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Application of a hydrological model to evaluate the potential hydro energy in a mountainous small river basin of Japan

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Abstract The low flow from mountainous basins has long been developed to supply water to urban areas downstream. Little attention was paid to developing hydro-electricity for the community in the hilly and mountainous regions. After the disaster of TEPCO's Fukushima no. 1 nuclear power plant, a new energy policy of Japan directs a decrease on the dependence on nuclear power. Feed-in tariff (FIT) of renewable energy was enacted on 1 July 2012 to cope with the increasing small-scale distributed types of natural energy development, including mini-hydro-power. The aim of this study is to apply the hydrological model (Fujimura *et al*., 2012) with an hourly time scale coupling the Diskin–Nazimov infiltration model for the mini-hydropower development. The Seto River basin (53.7 km^2), which is located in the central mountain region of Shikoku in western Japan, was selected to develop mini-hydro-electricity for the local community. The low flow of the Seto River, which is being diverted to supply M&I water for Kochi city by tunnels with a differential head of 25 m, is not used for mini-hydropower. The optimal parameters of the storage function equation for low flow are estimated on the basis of hydrological model analysis. The discharge duration curve and the potential hydropower duration curve are calibrated by the hydrological model to apply 20 years of hourly time-series data (1991–2010) using optimized parameters. The results of the analysis of the Seto River basin indicate that: (i) the set of two parameters in the storage function equation for the low flow in the hydrological model is identified, and (ii) the potential of the mini-hydropower is evaluated to satisfy local power demand as well as restoring the economy of the handicapped community with the surplus hydropower electricity.

Key words hydrological analysis; low flow; storage function equation; optimal parameters; hydropower duration curve