International Journal of Agricultural Engineering, Vol. 2 No. 2 (October 2009 to March 2010) : 254-258

Estimation of surface runoff from agricultural watershed using remote sensing and GIS technique

A.K. JADHAO, V.G. JADHAO AND M.P. TRIPATHI

Accepted : *July, 2009*

See end of the article for authors' affiliations

Correspondence to:
A.K. JADHAO
Faculty of Integrated Watered Development and Management, Water and Land Management Institute (WALMI), AURANGABAD (M.S.) INDIA

ABSTRACT

Soil Conservation Service-Curve Number (SCS-CN), is an empirical model was applied for estimating direct runoff from a small watershed (Arang) in Chhattisgarh (India). Various maps including Digital Elevation Model (DEM), watershed and sub-watershed boundaries, drainage network and soil texture were generated using topographic and soil resource data in the environment of a Geographical Information System (GIS). Supervised classification method was used for land use/cover classification of a satellite image of IRS 1D using daily rainfall data of selected events. Performance of model was evaluated by using several test criterions including graphical, statistical and mathematical. Results revealed that the observed runoff values were having good agreement with the runoff values predicted by the SCS-CN model. Student's t-test resulted that the means of observed and predicted runoff were found to be similar at 95 per cent confidence level. Value of coefficient of determination (r^2) was found to be 0.73 and it was indicated that the estimated runoff values for each selected rainfall events were having good agreement with the observed values. Overall deviation indicated that the model over predicted the daily runoff by 26.6 per cent. On the basis of the study it can be concluded that the SCS-CN model can estimate surface runoff from the Arang watershed marginally well for various daily storm events.

Key words : Remote Sensing, GIS, SCS–CN Model, Runoff, Land use map, Watershed

Most of the watersheds in India are still ungauged due to economic and social constraints. Several hydrological models including empirical models and physically based models are available to study the rainfall-runoff transformation process. The tediousness and time-consuming nature of extraction of watershed parameters can be eliminated by means of Remote Sensing Technology (RST) and Geographical Information System (GIS) in addition to obtaining high accuracy. Input data for the model can be extracted with the use of GIS mainly from the map layers including land use/cover, DEM, soil, slope, drainage and watershed and sub-watershed boundaries.

Several studies (Bingner *et al.*, 1996; Sharma *et al.*, 1996; Tiwari *et al.*, 1997; Wang and Hjelmfelt, 1998, Tripathi *et al.*, 2002) found that the remote sensing technique is most suitable to study the most recent pattern of land use/land cover. Among the various empirical models the Soil Conservation Service-Curve Number (SCS-CN) models have been widely used for establishing the rainfall-runoff relationship of different watersheds. Many studies applied SCS-CN model for estimating the surface runoff by deriving curve numbers using satellite data and GIS technique (Singh, 1994). Looking to the importance of empirical models, remote sensing data and GIS technique the current study was under taken with the use of a widely used empirical model (SCS-CN), remote sensing data and a GIS technique to estimate the surface runoff from a small watershed (*Arang)* in Chhattisgarh (India).

METHODOLOGY

Study area and data collection:

The selected watershed is a part of eastern plateau Mahanadi basin of Chhattisgarh state in India. It is located between $81^0 90^{|}$ to $82^0 0^{|}$ E longitude and $21^0 20^{|}$ to $21^0 26^{|}$ N latitude and covers an area of 54.50 km^2. The Arang is 3rd order watershed according to Strahler's stream ordering scheme (Strahler, 1957). The elevation of the watershed ranges from 270 to 290 m above Mean Sea Level (MSL). The average slope of the watershed was 1.5 per cent. Location map of the study area watershed is shown in Fig.1. Predominant soil of the watershed is clay loam. Sandy loam, loam, sandy clay are also found in the watershed. The watershed receives an average annual rainfall of 1420 mm, out of which the monsoon season (June to October) contributes more than 80 per cent rainfall.

The topographic map of the watershed was collected for use from the Department of Soil and Water Engineering, Faculty of Agricultural Engineering, I.G.A.U., Raipur. Soil texture map and soil resources data of the