

# **Nepal Sensitization Tour Groundwater Governance Project (GGA), Nov. 7-8, 2005**

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## **1. Introduction and background**

The second leg of the sensitization tour for the Groundwater Governance Project was held in Kathmandu, Nepal on 7<sup>th</sup> and 8<sup>th</sup> November. The participants from IWMI were Dr. Karen Villholth, the project leader from the Colombo office and Dr. Sunderrajan Krishnan from the Anand office. The highlight of this visit was a meeting organized at the Hotel Himalaya in which several members of the government bodies, Universities and media participated.

## **2. Objectives of trip**

The objectives of the trip were:

1. Meet and initiate collaboration with organizations and institutions involved in groundwater management, research and media coverage that may provide fellows and participate in action research within the project
2. Present the project, its scope and to advocate for active involvement and commitment
3. Present a draft proposal for a research agenda for the project
4. Make initial steps towards recruiting the fellows for the courses
5. Get feedback from the institutions in terms of capacity building needs and priority research topics that could prove valuable in the more detailed planning of the courses and the research

## **3. Description of groundwater setting/problems in that country/basin**

*Physical picture:*

Nepal lies in the central part of the 2400 km long Himalayan arc ranging from Assam to the Karakoram. It is swanked between the Tibetan region of China to the North and the North-Eastern states of India to its East, South and West. It is characterized by extremes in physiography and climate - right from the high Himalayas in the East and North-East at a height of several kilometers above sea-level it drops down to the Nepal Terai and then down to the Indian Gangetic Plains which are less than hundred meters above sea-level, all within a span of 200 kilometers in the E-W direction, see Figure 1. Between these extremes, the terrain passes through the various valleys – e.g. Kathmandu valley,

the Pokhara valley, the Mahabharata range, the Churia or the Siwaliks and then on to the Terai plains.

The precipitation is from two sources – the monsoons from June to September that constitute around 87% of the overall precipitation and the Westerlies (winds that blow across from the Mediterranean) in the winter months, which account for the remainder. Though a small component, the Westerlies are important since much of this precipitation is in the form of snow that is important towards the lean season flows of rivers in the summer months. For some northern regions like Jomsom, the winter precipitation can amount to as much as half of the total annual precipitation (Gyawali, 2003).

The geology of Nepal is unique – it marks the transition where the Southern Gondwana land collided with the Northern Eurasian land lifting the sediments of the then existing Tethys sea and forming the Himalayas. As a result, the Southern and Northern parts of Nepal show widely differing formations. One finds the Archean crystalline formations buried deep beneath the Alluvium of the Terai, the marine sedimentary deposits that were squeezed to form the high mountains, and also the Siwalik formation formed by earlier East-West flowing rivers.

The drainage of the entire country falls within the Gangetic basin, see Figure 2. Overall, Nepal can be divided into four major river basins – the Saptakosi, Gandaki, Karnali and the Mahakali – apart from some small south-flowing rivers Bagmati, Tinau etc. Primarily, the rivers flow North-East to South-West and flow out from Nepal, in general, transversely to the Indo-Nepal border. Exceptions exist such as the Kosi which forms the border for few kilometers between Nepal and Bihar in India. Apart from the rivers that arise from the high Himalayas, there are numerous streams and rivers that also originate from the smaller ranges such as the Mahabharata and the Siwaliks. These rivers differ in several aspects from the former in terms of silt load, seasonality, inter-annual variation in stream flows, etc. For example, the high Himalayan rivers are characterized by lean season flows attributed to snowmelt, whereas these latter rivers flow in lean season, if at all, only due to base flow from groundwater. Therefore, groundwater contribution plays a much important role in these lower stretches, e.g. rivers such as Tinau (Gyawali, 1999).

