SNOW AND GLACIER HYDROLOGY IN NEPAL: PROJECT RESULTS FOR THE PROVISION OF DATA AND INFORMATION FOR WATER RESOURCES' DEVELOPMENT

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Water is the primary renewable resource of Nepal and the main source of energy production in the country. To increase the efficiency of water resources' management in Nepal, information about the seasonal and regional distribution of river discharge originating from the snow and glacier fields of the high Himalaya, is necessary. In 1987 the Government of Nepal and the Government of Germany agreed to a technical cooperation project, between the Department of Hydrology and Meteorology (DHM) and the German Technical Agency (GTZ), to establish a measuring service for snow and glacier hydrology in Nepal.

Under difficult institutional and environmental conditions, six Hydrometeorological stations have been established in the high Himalayas for acquiring the meteorological and hydrological parameters. Modern technologies have been introduced with regard to station instrumentation, discharge measurments, data processing, and modelling. A monitoring system has been introduced to enable staff to control instrument functions, shorten repair times, check data plausibility, and analyse causes for data losses. On an average, about 70-75% of the data can be retrieved from the

station network. Since 1987, the data have been archived in an electronic database management system to facilitate queries, retrieval and the compilation of data products. Yearbooks, with mean daily data, have been prepared and published, including the 1993 data.

From the beginning, the elaboration of data products as input for water resources' planning and development was envisaged as an important objective. A conceptual mathematical snow and glaciermelt model has been selected and adapted to Himalayan conditions which show significant differences compared to conditions in the European Alps. The model has been calibrated for three of the six high mountain glacierized drainage basins, namely the Langtang, Imja, and Modi *Khola* basins. The model is applied by the trained staff of the Snow and Glacier Hydrology Unit within the DHM. The results show that, despite data gaps, it is possible to make good estimates of the snow and glaciermelt runoff from these basins. The model operates on a daily basis with precipitation and temperature as the main inputs. The results demonstrate that, together with daily radio contacts with all stations, it is possible to use the model operationally in a near real-time mode. The last step in the operationalisation of the system would be to establish telemetric capacity in stations that are of economic importance for harnessing water resources, e.g. in planned and implemented hydropower projects.

To assess water resources' potentials in the Himalayas, it is necessary to develop regionalisation models for basins without snow and glacier hydrology stations. Ground-based methods had to be preferred before remote-sensing techniques because of financial and technical constraints in the current project. First results obtained from the regionalisation effort indicate that simple regression models can give reasonable indications of snow and glaciermelt runoff potentials for ungaged basins in Nepal.