

Dataset Development on the Distribution of Large and Medium Hydropower Stations across the Qinghai-Xizang Plateau (2024)

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Abstract: As a crucial ecological barrier and a major hydropower energy base in China, hydropower development on the Qinghai-Xizang Plateau exerts a profound influence on the regional ecological environment. To support the evaluation of ecological effects of major construction projects under the Second Comprehensive Scientific Expedition to the Qinghai-Xizang Plateau, this study systematically collected and organized data on large and medium-sized hydropower stations that have been built or are currently under construction across the plateau. The dataset encompasses 61 hydropower stations distributed across 6 major river basins—the Yarlung Zangbo River, Yellow River, Jinsha River, Lancang River, Yalong River, and Min River—and includes key attributes such as station name, geographical location, total reservoir capacity, installed capacity, annual power generation, regulation performance, development mode, and construction period. The data sources consist of field surveys and literature review. There was a “dense in the east and sparse in the west” spatial pattern of the large and medium-sized hydropower stations on the Qinghai-Xizang Plateau. Significant inter-basin differences were observed in both installed capacity and reservoir scale. Although the pace of hydropower construction has slowed, the scale of individual projects has increased, and dam-type development remains predominant. This dataset provides a solid scientific foundation for assessing ecological impacts of hydropower projects, managing regional water resources, and planning energy systems under the goal of carbon neutrality.

Keywords: Qinghai-Xizang Plateau; large and medium-sized hydropower station; installed capacity; spatial distribution

DOI: <https://doi.org/10.3974/geodp.2025.04.02>

Received: 28-08-2025; **Accepted:** 15-11-2025; **Published:** 24-12-2025

Foundation: Ministry of Science and Technology of P. R. China (2019QZKK0403)

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Citation: Huang, Y. F., Yang, L. H., Song, X. F., *et al.* Dataset development on the distribution of large and medium hydropower stations across the Qinghai-Xizang Plateau (2024) [J]. *Journal of Global Change Data & Discovery*, 2025, 9(4): 382–386. <https://doi.org/10.3974/geodp.2025.04.02>.

1 Introduction

The Qinghai-Xizang Plateau plays a crucial role in shaping and regulating China's climate system^[1-6]. Clarifying the impacts and potential ecological risks of major hydropower development projects on the Plateau's ecological security barrier system is fundamental for strengthening ecological protection and taking corresponding preventive measures. According to the objectives of the Second Comprehensive Scientific Expedition to the Qinghai-Xizang Plateau, under the theme "Ecological and Environmental Effects of Major Construction Projects", it has become an urgent need to conduct scientific evaluations of the ecological and environmental effects of large-scale hydropower development projects on the Qinghai-Xizang Plateau. However, existing hydropower project data are fragmented, unsystematic, and lack key parameters necessary for ecological effect assessment.

This study, based on the task framework of the above scientific expedition, adopts a combined approach of field investigation and literature collection to systematically gather and organize multi-dimensional attribute data for 61 large and medium-sized hydropower stations distributed across the 6 major basins of the Qinghai-Xizang Plateau.

This work fills the data gap in the hydropower engineering system of the Qinghai-Xizang Plateau and supports the needs of the Second Comprehensive Scientific Expedition. In the future, this dataset can further serve regional water resource management and energy planning under the carbon neutrality target, providing a scientific foundation for sustainable regional development and policy decision-making.

