ABSTRACT

The watershed and channel parameters which include boundary, drainage network, watershed and channel slopes, aspect, flow direction, etc. are generated using ARC/INFO GIS software. Land use and land cover information are generated from Indian Remote Sensing Satellite data. The predictive capability of the distributed curve number technique with different values of initial abstraction is studied and its superiority over traditional composite technique is investigated. The impacts of curve number range, heterogeneity of watershed are studied for a hypothetical watershed and to a medium size agricultural watershed. The results obtained using distributed curve number technique with the help of GIS software is compared with observed runoff data. The distributed curve number technique results advocate the use of this approach with initial abstraction, as 0.2 times of potential maximum retention of soil for runoff estimation in small and medium size agricultural watersheds of similar hydro-meteorological conditions.

Synthetic unit hydrograph parameters are modeled with geomorphologic parameter for different duration unit hydrographs. Unit hydrographs derived from past runoff record during 1995 to 2001 are used and their parameters were modeled with geomorphologic parameters that have high correlation with them. The coefficients of the model are optimized using Gauss-Newton method of parameter optimization of non-linear model with robust technique. The results show that unit hydrograph parameters such as time to rise, time base and peak discharge can be successfully modeled with geomorphologic parameters of watershed for generating synthetic unit hydrographs for ungauged watersheds of similar hydrologic and climatic conditions.

Agricultural Non Point Source (AGNPS) model was calibrated and validated to simulate runoff, peak flow, sediment and nutrient yield from two agricultural watersheds namely Tarafeni (158.06 km^2) and Bhairabbanki (69.15 km^2) and its sub watersheds located in West Bengal state of India. The model calibration is performed using 31 storms of 1999 and 2000 for Tarafeni watershed and then validated with 18 storms of 2001 for both the watersheds. During AGNPS model calibration runoff and peak flow values were found to be under predicted for most of the small rainfall events (<50mm) and under AMC I condition and over predicted for medium and large events and also in AMC III condition. The model efficiency is found to be 0.994, 0.986 and 0.979; R^2 as 0.999, 0.995 and 0.997; RMSE as 0.77 mm and 4.68 $m^3 s^{-1}$ and 133 tons (8.41 kg ha^{-1}) respectively for runoff, peak flow and sediment yield at outlet. The CRM and student's t-test suggest the calibrated parameters are acceptable. During model validation for Tarafeni watershed the model efficiency is found to be 0.978, 0.965, and 0.957; R^2 as 0.985, 0.993 and 0.993; RMSE as 1.10 mm, 6.18 $m^3 s^{-1}$, 78.51 tons (4.97 kg ha^{-1} respectively for runoff, peak flow and sediment yield at the outlet. The model efficiency for Bhairabbanki watershed is estimated to be 0.895, 0.876, and 0.827; R^2 as 0.973, 0.979 and 0.928; RMSE as 1.52 mm, 5.11 $m^3 s^{-1}$, 41.7 ton (6.03 kg ha^{-1}) respectively for runoff, peak flow and sediment yield at outlet. The similar trend of CRM value is found. The students' t-test for significant difference showed that there is no significant difference between the observed and simulated values for all the parameters and for both the watersheds. The results of sensitivity analysis indicated that runoff is sensitive to only curve number. The peak flow is most sensitive to CN value followed by channel slope and field slope. The sensitivity analysis study also revealed that the variables most significantly affecting the sediment yield in descending order are CN, K, EI, P, C, LS, SL, CSS, CS based on mean absolute deviation value. In

Tarafeni watershed 9.9% area is under permissible soil erosion range, hence remaining 91.1% area needs soil conservation measures to improve water quality and land degradation problems. Similarly in Bhairabbanki watershed 3.2% of total area is under very severe erosion, 36.16% under severe erosion, 42.56% under very high erosion, 16.7% under high erosion, and 1.37% of total area under moderate erosion class. The most economical BMP for Tarafeni watershed is contour bunding in agricultural lands followed by converting fallow lands to agriculture, where as for Bhairabbanki it is conversion of fallow land to agriculture followed by contour bunding in agricultural lands.

Key words: Distributed curve number, Synthetic unit hydrograph, Hydrological models, AGNPS, Simulation, GIS, BMPs