# INTO THIN AIR

## Climate change on the Roof of the World

Retreating glaciers, low water levels in lakes, worsening floods and decreasing lean season flows in rivers will not only affect Tibetans.

**By Pushpa Adhikary**

The Tibetan plateau is the headwater of rivers that flow down to half of humanity. The Yellow River and the Yangtse start in northeastern Tibet and flow across China, the Mekong originates in eastern Tibet as do the Irrawady and Salween that traverse down to

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*Rarefied atmosphere on the Tibetan plateau.*

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***Fluctuating levels in recent times - fording a river in Tibet.***

Burma. The Tsang Po starts near Tsho Mipham (Lake Manasarovar) and travels eastwards for nearly 2,000 km before cutting through the Himalaya to become the Brahmaputra and empties into the Bay of Bengal. Most major rivers in Nepal originate in the Tibetan plateau and cut deep gorges to flow down to the Ganga. And there is the Indus and its tributaries which also start near Lake Manasarovar and flow westwards into Pakistan and empty in the Arabian Sea.

What happens to the water towers of the Tibetan plateau has a bearing on about three billion people in China, Southeast Asia, and South Asia. It is the snows melting on the Tibetan plateau in summer in the dry season that keeps these rivers flowing. There is also growing evidence that the Tibetan Plateau has a bearing on world climate. The elevation of the plateau cuts the jet stream in half during the northern winter, and it is the northward movement of the jet stream in spring that allows the monsoon rains to gradually push itself into the South Asian subcontinent.

Apart from the South polar ozone hole and evidence of depletion of stratospheric ozone over the Arctic Circle, Chinese scientists have recently also found evidence of ozone depletion over the Tibetan plateau. It is not yet certain what is causing this depletion at a point where the thickness of the atmosphere is reduced because of the plateau's elevation.

Professor Ying Xuexiang from

Chinese Academy of Social Sciences has been researching changes in the global climate and says that the same breakdown of ozone molecules by solar high-energy particles that takes place over the poles could be happening in the stratosphere above Tibet. Atmospheric ozone depletion takes place mainly because of the release of artificial CFC (chloro-fluoro-carbons) chemicals used in the computer and refrigeration industries.

More alarming is the fact that glaciers across the Himalaya and Hindu Kush mountains as well as the Tibetan plateau are receding. Glacier snouts are higher up the mountains, and large lakes have formed from snowmelt dammed up by terminal moraines from the slopes of Kanchenjunga to K-2. What is unclear is what is causing this - is it global warming, or is it the cyclical warming up of the earth?

Consider other evidence:

- Before emptying into the Yellow Sea, the 5,464-km long Yellow River runs from northeastern Tibet through nine provinces and autonomous regions. Since the early seventies, the mighty river has failed to reach the sea for progressively longer periods. During 1997 it was dry for 226 days.
- Recent surveys show that the water level in Eling and Zhaling lakes, the main source of Yellow River in

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***Kiyang run wild in the fragile ecology of the Tibetan plateau.***

northern Tibet, was one meter below the 4,268 meter level in 1993. The flow rate has also fallen drastically from 7.8 cubic meters per second to 2.7 cubic meters per second.

- Madoi County in China which covers an area of 25,000 sq km, once had 4,077 lakes measuring more than one sq km each. Today, over 2,000 smaller lakes that used to dot the grasslands and river valleys no longer exist.

Northern Tibet boasts the largest animal husbandry area in China. But recently, natural calamities such as drought, snowstorms, high winds and low temperatures have kept its grass and livestock output unstable.

Outside of the North and South Poles, Tibet is one of the few places on earth that is still predominantly wilderness. The highest mountains, deepest gorges, vast grasslands, many lakes and the uncharted, primeval cloud forests of southeastern Tibet are what give the roof of the world its uniqueness.

There are indications that the plateau climate has gone through successive periods of frost and thaw. The latest warming cycle seems to have begun 8,000 years ago. There are longer, warmer summers and there is more rain. Forest coverage has increased in southeastern Tibet bordering India and Burma. Some of the lakes dried up and grasslands expanded in the west.

