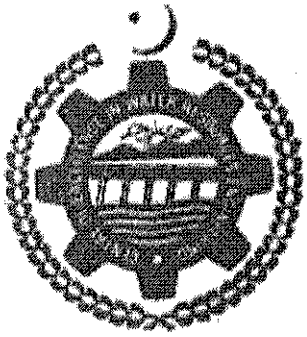
THESIS

GIS AND HYDROLOGICAL MODELING FOR WATER RESOURCES DEVELOPMENT OF HILL TORRENT IN POTHOWAR AREA



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ABSTRACT

Climatically major part of Pakistan falls in arid to semi arid zone, where the rains are seasonal and sporadic. Almost all hilly nullahs/hill torrents originating from the mountains of these areas receive non-perennial flows and pass through large tracts of fairly leveled and fertile land before they join the Indus Basin System. These hill torrents bring in flashy floods of shorter duration and higher magnitudes. Due to steep gradients, flood flows move with high velocity, which result in damages to standing crops, irrigation system, houses, roads etc, and some time human lives also. In fact, these hill torrents have lot of potential for agriculture produce to meet up the shortage of food and raw materials for agro based industries, if studied and managed wisely.

Pothowar Hill Torrent is one of the major hill torrent of Punjab Province. Pothowar area is one of the regions of Pakistan where the topography is classified as plateau along with intermittent gulleys and ravines; and as such no large canal system can be developed. The physical features of the area dictate the provision of local irrigation system for isolated small tract of land having topographic uniformity. Nevertheless the hill torrents flood flows are mostly wasted except those where storage arrangements have been provided. The plateau comprising the districts of Rawalpindi, Attock, Jhelum and Chakwal, forms about 40% of Punjab Barani (Rain fed) Tract (PBT). A small part of Gujrat District also forms part of Pothowar plateau.

In recent years, advances in the Geographic Information System (GIS) have opened many opportunities for enhancing hydrologic modeling of watershed system. Geospatial Hydrologic Modeling Extension (HEC-GeoHMS) has been used for the digital elevation model (DEM), soil type, land use information, etc. HEC-GeoHMS operates on DEM to develop sub-basin boundaries and prepare a number of hydrologic inputs.

Model "Design Flood for Windows (DFW)" estimates the peak flood discharge at study area for different return periods. Analytical Frequency Analysis of annual maximum historical peak flow data at Chirah and one day annual maximum effective rainfall data of Islamabad was carried out by using Gumbel Distribution to determine flood peaks and rainfall respectively of selected return period (2.33, 5, 10, 25, 40, 50 and 100 years). Effective rainfall was determined by subtracting losses like infiltration losses from actual rainfall. Snyder's method was used to synthesize flow pattern of a unit hydrograph for the study area. Time to peak was calculated as 14.1 hours and peak discharge was 196586.3 cusecs. Peak discharge obtained by Snyder's method was used to compute peak discharge of 100 years return period. Computed value of peak discharge at 100 years return period was 163753.23 cusecs or 4640.54 cumecs as compared to the actual value 174714 cusecs or 4951.15 cumecs of peak discharge at 100 years return period. The iterative results were close to the observed results i.e. errors 6%.

Model development would be useful for planning and management of the hill torrents areas of Pakistan. Model will estimate the peak flow discharge at Chirah for different return periods. This would help to design the flood control structures in consideration of floodwater storage and its utilization. Further more the model can be used to evaluate the impact of changes in hydrologic conditions.