Almost half of Nepal's 20 million-odd population lives in the Terai, which is a 30 km wide belt spanning across the country, from North-West to South-East. Alluvial aquifers underlie this belt to a thickness of 1-2 km, below which the Siwalik sediments are found. Apart from these, the important aquifers, from the view point of endowment and use, are the valley aquifers such as the Kathmandu valley, which by itself hosts 1.5 million people. Whereas the Terai aquifers are recharged primarily from the Bhabhar zone (a sand and gravel formation that absorbs water from the rivers and feeds the Terai aquifers) at the foothills of the Siwaliks, the valley aquifers are fed mainly by the streams from the enveloping mountains through smaller recharge zones at the base of these hills. Streams, many perennial, form a primary source of water for much of the hills of Nepal and these same streams also act as a source of recharge for aquifers. The system of community based water management using these streams is a widespread practice across these hilly regions.

### *Terai aquifers:*

On an overall basis, the extraction of groundwater in the Terai region annually is little more than 10% of the estimated annual recharge of 8800 MCM within this region (Kansakar, 2005). This means that there is possibility of increased use of this resource. However, increasing use would mean dropping of water tables beyond the shallow aquifer and also potential pollution of the major source of drinking water for the majority of people of this region, not from the extraction itself but from the increased waste water load and the agricultural and industrial chemicals associated with intensified use.

Developmental factors presently hinder an increase in development of this resource. Current electricity generation in Nepal serves only 15% of the population or 32% of the area. Previous subsidies on capital cost of tube-wells have now been changed to encourage group-owned shallow tube-wells through indirect subsidies. However, these policies do not benefit majority of the farmers since 60% of Terai farmers own less than a single hectare of land and 38% own less than 0.5 hectares. Group cohesion is difficult amongst these farmers, so is possibility of individual ownership. Treadle pumps have become widespread, but the manual labor involved poses a limit to extraction for irrigation. The current socioeconomic and energy situation, therefore, demands some technology that lies between the treadle pump and the tube-well so that it is economically and socially viable (Kansakar, 2005).

### *Valley aquifers:*

The Kathmandu valley aquifer exemplifies the state of the valley aquifers and also the future state of other such aquifers if appropriate measures are not undertaken. The valley is underlain by a multi-layered alluvial aquifer with a 30-50m thick shallow aquifer zone. The traditional model of managing water in the hills enveloping these valleys has been of using spring water which is commonly a perennial source of water. There exists well managed systems of trapping spring water (see Figure 3) and channeling it to fields located as terraces on the hill-side. Because of high water availability and a shallow water table (not more than few meters deep), the primary source of domestic water in the valley for centuries has been the thousands of spouts or shallow step wells. These “wells”, typically a community asset, are basically a deep pit with steps, perforated at the sides of the bottom which slopes from the inlet that receives water to an outlet which recharges the waste water back to the aquifer, see Figure 4. In recent times, with appropriation of water in the hills, changing land-use and increased groundwater use, such wells, though still in use, are becoming increasingly drier. The valley aquifer also faces challenges from pollution due to sewage and industrial sources. There have also been alarms over high levels of arsenic in some parts of the deeper aquifer, a possibility that is being debated and studied. Groundwater, therefore, being over-exploited in this valley aquifer (water tables fall by average of 1m every year in some areas (Sharma, 1995)), there are now attempts to import surface water from sources beyond the valley.

### *Challenges ahead:*

#### i) Ensuring safe drinking water

Shallow groundwater is the main source of drinking water for the Terai region of Nepal and also for much of the valley areas. With increasing use of groundwater, there is a need felt to transition to use of deeper sources that are claimed to be relatively safer for the Terai area. Especially in areas with risk of arsenic contamination, safer layers need to be identified and protected.

#### ii) Estimating the extent of arsenic

High levels of arsenic are reportedly being observed in several areas. Though not an alarm now, there is no definite pattern arising. The Water Supply and Sanitation Department plans to shift the main drinking water source from the hand pumps that tap the shallow aquifers to deeper tube-wells mainly because of this reason.

#### iii) Developing groundwater in the Terai

Potential exists for increasing use of groundwater in the Terai. However, several socioeconomic factors prevent this possibility. Another important aspect is the increasing development and urbanization along the Bhabhar zone that would impact the recharge to the Terai aquifers. Appropriate policy measures such as appropriate subsidies, promotion of new technologies and development of local institutions to manage groundwater need to be designed.