Professor Zhang Jiang Hua from the Chinese Academy of Social Sciences in Beijing believes that global buildups in the levels of carbon dioxide and other greenhouse gases are accelerating the current natural warming cycle in Tibet.

"The global warming phenomenon is the main reason for receding snow in the mountains," says professor Zhang. "Tibetans alone cannot control it. For that there should be global initiatives." While a lot of what happens on the plateau is dependent on global atmospheric trends, Zhang believes China can do its share by protecting forests and controlling fossil fuel burning.

### Protect watershed

Prof Ying agrees that it is important to protect the Tibetan watershed since it has such a large impact on regions downstream. He says: "Global warming can lead to adverse consequence either leading to floods because of excessive snow melt or causing droughts due to decrease in precipitation. Neither scenario is encouraging but there is little people in Tibet can do. The only thing we can do is to try to protect what we have."

The plateau is one of the few wilderness areas left in the world besides the poles. Tibet's population density is only two persons per sq km, and although pollution is virtually non-existent, modernisation is fast catching up.

New factories and cement plants have brought smokestacks to the plateau. More worrying is the destruction of forests in the southeast. Since 1976, logging in Bomi district

in Eastern Tibet has been intensified and ecologists say it has worsened floods downstream in the Yangtse plains.

In 1992, Tibet promulgated a local decree concerning the protection of wildlife, stipulating legal measures to curb hunting and logging. Nature reserves were introduced and today are a key component of environmental protection in Tibet.

PANOS/Kunda Dixit

***Mt Everest - what if most of this snow begins to melt?***

# FURTHER READING AND WEBSITES

## CHAPTER 1 - GREENING HILLS

**Shrestha, M. L. et al, 1995.** *Community Forestry Manual.* Kathmandu: His Majesty's Government of Nepal, Department of Forestry, Community and Private Forest Division.

**Mathema, P.; Shrestha, K.B.; and Sthapit, K.M., 1998.** *Community Forestry Management in Nepal: Implications for Policy and Human Resources Development.* Paper submitted to ICIMOD.

**Bhatia, A. (ed), 1995.** *Seminar on Conflict Resolution in Natural Resources - Nepal Madhyasthata Samuha.* Kathmandu: ICIMOD

**Shrestha, K.B., 1996.** *Community Forestry in Nepal: An Overview of Conflicts - Nepal Madhyasthata Samuha.* MNR Discussion Paper 96/2. Kathmandu: ICIMOD

**Malla, S. P., 1996.** *Jalbire Women's Community Forestry Group - Nepal Madhyasthata Samuha.* MNR Discussion Paper 96/1. Kathmandu: ICIMOD

**Forestry in Nepal**
http://www.panasia.org.sg/nepalnet/forframe.htm
**FAO's website on Forestry**
http://www.fao.org/waicent/faoinfo/forestry/forestry.htm
**Forest Innovations (IUCN/WWF Joint Web Site)**
http://www.forests.iucn.org

## CHAPTER 2 - FLEEING THE MOUNTAINS

**Groetzbath, E., 1983/84.** 'Mobility of Labour in High Mountains and the Socio-economic Integration of Peripheral Areas'. In *Journal of Himalayan Studies and Regional Development,* Vol. (7,8):29-35p.

**Khanka, S. S., 1985.** 'Labour Migration and its Effect in Low Developed Region of Uttar Pradesh'. In Singh, J. S. (ed), *Environmental Regeneration in Himalaya: Concept and Strategies* - Reports from the Seminar on ... held on 24-26 Oct 1983 at Nainital. Nainital: Gyanodaya Prakashan.

**Rawat, P. S., 1983/84.** 'Patterns of Rural Urban Migration: A Case Study of Rural Society in the Garhwal Himalaya'. In *Journal of Himalayan Studies and Regional Development,* Vol. (7,8):37-40p.