2 Data Sources and Methods

This study is based on the objectives of the Second Comprehensive Scientific Expedition to the Qinghai-Xizang Plateau, under the theme "Ecological and Environmental Effects of Major Construction Projects". It follows the standards specified in the Classification and design safety standards for hydropower projects (DL 5180—2003)^[7]. A total of 61 large and medium-sized hydropower stations (each with an installed capacity $\geq 50,000$ kW) that have been built or are under construction across the 6 major river basins of the Qinghai-Xizang Plateau were systematically investigated and documented. Data collection was carried out through 2 complementary approaches: (1) Field investigation—using GPS positioning (accuracy ± 10 m) and on-site institutional visits to obtain first-hand data such as geographical location, construction status, and engineering scale of hydropower stations; (2) Engineering literature review—supplementing technical parameters by referencing journal articles and published materials^[8-17]. Data quality control was ensured through multi-source cross-validation (e.g., comparing enterprise data with government bulletins) and spatial verification (using coordinate pickers from the Gaode Map Open Platform). The dataset was organized into 6 sub-tables corresponding to the 6 river basins, encompassing 12 core indicators, including the station name, installed capacity, and regulation performance. Owing to the expedition's route, data on large and medium hydropower stations in the Yarlung Zangbo River, Yellow River, Lancang River, Yalong River, and Min River basins came from firsthand visits by authors. Data for the Jinsha River basin were collected from academic journals.

In terms of data development, this study standardized all key fields, including the station name, river basin, administrative division, installed capacity, total reservoir capacity, regulation performance, and development mode. Logical consistency tests were performed on indicators such as the construction year, installed capacity, and reservoir capacity, and all outliers and duplicate records were removed. Based on the QGIS platform, the geographical coordinates of each hydropower station were converted into spatial point vector data, and

spatial partitioning was conducted according to the 6 major river basins for regional management and analysis.

3 Data Results

3.1 Dataset Composition

The Dataset on the distribution of large and medium hydropower stations across the Qinghai-Xizang Plateau (2024) consists of 6 parts, corresponding to the 6 major river basins: the Yarlung Zangbo River, Yellow River, Jinsha River, Lancang River, Yalong River, and Min River. Each sub-dataset includes detailed records of the large and medium-sized hydropower stations that have been built or are under construction within the respective basin.

3.2 Data Results

From the perspective of spatial distribution, the 61 large and medium-sized hydropower stations exhibit a significant spatial imbalance (Figure 1), with the characteristic pattern of being “dense in the east and sparse in the west”. Most stations were concentrated in the southeastern region of the plateau. Among them, the Min River Basin contained the largest number of hydropower stations (20 in total), accounting for 32.8% of all stations, while the Jinsha River Basin had the highest number of stations under construction (6 in total), representing 54.5% of all ongoing projects.

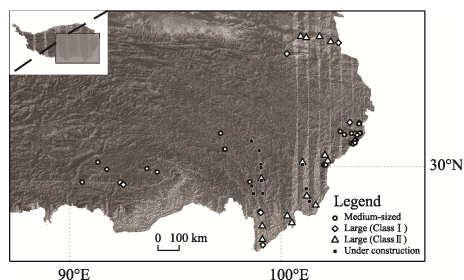


Figure 1 Distribution map of large and medium hydropower stations on the plateau

In terms of elevation gradient, large and medium-sized hydropower stations were mainly concentrated within 1,000–4,000 m, which aligned closely with the topographic characteristics of the deep canyon regions of the plateau. These canyons, characterized by fast-flowing rivers and abundant hydropower potential, provide favorable natural conditions for hydropower development. The 11 projects currently under construction were extending into remote areas such as the upper reaches of the Jinsha River, reflecting a relationship between the development sequencing and project accessibility: earlier developments prioritized areas with convenient transportation, while later phases gradually expanded into more remote regions—an indication of technological advancement and growing energy demand.

Time series analysis shows that the period 2005–2010 marked the first major peak in hydropower construction on the Qinghai-Xizang Plateau, with an average annual increase of 2.8 large and medium-sized stations, and a record high of 8 new stations in 2006. During this period, strong policy support attracted substantial capital and technological investments, driving rapid growth in hydropower construction. After 2010, the pace of new construction slowed, but the scale of individual projects increased. For example, the Lianghekou Hydropower Station, which began construction in 2015, had a reservoir capacity of 12 billion m³. This change reflects both the maturity of large-scale project conditions and the growing need for enhanced water regulation to improve resource utilization efficiency and meet broader energy demands. The average installed capacity of hydropower stations rose from 698,200 kW during 2000–2005 to 1,260,500 kW during 2020–2025 (Figure 2), demonstrating significant improvement in hydropower technology and engineering capability.

