M.Sc. Thesis

IMPACT OF MANGLA DAM RAISING ON FLOODS IN JHELUM RIVER

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ABSTRACT

The Mangla dam is the 7th largest dam of the world, built in 1967 with storage capacity of 5.88 Million Acre Feet (MAF) across the river Jhelum in Pakistan. Downstream of the dam, major cities (Jhelum, Khushab, Rasul and Jhang etc.) are located along the flood prone areas of river. In 1992, the reservoir collected excessive inflow and released maximum outflow from the dam which caused massive flood damages at downstream. In 2004, Mangla dam reduced its capacity to 4.6 MAF, due to sedimentation. Mangla dam was raised by 30 ft in 2009, which increased its capacity to 7.4 MAF. Floods have become frequent phenomena in study area, due to heavy precipitation, which usually occurs during monsoon season triggered severe flooding.

In present study, MAKESENS 1.0 software was used to analyze the increasing and decreasing flow trends of Marala barrage and Mangla dam. The Hydrologic Engineering Center Hydrological Modeling System (HEC-HMS) was used for reservoir routing and Hydrologic Engineering Center River Analysis System (HEC-RAS-5.0.3) was applied to downstream reach of river Jhelum from Mangla dam to see the impact of dam raising on floods at different locations.

Flow analysis of annual maximum instantaneous peak discharge of 46 years (1968-2014) of Marala barrage and Mangla dam showed an increasing trend. HEC-HMS model was used for reservoir routing to see the impact of Mangla dam raising on flood flows regulation using revised Standard Operating Procedures (SOPs). The HEC-HMS model was calibrated and validated by reservoir level of 2010 and 2012 respectively, then this model was applied to rout the historic floods i.e 1988, 1992 and 2010 flood, through raised Mangla dam.

The maximum outflow from the reservoir routing was used in HEC-RAS for flood inundation mapping along the study reach. The HEC-RAS was calibrated and validated by observed level at Rasul barrage in 2010. Then the model was applied for water surface profile computation and flood inundation against the observed and simulated maximum flood discharges. The result showed that after raising of Mangla dam, it has the capacity to hold the huge quantum of water during flood seasons to reduce the flood impact downstream of the dam. The flood inundation area estimated by model against the observed outflow value of 1992 flood was 1083 km^2 and against the simulated outflow value was 919.40 km^2. The inundation area saved was 163 km^2 (40278 acers) and the lag time observed during routing was 8 hours. Flood hazard maps were developed for flood category-I and category-III. In case of flood category-I, area covered by water depths for low (>2m), medium (3-4m), high (4-5m) and Ex. high (<5m) was 215.30 km^2, 169.72 km^2, 118.93 km^2 and 93 km^2 respectively. In case of flood category-III, area covered by water depths for low (>2m), medium (3-4m), high (4-5m) and Ex. high (<5m) was 173 km^2, 226.32 km^2, 263.48 km^2 and 329.41 km^2 respectively.