ASSESSMENT OF FLOW REGULATION EFFECTS OF MANGLA DAM RAISING ON DOWNSTREAM RIVER REGIME

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ABSTRACT

Dam construction as well as its raising for water storage changes natural flow regime at downstream due to flow regulation phenomenon of the dam. Changes in flow regime also effect the river regime with the passage of time. Changes in regime due to flow regulation also effect the water management and planning of downstream area. Assessment of flow regulation effects on flow regime is essential for accurate water management and planning. This study helps and suggests a method of assessment of flow regulation effects on downstream flow regime and river regime.

Flow duration curves at downstream on Jhelum barrage were developed with and without dam regulation to assess the effect of flow regulation through a dam. Regulated flows were available at Jhelum barrage. HEC-RAS model of the reach between Mangla dam and Jhelum barrage was developed for the generation of unregulated flows at Jhelum barrage. The model was first calibrated by observed water level at Jhelum Bridge for the flood year 2010 and observed inflows at Rasul barrage, after that the model was validated for another year 2011. Afterwards this model was applied to generate unregulated flows at Rasul barrage for the year2010, 2011 before dam raising period and 2012 till 2016 after dam raising period.

Flow duration curves of inflows and outflows at Mangla dam were developed for evaluating the annual storage volume and storage duration. Assessment of flow regulation effects on downstream was made by comparing the regulated and unregulated volume. Regulated and un-regulated flow duration curves of respective year were plotted at Jhelum barrage. Then regulated volume of water and regulated duration was calculated. With the help of these curves comparison between the annual storage volume at Mangla and annual regulated volume reached at Jhelum barrage,

was made. It was calculated that before dam raising in year 2010, 2011 reservoir stored 48.41 and 34.72 billion $m^3$of water in 139 and 109 days of the high flow period respectively. Similarly, after dam raising in year 2012, 2013 it stored 33.84 and 40.90 billion m^3 of water during 99 and 80 days of the high flow period respectively. The same stored volume of water then released in the rest of the period of the year. Evaluation of regulated and unregulated flow duration curves developed at Jhelum barrage showed that before raising in year 2010, 2011 dam regulated 47.67 and 25.82 billion m^3 of water with regulation duration of 225 and 268 days and after raising in year 2012, 2013 it regulated 68.83 and 38.10 billion cubic meter with regulation duration of 281 days and 319 days, respectively. This shows that after raising the dam, increased volume of water reached at Rasul barrage after regulation.

This procedure accurately developed flow duration curves and then effectively evaluated the effect of regulation by Mangla dam raising on downstream flow regime. The technique is to develop natural flow regime, and the outcome of this study will likely be helpful in evaluating the effects of flow regulation, as well as water resources planning and management.