**Rawat, R.,1997.** *Return Migration and Rural Development. Tehri Garhwal*: Siddhi Publishers and Distributors.

**Rawat, P. S., 1987.** 'Migration and Development in U. P. Himalaya'. In Pangtey, V. P. S.; Joshi, S. C. (eds.) *Western Himalaya: Environment Problems and Development.* Nainital: Gyanodaya Prakashan.

**Yadav, R. C. and Narain, S., 1983/84.** 'Out migration from Garhwal'. In *Journal of Himalayan Studies and Regional Development*, Vol. (7,8):45-49p.

**The Uttarakhand Homepage**
http://www.geocities.com/~karnavati/

## CHAPTER 3 - SELF -SUFFICIENT SLOPES

**Newman, L.F. (ed) 1990.** *Hunger in History: Food Shortage, Poverty, and Deprivation.* Oxford: Basil Blackwell.

**Jodha, N.S., 1996.** 'Enhancing Food Security in Warmer and More Crowded World: Factors and Processes in Fragile Zones'. In T.E Downing (ed), *Climate Change and World Food Security.* Berlin: Springer.

**Jodha, N.S. 1997.** 'Agricultural Growth and Sustainability: Perspectives and Experiences from the Himalayas'. In S.A. Vosti and T. Reardon (eds.), *Sustainability, Growth,and Poverty Alleviation : A Policy and Agroecological Perspective.* Baltimore: Johns Hopkins.

**Ensuring Local Food Security: An Example from the Mountains of Nepal**
http://www.icimod.org.sg/publications/IMD/issue4.htm
**WAICENT - The World Agricultural Information Centre**
http://www.fao.org/waicent/search/default.htm
**Topics in Sustainable Agriculture**
http://www.ocf.berkeley.edu/~tselby/index.htm

## CHAPTER 4 - TO FETCH A PAIL OF WATER

**Verkruijsse, B. et al, 1992.** *Annotated Bibliography: Gender and Irrigation and Soil and Water Conservation.* Wageningen: Department of Irrigation and Soil and Water Conservation and Department of Gender Studies in Agriculture, Wageningen Agricultural University.

**Van Koppen, B., 1998.** *More Jobs Per Drop: Targeting Irrigation to Poor Women and Men.* Amsterdam: Wageningen Agricultural University, Royal Tropical Institute.

**Gurung, J. D. (ed),1999.** *Searching for Women's Voices in the Hindu Kush-Himalayas.* Kathmandu: ICIMOD

**Mountain Women of the Hindu Kush-Himalayas**
http://menris1.icimod.org.np/intranet/homepage/publications/IMD/imd-98-6.htm

**Women and Water Resources**
http://www.fao.org/sd/fsdirect/fbdirect/FSP003.htm
**Women and Water Resources Supply and Use:Sub-Saharan Africa**
http://www.pangea.org/orgs/unesco/waw/WaW.html

## CHAPTER 5 - GREEN TREKS

**Banskota, K. and Sharma, B., 1995.** *Tourism for Community Development: Case Study Report on the Annapurna and Gorkha Regions of Nepal.* (MEI discussion paper, 95/11). Kathmandu: ICIMOD.

**Banskota, K. and Sharma, B., 1998.** *Mountain Tourism for Local Community Development in Nepal: A Case Study of Upper Mustang.* (MEI Discussion Paper 98/1). Kathmandu: ICIMOD.

**World Travel & Tourism Council - ECONETT**
http://www.wttc.org/
**World Tourism Organization**
www.world-tourism.org
**Sustainable Mountain Tourism in the Hindu Kush-Himalayas**
http://www.icimod.org.sg/focus/tourism/mtour_toc.htm

## CHAPTER 6 - LANDSLIDING AWAY

**Gupta, A.K., 1997.** 'Effect of Natural Disasters on Roads in India'. In *Proceedings of PIARC G2 Group Seminar on Natural Disaster Reduction for Roads*, pp. 1-16. New Delhi: Central Road Research Institute.

