



## **Climate Change and its Impacts on Water Resources and Management of Tarbela Reservoir under IPCC Climate Change Scenarios in Upper Indus Basin, Pakistan**

Firdos Khan and Jürgen Pilz

Institute of Statistics, Alpen-Adria University, 9020 Klagenfurt, Klagenfurt, Austria

Water resources play a vital role in agriculture, energy, industry, households and ecological balance. The main source of water to rivers is the Himalaya-Karakorum-Hindukush (HKH) glaciers and rainfall in Upper Indus Basin (UIB). There is high uncertainty in the availability of water in the rivers due to the variability of the monsoon, Western Disturbances, prolonged droughts and melting of glaciers in the HKH region. Therefore, proper management of water resources is undeniably important. Due to the growing population, urbanization and increased industrialization, the situation is likely to get worse.

For the assessment of possible climate change, maximum temperature, minimum temperature and precipitation were investigated and evidence was found in favor of climate change in the region. Due to large differences between historical meteorological data and Regional Climate Model (RCM) simulated data, different statistical techniques were used for bias correction in temperature and precipitation. The hydrological model was calibrated for the period of 1995-2004 and validated for the period of 1990-1994 with almost 90 % efficiencies. After the application of bias correction techniques output of RCM, Providing Regional Climate for Impact Studies (PRECIS) were used as input data to the hydrological model to produce inflow projections at Tarbela reservoir on Indus River. For climate change assessment, the results show that the above mentioned variables have greater increasing trend under A2 scenario compared to B2 scenario. The projections of inflow to Tarbela reservoir show that overall 59.42 % and 34.27 % inflow increasing to Tarbela Reservoir during 2040-2069 under A2 and B2 scenarios will occur, respectively. Highest inflow and comparatively more shortage of water is noted in the 2020s under A2 scenario. Finally, the impacts of changing climate are investigated on the operation of the Tarbela reservoir. The results show that there will be shortage of water in some months over different years. There are no chances of overtopping of the dam during the 2020s and the 2050s under A2 and B2 scenarios.

### KEY

**WORDS:** Climate Model, Climate Change, Hydrological Model, Climate Change Scenarios, Tarbela Reservoir, Inflow, Outflow, Evaporation, Indus River, Calibration, Bias Correction.