Abstract

The purpose of this article is to determine the response of river discharge to precipitation variability in the Gucha-Migori River Basin, where recurrent flood events persist despite the limited application of non-structural mitigation measures. Understanding the rainfall–runoff relationship is essential for improving flood risk management and decision-making. The study employed the Hydrologic Engineering Centre–Hydrologic Modelling System (HEC-HMS) to simulate river discharge using precipitation data for the period 1969–2015. The model's performance was evaluated through R^2 and Nash–Sutcliffe efficiency during calibration and validation. A correlation analysis was also done to determine how seasonal rainfall relates to river discharge. The results show that the HEC-HMS model achieved moderate performance, with R^2 and Nash values of 0.52 and 0.36 during calibration, and 0.42 and 0.31 during validation, respectively. The findings further indicate a statistically significant positive relationship between seasonal precipitation and river discharge at the 0.05 significance level, confirming that precipitation variability strongly influences discharge patterns in the basin. The study concludes that precipitation variability is a key driver of river discharge and that HEC-HMS is a suitable tool for simulating rainfall–runoff processes. It is recommended that hydrological modelling be integrated into flood risk assessment and early warning systems to enhance preparedness and support sustainable water resource management in the basin. The findings provide a basis for improving flood response planning and reducing vulnerability to flood hazards.