

simplified model assumed. It is necessary to prepare new gravity maps and images incorporating additional data.

The Auto Trace and Digitise (ATD) software developed by us will be available shortly as a commercial package with differential price for research and educational institutions. Presently the supporting documentation is under preparation and we plan to release the software during AEG Silver Jubilee Seminar on 18th November 1999 at Chandigarh.

BOOK REVIEW

INVENTORY OF THE HIMALAYAN GLACIERS. M.K. Kaul (Editor)
(1999). Spl. Publ. No.34, Geological Survey of India, 27, Jawaharlal Nehru
Road, Calcutta, 165p., Price: Rs.745; \$43; £ 26

The Global Environment Outlook report CEO 2000, said that more than half of humanity relies on the fresh water that accumulates in the mountains. Growing population, land degradation, intensifying agriculture, increasing urbanization and industrialization have led to a fourfold increase in global freshwater abstractions. It added that over the next 25 years, the world would begin to run out of fresh water, and 'water wars' over scarce resources could spread across the world.

To avoid a water crisis in the next millennium, effective management of mountain water resources is essential to satisfy the growing demands. Nowhere is this need greater than in the south Asia where the snow and glaciers of the Karakoram/Himalaya mountain ranges provide up to 80 % of lowland dry-season flows of the Indus, the Ganges and the Brahmaputra rivers and their vast irrigation networks. Reliable estimates of seasonal flows are vital for agriculture, water supply, hydropower and industry in the region; however, there is limited quantitative understanding of the contribution of snow and glacier melt to downstream water resources.

Globally, long-term glacier observations are over a century-long tradition. It started with the establishment of the International Glacier commission during the 6th International Geological Congress at Zurich, Switzerland in 1894. Later, the Glacier Commission was renamed as International Commission on Snow and Ice (ICSI) and became part of the International Association of Hydrological Sciences (IAHS) under IUGG. The most detailed data were available for glaciers in Europe (Alps and Scandinavia). A general tendency towards glacier shrinkage was recorded, as well as some spectacular changes, such as disappearance of ice in glacier Bay (Alaska)-the largest retreat of glaciers ever directly observed by man. Nevertheless, studies on glacierized basins were focussed within the framework of the IHD (1965-1974) initiated by ICSI (IAHS). Under this programme UNESCO (1970) published guidelines concerning data acquisition and this was a major step towards standardization of global glacier data.

The long-awaited publication of the inventory of the Indian Himalayan glaciers by the Geological Survey of India is indeed an invaluable volume for researchers in high mountain hydrology. The Karakoram/Himalaya glaciers are unique in depending on precipitation received both in winter and summer, making them more sensitive to air temperature variations than most other glaciers. The other important feature of these glaciers is the presence of extensive debris-cover in the ablation region. For example, a year round discharge monitoring from three drainage basins in Langtang valley, Nepal Himalaya, revealed that the discharges for unit basin area was twice larger

at a basin where glacier area with debris was relatively large than those at the other two basins where much less area of debris covered glaciers, indicating a significant ice melt under a debris layer. Statistical analysis of glacier inventory for three drainage basins near Mt. Sagarmata, shows that 35 % of total glacier area is covered by debris. This is due to the fact that generally large glaciers longer than 2 km all have debris-covered parts in the ablation area. These facts clearly indicate that the debris-cover has an important bearing on ice melting and glacier response to climate.

The volume under review gives a detailed glacier inventory for five drainage basins namely Jhelum and parts of Satluj in the Indus basin and Bhagirathi, Tista and Arunachal Himalaya in the Ganga/ Brahmaputra basins. Each basin catalogue information on total basin area, number of glaciers, glacierized area, percentage of glacierized area, distribution of glacier areawise and lengthwise and total ice volume. Strangely, however, information on the debris-covered glaciers and length of observation period are missing. The glaciers in Tista basin, Arunachal Himalaya and Bhagirathi basin have substantial impact on monsoonal precipitation which provides much accumulation in summer when strong ablation occurs simultaneously. In my view many small glaciers in these basins must have vanished by the impact of climate change as the retreating speed has accelerated since 1980's.

Nevertheless, the present inventory is a snap shot of the Indian Himalayan glaciers as it identified only 1205 glaciers by detailed assessment in five drainage basins and left out many large important drainage basins. This inventory has overestimated the number and area of glaciers, mainly due to the fact that both glaciers and snowfields were included. The topographic maps used as a source material did not distinguish cartographically between true glaciers and snowfields.

A long-term concern is the evidence of widespread and rapid deglaciation in the Karakoram/ Himalaya. Glacier retreat will lead to temporary increase followed by reduction in river flows but the quantities, timing and consequences are unknown. Therefore, a regional hydrological model is required, incorporating snow and glacier melt, to provide forecasts for dry-season river flows and predictions of the effects of deglaciation.

In view of impending water crisis there is an urgent need to upgrade the technology level for glacier inventory by using high-resolution satellite imagery. One such initiative is the international GLIMS (Global Land Ice Measurement from Space) project designed to monitor the world's glaciers primarily using data from the ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) instrument aboard the EOS Terra (formerly AM-1) spacecraft scheduled to launch in October 1999. The reviewer is the chief for south Asia Regional centre covering India, Nepal and Bhutan.

On the whole, the volume is well edited and catalogue glaciers for the first time in five drainage basins in the Indian Himalaya. It is likely to be widely referenced book.

*Chairman, ICSI Working Group on Himalayan
Glaciology, School of Environmental Sciences,
Jawaharlal Nehru University, New Delhi - 110067
e-mail: iqbalhasnain@hotmail.com*

SYED IQBAL HASNAIN