MAIN PROBLEMS IN THE DEVELOPMENT OF HYDROPOWER IN KHOREZM REGION

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Abstract

This article analyzes the main problems in the development of the hydropower sector in Khorezm region. The natural and geographical features of the region, dependence on the Amudarya, outdated infrastructure, distribution of water resources and the negative impact of climate change on hydropower production are considered on a scientific basis. Also, the importance of small and micro-hydropower plants, obstacles to their implementation and proposals for solutions to these problems are given.

Keywords:

hydropower, Khorezm region, Amudarya, small hydropower plant, infrastructure, water resources, climate change, environmental risk, energy source

Relevance of the topic Energy security is one of the main factors of economic and social development of any country. The demand for electricity in the Khorezm region is increasing year by year. This increases the need for renewable energy sources, in particular hydropower, in the region. Hydropower is an environmentally friendly, sustainable and economically viable source of energy. However, there are a number of problems in this area in the Khorezm region, and their in-depth study and development of scientifically based solutions are an urgent issue

Scientific and theoretical significance The article systematically analyzes the factors hindering the development of hydropower. Through a scientific theoretical approach, the natural resource potential of the Khorezm region, the possibilities of using river flows, and the efficiency of existing hydroelectric power plants are studied. This will serve as a theoretical basis for creating a sustainable and environmentally safe hydropower system in this region in the future.

Research methodology The following scientific methods were used in writing this article: Analysis and synthesis - assessment of the state of existing hydropower plants and water infrastructure; Statistical method - comparison of data on water consumption, the amount of energy produced, the level of consumption; Observation and expertise - ecological, economic and technical conditions in the region were studied; Comparison - the conditions of the Khorezm region were compared with the experience of other regions or countries.

Research results. Hydropower production in the Khorezm region depends mainly on the waters of the Amu Darya, and this resource has a transboundary nature. Since the relief of the region is not mountainous, the construction of large hydropower plants is economically inefficient. Water distribution is mainly carried out on the basis of the irrigation network, which limits its use in the energy sector. Outdated infrastructure, lack of sufficient investment, the negative impact of climate change, and a shortage of personnel further exacerbate the problems. The risk of ecological imbalance, especially water shortages in downstream areas, necessitates ecological planning of hydropower infrastructure.

Hydropower statistics for Uzbekistan

There are a total of 40 hydropower plants in the country with a total installed capacity of 1912MW: 307MW large, 512MW run-of-river, and 205MW mini, and 1400MW reservoir hydropower plants. Annual production is approximately 6.5 billion kWh, which is ~8.8% of the country's total electricity

1- table

Hydropower statistics for Uzbekistan

Statistical indicator.	Amount.	. Year or period.
Total installed hydropower capacity in the country:	1912MW (307MW large, 512MW run of river, 205MW mini, 1400MW reservoir)	2023
Annual production in Uzbekistan:	6.5 billion kWh (~8.75% of total production)	2022
Technically usable capacity:	27–27.5 billion kWh/year (active utilization rate ≈23–27%)	2023
Tuyamuyun HPP:	150MW capacity, annual production 571GWh	updated: October2024 (actually active since 1983))

Khorezm region - domestic hydropower production

As the concept of Khorezm has grown, hydropower plants within the region have their own potential: Tuyamuyun hydropower complex (along the Amu Darya) - capacity 150MW, annual production 571GWh. In January-August 2021, the amount of electricity generated by large industrial enterprises in the region amounted to 111.5 million kWh - this is 1.6% of the volume of industrial production.

Irrigation and economic impact of electricity

276,700 hectares of land are irrigated through the Toshsoqa irrigation system, which saves 31.6 million kWh of electricity, depending on the water of the Amu Darya. Out of 607 hydrotechnical structures, 318 were reconstructed, and 279 pumping units were abandoned - this is also a positive result from an ecological point of view.

Numerical analysis of development opportunities and problems

Uzbekistan's technically usable hydropower potential is 27 billion kWh per year, currently only ~23–27% is used. According to data for 2023, the country's hydropower potential has reached 2415 MW, which is an increase of 500 MW compared to 2019. The existing large hydropower plants in the Khorezm region are water-dependent, especially due to climate change - in spring and summer the water level on the Amu Darya River will drop sharply

2- table

Statistical conclusions

Indicator	Quantity
Large HPP production in Khorezm (8 months)	111.5 million kWh
Electricity saved through the Toshsoqa system	31.6 million kWh
Tuyamuyun GP complex production	571 GWh
Installed capacity - total in Uzbekistan	1912 MW
Technical useful potential	27 billion kWh/year
Used share	23–27%
Share of HPP in Khorezm within the industry	1.6%

Analytical commentary

Although the hydropower industry in Khorezm is still developing, this sector demonstrates optimal use of a very small part of the available resources (for example, the economic savings of Tashsoqa). Tuyamuyun GP, as a large

infrastructure, makes a significant contribution to the energy balance of the region. Based on statistical indicators, it is possible to increase the energy potential of the region by strengthening small (mini and micro) HPPs without waste. Acknowledgements I would like to express my deep gratitude to the leadership of the Ministry of Energy of the Republic of Uzbekistan, the Tuyamuyun Hydropower Plant Department, and the Khorezm Regional Water Management Department for their practical and informational assistance in conducting this research work. I also express my gratitude to the scientists and consultants of the Faculty of Geography and Natural Resources of Urgench State University, who provided statistical and technical information.

Conclusions and proposals

The following measures should be taken to develop hydropower in the Khorezm region: Expanding the possibility of obtaining energy from water flows through the introduction of small and micro-hydroelectric power plants; Modernizing infrastructure, reconstructing existing hydropower plants. Strengthening cooperation with local personnel training, research institutes; Implementing investment projects with international financial institutions; Implementing hydropower projects based on environmental expertise, ensuring environmental safety.

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