**Li Tianchi, 1996.** *Landslide Hazard Mapping and Management in China.* Kathmandu: ICIMOD.

**Malik, M.H. and Farooq, S., 1996.** *Landslide Hazard Management and Control in Pakistan.* Kathmandu: ICIMOD.

**Thakur, V., 1996.** *Landslide Hazard Management and Control in India.* Kathmandu: ICIMOD.

**Upreti, B.N. and Dhital, M.R., 1996.** *Landslide Hazard Management and Control in Nepal.* Kathmandu: ICIMOD.

**Kreutzmann, H., 1994.** 'Habitat Conditions and Settlement Processes in the Hindu Kush-Karakoram'. In *Petermanns Geographische Mitteilungen*, 138, 1994/6, pp.337-356. Sonderdruck: Justus Perthes Verlag Gotha Gumbo

**ReliefWeb: Natural Disasters**
http://wwwnotes.reliefweb.int/FILES\rwdomino.nsf/VNaturalDisastersTheLatest/
**Habitat and Hazards in the Himalayas of Nepal**
http://www.icimod.org.sg/publications/IMD/issue973.htm
**Mountain Accessibility and Rural Roads: Innovations and Experiences from Nepal**
http://www.icimod.org.sg/publications/IMD/issue975.htm
**Mountain Risks and Hazards**
http://www.icimod.org.sg/focus/risks_hazards/hazard_toc.htm

## CHAPTER 7- WAITING FOR THE BIG ONE

**Bilham, R.; Bodin, P; and Jackson, M., 1995.** 'Entertaining a Great Earthquake in Western Nepal. Historic Inactivity and Geodetic Test for the Development of Strain'. In *Journal of the Nepal Geological Society,* Vol. 11 (sp. Issue) 1995.

**The World-Wide Earthquake Locator**
http://www.geo.ed.ac.uk/quakes/quakes.html
**Natural Hazards in Nepal**
http://www.panasia.org.sg/nepalnet/watframe.htm#hazards

## CHAPTER 8 - GOING WITH THE FLOW

**Shamsul Haque, A. K. M., 1995.** 'Flood Forecasting and Warning Processes for the River System in Bangladesh'. In *Proceedings of the International Seminar on Water Induced Disaster, March 1995, DPTC and JICA.* Kathmandu: DPTC/HMG Nepal.

**Myint, A. K. and Hofer, T.,1998.** *Forestry and Key Asian Watersheds.* Kathmandu: ICIMOD

**Messerli, B.and Hofer, T., 1995.** 'Assessing the impact of anthropogenic land use change in the Himalayas'. In: Chapman, G. P.; Thompson, M. (ed) *Water and the Quest for Sustainable Development in the Ganga Valley.* London: Mansell Pub.

**Ives, J., 1986.** *Glacial Lake Outburst Floods and Risk Engineering in the Himalaya.* Occasional Paper No. 5. Kathmandu: ICIMOD

**ICIMOD 1996.** *Workshop on Hazard Mitigation in the Northern Sunkoshi and Bhote Koshi Water Catchment Areas (HMWA),Nepal, Organized by the Nepal-Switzerland Cooperation Project and ICIMOD.* Kathmandu, Nepal (May 8-10, 1996). Kathmandu: ICIMOD

**Water ..Leading Cause of Natural Disasters**
http://202.253.138.133/scripts/dbml.exe?template=/ENV/active1.dbm&type=1&ID=58
**International Center for Disaster-mitigation Engineering (INCEDE)**
http://incede.iis.u-tokyo.ac.jp/default.html
**Water Resources: Bangladesh**
http://www.geocities.com/Athens/Academy/5772/water1.html
**People and the Planet: Rivers of Life, Volume 5 Number 3 1996**
http://www.oneworld.org/patp/previous.html

## CHAPTER 9 - SMALL IS PRACTICAL

**Rijal, K.,1997.** 'Rethinking Water Resource Development'. In Ray, J. K. (ed), *India -Nepal Cooperation: Broadening Measures.* Calcutta: K. P. Bagchi & Company, pp. 127-150.

