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ORIGINAL PAPER

# Runoff modelling of Aripal watershed using SWAT model

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**Abstract**
Accuracy in watershed modelling has improved because of the use of continuous-time and distributed hydrologic models like SWAT (Soil and Water Assessment Tool). However, it has also significantly increased the amount of work required for users to parameterize the watershed in general and to accurately describe the watershed's spatial variability in particular. Some of the challenges involved in maintaining geographical data have been eased by recent advancements in geographical information systems (GIS). This paper addresses the first ever research conducted in the Aripal watershed, which is significant due to its topography and remote accessibility issues. The Soil and Water Assessment Tool (SWAT) with an interface to ArcView GIS software was used to assess the runoff of the Aripal watershed, a sub-catchment of the Jhelum River, a significant Himalayan River situated in J&K, India. Soil map, land use-land-cover map, slope map, and historical weather and discharge data served as the primary inputs to the model giving runoff as the output from the watershed. Two statistical measures, coefficient of determination ($R^2$) and Nash–Sutcliffe efficiency coefficient (NSE) were calculated for the purpose of assessing model performance. Calibration of model was done for runoff values between 2005 and 2013 and validation for the period 2014–2018.The value of $R^2$ achieved was 0.904 for calibration period suggesting a good relation between observed/measured and predicted values, and for the validation period it was found to be 0.766. The value of NSE was found to be 0.718 for calibration period and 0.813 for the validation period**.** Thus, SWAT was found to be an appropriate tool for watershed runoff modelling. The extreme flood event that occurred in the catchment in 2014, on the other hand, was underestimated by the model. Sensitivity analysis was carried out to identify the most influential variables in the determination of runoff from the watershed.

**Keywords** SWAT · Streamflow · GIS · Runoff · Aripal watershed · Digital elevation model (DEM) · *R* square coefficient · Nash–Sutcliffe model coefficient of efficiency

## Introduction

Surface runoff refers to that part of precipitation that does not penetrate into the soil; however, it flows over the surface of land and joins surface water sources like rivers, lakes, and streams. Surface runoff varies with time and space, being considered as the best example of unsteady spatially varied flow (SVF), with around 33% of all precipitation that falls on land converts to runoff; the rest 67% meets the needs of evapo-transpiration, or infilters into the soil (Perlman 2016). Runoff is the only effective fraction of rainfall that returns

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