小水力發電潛能流量查詢系統初步建置－以高屏溪流域為例

Preliminary Establishment of a Flow Information System for Assessing Small Hydropower Potential: A Case Study of the Gaoping River Basin

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摘　要

為推動臺灣 2050 年淨零轉型的目標，除太陽能、風力與地熱能外，小水力發電亦為再生能源的新勢力。發展小水力發電的首要工作為具體掌握河川各時間與空間區段的流量資料進而推估潛力場址之發電潛能。然而，絕大多數河段並無長期觀測流量資料可供發電潛力場址估算裝置設計流量，且臨時設置流量監測設備進行短期資料蒐集亦無法代表長期流量特性。基此，本研究將透過現有水文測站之長期觀測流量資料推估未設測站地點計算發電潛能所需流量資料並產製相關水文地文圖資，提供開發業者或有意願投入公民電廠社區居民或公民團體作為快速評估潛力場址發電潛能之友善參考工具。

本研究擇定高屏溪流域為示範區域，水文資料主要蒐集流域內主、支流現存測站之歷史觀測流量紀錄，流量站包含：里嶺大橋站、杉林大橋(2)站、六龜(1)站、三地門站與大津橋(1)站。地文資料主要蒐集新版臺灣本島網格數值地形模型資料，利用地理資訊系統進行高屏溪水系主、支流及其集水區範圍繪製，並進一步演算各支流長度與坡度等地文資料。進一步採用現存流量站的歷史觀測日流量紀錄繪製全年流量超越機率曲線，同時計算各個超越機率流量(如 Q10、Q20、Q30、…、Q90)。初步設定以 Q50 作為小水力發電裝置設計流量，採用面積比例法延伸推估至其他小支流之未設測站地點。若設定以其他超越機率流量為裝置設計流量(如 Q80)，亦以前述相同方法延伸推估至其他未設測站地點。最後，建置網路版查詢系統做為建置小水力發電潛能評估查詢系統之雛型，未來可進一步與其他相關小水力發電潛能評估圖層資料(如電力系統送電線圖層)進行套疊，延伸更完整且全面性之應用層次。

關鍵詞：小水力發電，發電潛能流量，流量超越機率曲線，未量測地點

Abstract

To support Taiwan's goal of achieving net-zero emissions by 2050, in addition to solar, wind, and geothermal energy, small hydropower is emerging as a promising renewable energy source. A fundamental step in the development of small hydropower is acquiring accurate and site-specific river discharge data across spatial and temporal scales to estimate the hydropower potential of candidate sites. However, most river reaches lack long-term flow observations necessary for designing hydropower systems, and short-term monitoring through temporary instruments often fails to capture long-term flow characteristics. To address this gap, this study utilizes long-term discharge records from existing hydrological stations to estimate flow conditions at ungauged sites required for hydropower potential assessment. In addition, relevant hydrological and geomorphological maps and datasets are generated to serve as user-friendly reference tools for developers, community residents, or citizen groups interested in community-based small hydropower projects.

The Gaoping River Basin was selected as a demonstration area. Hydrological data were collected from existing flow stations on the main river and its tributaries, including Lilin Bridge Station, Shanlin Bridge(2) Station, Liugui(1) Station, Santimen Station, and Dajin Bridge(1) Station. Geomorphological data were derived from Taiwan’s updated gridded Digital Elevation Model (DEM). Using Geographic Information System (GIS) techniques, the river network and corresponding catchment boundaries were delineated, and the length and slope of each tributary were calculated. Daily flow records from the gauging stations were used to construct annual Flow Duration Curves (FDCs), and flow exceedance values (e.g., Q10, Q20, Q30, ..., Q90) were computed. Initially, the median flow (Q50) was adopted as the design discharge for small hydropower devices, and the area-ratio method was applied to extrapolate flow values to ungauged tributaries. Alternative exceedance flows (e.g., Q80) can also be used for design discharge estimation using the same approach. Finally, a prototype web-based query system was developed as the foundation for a small hydropower potential assessment platform. This system can be further integrated with additional spatial data layers, such as power grid transmission line maps, to enhance its comprehensiveness and applicability in future planning and development.

Keywords: small hydropower generation, hydropower potential discharge, flow exceedance probability curve, ungauged sites