

Hydro-Meteorological Study of Dudhkoshi Basin with Frequency Analysis and Flood Forecasting using HEC-HMS Model



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Abstract

Many rivers in Nepal are either ungauged or poorly gauged due to complex terrains, extreme monsoon climate and lack of technical and financial capabilities. In this context, the role of hydrological models are extremely useful. A model, once calibrated and verified on catchments, provides a multi-purpose tool for further analysis. Hydrological simulation methods are relatively simple and reasonably accurate in practical applications.

The study was carried out in DudhKoshi River basin, Nepal. Long term hydrology, Flood frequency analysis using statistical approach and Regional Climate Model (RCM) were used to determine the characteristics of high flow events in the basin. High flow events are a key component in river engineering, for the design and risk assessment of various projects. In case of ungauged basin where no historical data are available, regional flood frequency analysis is considered as a viable means to approximate at-site flood characteristics by exploiting the information available at neighboring sites.

This research investigates the potential changes on discharge and flood events in future in DudhKoshi Basin. For this study, a lumped hydrological model developed in HEC-HMS 4.0 is implemented over the study area (3849 km²), calibrated and validated at a daily time step, fed by ground observations and using the future decadal climate data obtained from the RCM named Providing Regional Climates for Impact Studies (PRECIS). The result shows that HEC-HMS has the best fit among the methods used. The simulation depicts a univocal increasing trend of discharge for middle centuries (2030-2060) indicating the possibility of increased frequency and intensity of floods.

It is suggested that the calibrated model then can be used as a decision support tool in the operation and management of DudhKoshi Dam Reservoir. Hence, Hydrological modeling is a powerful technique in the planning and development of integrated approach for management of water resources.

Keywords: Frequency analysis, HEC-HMS, Flood

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List of Acronyms

%	Percentage
⁰ C	Degree Celcius
A.D	Of the Christian Era (from the latin <i>anno domini</i>)
B.S.	Bikram Sambat
CIWEC	Canadian International Water and Energy Consultants
CN	Curve Number
CUH	Clark's Unit Hydrograph
DEM	Digital Elevation Model
DHM	Department of Hydrology and Meteorology
et al.	And others (from the latin <i>etalii</i>)
FDC	Flow Duration Curve
GEV	Generalized Extreme Value Distribution
GIS	Geographical Information System
GLOF	Glacier Lake Outburst Flood
HEC-HMS	Hydrologic Engineer Center's Hydrologic Modelling System
LP-III	Log Pearson Type III
NAST	Nepal Academy of Science and Technology
NEA	Nepal Electricity Authority
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PPT	Precipitation
PRECIS	Providing Regional Climates for Impact Studies
RCM	Regional Climate Model
Recham	Research Center of Hydrology and Meteorology
Sq.km	Square Kilometer
St	Storage Coefficient

Tc	Time of Concentration
TRMM	Tropical Rainfall Measuring Mission
TU	Tribhuvan University
UNEP	United Nations Environment Programme
WECS	Water and Energy Commission Secretariat
WMO	World Meteorological Organization