



Watershed Modelling of the Mindanao River Basin in the Philippines Using the SWAT for Water Resource Management

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Abstract

This study aims to simulate the watershed of the Mindanao River Basin (MRB) to enhance water resource management for potential hydropower applications to meet the power demand in Mindanao with an average growth of 3.8% annually. The soil and water assessment tool (SWAT) model was used with inputs for geospatial datasets and weather records at four meteorological stations from DOST-PAGASA. To overcome the lack of precipitation data in the MRB, the precipitation records were investigated by comparing the records with the global gridded precipitation datasets from the NCDC-CPC and the GPCC. Then, the SWAT simulated discharges with the three precipitation data were calibrated with river discharge records at three stations in the Nituan, Libungan and Pulangi rivers. Due to limited records for the river discharges, the model results were, then, validated using the proxy basin principle along the same rivers in the Nituan, Libungan, and Pulangi areas. The R^2 values from the validation are 0.61, 0.50 and 0.33, respectively, with the DOST-PAGASA precipitation; 0.64, 0.46 and 0.40, respectively, with the NCDC-CPC precipitation; and 0.57, 0.48 and 0.21, respectively, with the GPCC precipitation. The relatively low model performances in Libungan and Pulangi rivers are mainly due to the lack of datasets on the dam and water withdrawal in the MRB. Therefore, this study also addresses the issue of data quality for precipitation and data scarcity for river discharge, dam, and water withdrawal for water resource management in the MRB and show how to overcome the data quality and scarcity.

Keywords: SWAT; Mindanao River Basin; Discharge; Watershed Modelling; Precipitation; Proxy Basin.

1. Introduction

Among the developing countries, the Philippines faces a considerable challenge regarding development due to the continuous increase in electricity demands, with an annual average rate of increase of 4.3% [1]. The power demand of the Mindanao island group in the Philippines has increased by 3.8% annually over the past decades [2]. In April 2017, the maximum power peak demand in Mindanao reached approximately 1,696 MW [3]. However, the Mindanao water resources contributed 38%, or 1,947 GWh, of the gross power generation from hydropower in June 2017 [3]. Regardless of the current contribution of water resources to renewable energy, the power demand continues to outpace the supply. Thus, to address this emerging problem, assessment for a potential source of sustainable renewable energy is needed. The purpose of this study is to enhance water resource management for hydropower application in Mindanao to improve the electrification situation and support the implementation of the Renewable Energy Act of the Philippines.

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