**Joshi, R.D. and Amatya, V.B. (eds.),1996.** *Report of a National Seminar on Mini- and Micro-hydropower Development in the Hindu Kush-Himalayan Region - The Nepal Perspective,* jointly organized by the Agricultural Development Bank of Nepal and International Centre for Integrated Mountain Development. Kathmandu: ICIMOD.

**Junejo, A.A. (compiled by),1997.** *A Manual of Private and Community-based Mini- and Micro-Hydropower Development in the Hindu Kush-Himalayas - A Reference Document for Decision-Makers, Planners, and Assessors.* Kathmandu: ICIMOD

**ICIMOD, 1994.** *Mini- and Micro-Hydropower for Mountain Development in the Hindu Kush-Himalayan Region. Report of the International Experts' Consultative Meeting,* Kathmandu, 13 - 17 June 1994. Kathmandu: ICIMOD.

**Energy in Mountain Areas**
http://www.icimod.org.sg/focus/energy/energy-toc.htm
**International Network on Small Hydro Power (IN-SHP)**
http://www.digiserve.com/inshp/

## CHAPTER 10 - THE REAL GOLDEN TRIANGLE

**Biswas, A. K. and Hashimoto, T.(eds.), 1997.** 'Asian International Waters : From Ganges-Brahmaputra to Mekong'. In *Water Resources Management, No 4.* Oxford University Press (can be ordered from Amazon.com)

**Joel M. Halpern, et al 1990.** *Mekong Basin Development : Laos and Thailand : Selected Bibliographies.* Dalley Book Service (can be ordered from Amazon.com)

**ASEAN-Mekong Basin Development Group [Mekong]**
http://www.polisci.com/world/intorg/20015.htm
**Must the Mekong Die?**
http://www.oneworld.org/patp/vol5_3/mekong.html
**Natural Resource Management in the Mekong River Basin: Perspectives for Australian Development Cooperation**
http://www.usyd.edu.au/su/geography/hirsch/index.htm
**MEKONG FORUM Home Page**
http://www.mekongforum.org/index.html

## CHAPTER 11 - TURNING WATER INTO DOLLARS

**Rijal, K., 1997.** 'Rethinking Water Resource Development'. In Ray, J. K. (ed), *India -Nepal Cooperation: Broadening Measures.* Calcutta: K. P. Bagchi & Company, pp. 127-150.

**Joshi, R.D. and Amatya, V.B. (eds.), 1995.** *Report of the National Seminar on Mini- and Micro-Hydropower Development in the Hindu Kush-Himalayan Region - The Nepal Perspective.* Kathmandu, 1 - 2 September, 1994. Kathmandu: ICIMOD.

**Water and Energy Commission Secretariat, Nepal**
http://www.panasia.org.sg/nepalnet/wecs/home.htm
**Energy in Mountain Areas**
http://www.icimod.org.sg/focus/energy/energy-toc.htm
**Hydropower in Nepal**
http://www.panasia.org.sg/nepalnet/tecframe.htm#Energy

## CHAPTE12 - FEELING THE HEAT

**Chalise, S.R., 1994.** 'Mountain Environment and Climate Change in the Hindu Kush-Himalayas'. In Benston, M. (ed) *Mountain Environments in Changing Climates.* London: Routledge.

**Tata Energy Research Institute (TERI) - Climate Change**
http://www.teriin.org/climate/climate.htm
**Climate Change in Asia**
http://www.ccasia.teri.res.in/
**Global Change: Review of Climate Change and Ozone Depletion**
http://www.globalchange.org/
**State of the Climate**
http://www.panda.org/climate_event/

## CHAPTER 13 – INTO THIN AIR

**Stone, P. B. (ed), 1992.** *The State of the World's Mountains, A Global Report,* Zed Books Ltd.

**Flooded Out**
http://www.newscientist.com/ns/19990605/newsstory4.html

**Stratospheric Ozone and Human Health Project, WMO/UNEP**
http://sedac.ciesin.org/WMO/china.html

**Snow Lines over Kathmandu**
http://www-nside.colorado.edu/NASA/YEARBOOK_1996/snow_lines.html