/news/world-europe-68746276>
25. ALJAZEERA News – 2024. <https://www.aljazeera.com/news/2024/4/6/russia-evacuates-4000-people-after-floods-dam-burst-near-kazakh-border>
26. Reliefweb – 2024. <https://reliefweb.int/report/sudan/sudan-collapse-arbaat-dam-port-sudan-red-sea-state-flash-update-no-02-29-august-2024-enar>

27. United Nations News – 2024. Available at: <https://news.un.org/en/story/2024/08/1153651>
28. United Nations Office for the Coordination of Humanitarian Affairs (OCHA) – 2024. Available at: <https://www.unocha.org/publications/report/sudan/sudan-collapse-arbaat-dam-port-sudan-red-sea-state-26-august-2024-enar>
29. European Union Civil Protection and Humanitarian Aid – 2025. Available at: https://civil-protection-humanitarian-aid.ec.europa.eu/news-stories/stories/disaster-photos-nova-kakhovka-dam-breach-ukraine_en
30. United Nations News – 2025. Available at: <https://ukraine.un.org/en/295829-flooding-was-%E2%80%98just-beginning%E2%80%99-kakhovka-dam-disaster-two-years>
31. Habil Huseynov, Surxay Safarov. Assessment of potential flood risk along the Kura River in the Yevlakh–Neftchala zone, The Seventh Eurasian Conference RISK-2025 “RISK-ORIENTED DESIGN AND OPERATION OF INFRASTRUCTURE SYSTEMS: SUSTAINABILITY PARADIGM”, Abstract Book – 2025, pp. 117-118 www.eurasianrisk2025.com
32. Habil Huseynov. Asian Disaster Reduction Center (ADRC) Visiting Researcher FY23 Country Report Azerbaijan – 2023, pp. 21, Japan. Available at: https://www.adrc.asia/aboutus/vrdata/CR/FY2023_Azerbaijan_CountryReport.pdf
33. Habil Huseynov, Aprel Babayev, Maharram Abdullayev. Flood disaster risk management during military conflicts, International Conference on “Environmental impact of military conflicts” dedicated to the “Year of Constitution and Sovereignty” – 2025, Baku, Azerbaijan, pp. 243-244.

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ГИДРОДИНАМИКАЛЫҚ АПАТТАР: ПАЙДА БОЛУ СЕБЕПТЕРІ ЖӘНЕ МИНГЯЧЕВИР СУ ҚОЙМАСЫ БӨГЕТІ ҮШІН ЫҚТИМАЛ ҚАУІПТЕР

Аңдатпа. Гидродинамикалық апаттар гидротехникалық құрылыстардың істен шығуы салдарынан туындайтын, кең аумақтардың су басуына және ауқымды әлеуметтік-экономикалық зардаптарға әкелетін Төтенше жағдайлар болып табылады. Мақалада гидродинамикалық апаттардың, әсіресе су қоймалары бөгеттерінің бұзылуынан туындайтын апаттардың пайда болуына әсер ететін факторлар жүйелі түрде талданған. Әлемде орын алған нақты оқиғалар негізінде олардың келтірген салдары, сондай-ақ апаттардың туындау себептері жан-жақты зерттеліп. Еліміз жағдайында осындай гидродинамикалық апаттардың ықтимал пайда болу себептері талданған. Зерттеу нысаны ретінде алынған Мингячевир су қоймасы бөгетінің мүмкін апаттар салдарынан бұзылу қаупі бағаланған. Зерттеу нәтижелері техникалық, табиғи және антропогендік факторлардың өзара ықпалы гидродинамикалық апаттардың ауқымы мен әсер ету күшін едәуір арттыратынын көрсетеді.

Түйінді сөздер: гидродинамикалық апат, су басу, гидротехникалық құрылыстар, төтенше жағдай, су қоймасы, тасқын, бөгеттің бұзылуы, Мингячевир су қоймасы бөгеті.

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ГИДРОДИНАМИЧЕСКИЕ АВАРИИ: ПРИЧИНЫ ВОЗНИКНОВЕНИЯ И ПОТЕНЦИАЛЬНЫЕ УГРОЗЫ ДЛЯ ПЛОТИНЫ МИНГЯЧЕВИРСКОГО ВОДОХРАНИЛИЩА

Аннотация. Гидродинамические аварии являются чрезвычайными ситуациями, возникающими в результате выхода из строя гидротехнических сооружений и приводящими к затоплению и подтоплению обширных территорий, а также к крупномасштабным социально-экономическим последствиям. В статье системно проанализированы факторы, обуславливающие возникновение гидродинамических аварий, в частности катастроф, возникающих вследствие разрушения плотин водохранилищ. На основе реально произошедших в мире событий детально исследованы вызываемые ими последствия, а также причины возникновения аварий. Проанализированы возможные причины потенциального возникновения подобных гидродинамических аварий в условиях нашей страны. В качестве объекта исследования проведена оценка риска вероятного разрушения плотины Мингячевирского водохранилища в результате возможных аварий. Результаты исследования показывают, что взаимное воздействие технических, природных и антропогенных факторов в значительной степени увеличивает масштабы и силу воздействия гидродинамических аварий.

Ключевые слова: гидродинамическая авария, подтопление, гидротехнические сооружения, чрезвычайная ситуация, водохранилище, наводнение, разрушение плотины, плотина Мингячевирского водохранилища.

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