In terms of regulation type, daily regulated stations accounted for 64.3% (36 stations), indicating that most facilities were designed primarily to handle short-term peak-load demands, with limited ability to regulate intra-annual runoff distribution. Regarding development mode, dam-type projects made up 50.8% (31 stations), slightly higher than diversion-type projects (47.5%, 29 stations), with only 1 pumped-storage station recorded. This distribution pattern reflects the geographical and engineering characteristics of hydropower development on the Qinghai-Xizang Plateau: the canyon terrain is favorable for intercepting river flow and forming large reservoir capacities, which facilitates water regulation and power generation. In contrast, diversion-type development harnessed the river's potential energy drop for power generation, minimizing large-scale inundation and thereby reducing ecological impact—an approach particularly significant for the fragile ecological environment of Qinghai-Xizang Region.

Overall, China's hydropower development on the Qinghai-Xizang Plateau has achieved remarkable progress, forming a regionally distinctive hydropower development pattern. Through the rational planning and coordinated development of various river basins, the major hydropower projects in the region have made substantial contributions to the national energy supply, while optimizing the use of the plateau's rich hydropower resources.

4 Discussion and Conclusion

The Dataset on the distribution of large and medium hydropower stations across the Qinghai-Xizang Plateau (2024) systematically integrates the core attribute information of 61 large and medium-sized hydropower stations distributed across the 6 major river basins. This dataset directly supports the Second Comprehensive Scientific Expedition to the Qinghai-Xizang Plateau, particularly the research theme “Ecological and Environmental Effects of Major Construction Projects”.

The results revealed a clear spatial pattern of “dense in the east and sparse in the west” with hydropower stations mainly concentrated within the 1,000–4,000 m. In temporal terms, the period 2005–2010 marked a construction boom, followed by a slowdown in new projects but a steady increase in the scale of individual stations. The average installed capacity rose from 698,200 kW in 2000–2005 to 1,260,500 kW in 2020–2025, reflecting continuous technological advancement and optimization in hydropower engineering.

Regarding regulation performance daily regulated stations dominated the dataset, indicating that many facilities are still focused on short-term peak demand adjustments. In terms of development mode, dam-type hydropower stations slightly outnumbered diversion-type stations, illustrating the continued importance of reservoir-based hydropower for resource regulation and energy supply stability.

Overall, this dataset provides a comprehensive and reliable record of the spatial distribution, scale characteristics, and construction timelines of large and medium-sized hydropower stations built and under construction on the Qinghai-Xizang Plateau. It lays a solid data foundation for advancing understanding of the current status and future trends of hydropower development, facilitating scientific evaluation of its ecological impacts, and

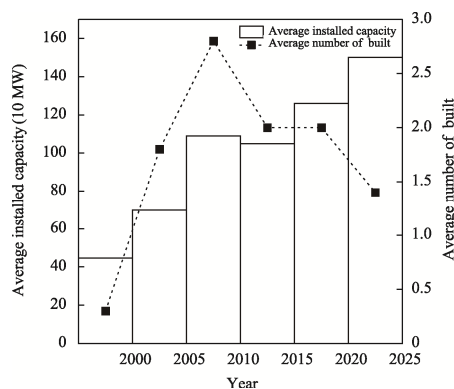


Figure 2 Annual average number of stations constructed, and the average installed capacity

supporting the formulation of sustainable strategies for regional water resource and energy management under the national carbon neutrality goals.

Author Contributions

Huang, Y. F. was responsible for the overall design and development of the dataset and authored the data paper. Zhang, X. Z. participated in data collection and processing. Yang, L. H. and Song, X. F. revised and refined both the dataset and the data paper.

Conflicts of Interest

The authors declare no conflicts of interest.

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