#### iv) Controlling failure of wells

Terai plains report a very high rate of well failure after installation. Part of the reason is corrosion of poor quality pipes used for installations. Though the solution seems as simple as providing for coating material for pipes, absence of such procedures have led to high failures of wells in the region.

#### v) Ensuring health of valley aquifers: pollution, overexploitation

As in Kathmandu valley, various other valley aquifers present a picture of increasing exploitation and pollution with development. One solution in these areas could be to provide imported surface water at lesser costs, being tried in Kathmandu area now. But the high cost of pumping water over the hills into the valley areas and maintenance of the system could be impediments to their long-term sustenance.

## **4. Description of tour, referring to an itinerary, and a complete list of people and institutions visited**

### *Itinerary:*

On Monday 7<sup>th</sup>, there were informal discussions on the project and the meeting. The main meeting was conducted on the 8<sup>th</sup> from 9 am till 4 pm. The meeting was attended by 20 participants from the Department of Irrigation, the Department of Water Supply and Sanitation, the Water & Energy Commission Secretariat, the Groundwater Resources Development Project, Department of Geology of Tribhuvan University, Dept. of Environmental Science of Kathmandu University and Correspondent of Rising Nepal along with IWMI Researchers (see list of participants at the end of the report). The meeting was organized by Sudarshan Pandey of the IWMI-Nepal office.

The meeting commenced with a presentation by Dr. Karen Villholth and Dr. Sunderrajan Krishnan with a description of IWMI and then the details about the project. One suggestion given by Mr. Khem Raj Sharma was to consider students and practitioners of environmental law as fellows for the course. It was suggested that the research in this project should look for alternatives to legislation for governing groundwater.

Then, there were presentations by Mr. Pratap Singh Tater, Dr. Khem Raj Sharma, Mr. Ghanashyam Bhattarai, Dr. Surendra Raj Pant and Mr. Suresh Das Shreshta of the Department of Geology, Tribhuvan University and Dr. V. Krishnamurthy and Dr. Sanjay Nath Khanal of Kathmandu University (the full affiliations and contact information for these presenters are listed below in this list of participants).

Mr. Tater informed that groundwater legislation has been drafted in Nepal. It has been modeled based on the corresponding legislation in India. He suggested several issues which could be addressed within this project: a) the issues of electricity subsidies and the lack of records of tube-wells after subsidies were removed in 1999, b) managing arsenic pollution, c) make comparative studies of how deep tube-wells are managed by water user associations.

Mr. Shreshta informed that his institute has been involved in post-project management analysis of various water management projects implemented by the government. He stressed the importance of a better understanding of the geological aspects of groundwater in Nepal which are essential towards proper management. One important tool towards this is geophysical methods that can provide better knowledge of the resource.

Mr. Kansal and Mr. Krishnamurthy shared the various curriculum development activities in progress within their university. They suggested that one aspect that this project can look into is the need for having better standards for water quality for various uses and also issues of reuse of waste in agriculture and other purposes.

One final output of the meeting was the formation of a group in Kathmandu that would plan research activities as part of this project. Kathmandu University represented by the Dept of Environmental Sciences took the lead towards this purpose.

*Interested lecturers in the School:*

Dr. Dibya Ratna Kansakar expressed interest in teaching in the School. The Kathmandu University professors expressed interest in terms of teaching as well as curriculum development.

*Research areas/topics:*

The group in Nepal will formulate these topics.

*Comments/suggestions received on the project, course outlay and organization, research organization, etc.*

One point brought out by several participants was that there are relatively few fellows from Nepal for the project. A number of five fellows every year would be ideal for providing some impetus to the research work.

## **5. Conclusions and recommendations**

Groundwater is increasingly becoming an important issue in Nepal. The landscape shows wide variation from areas where socioeconomic conditions prevent utilization of a vast resource to areas where aquifers are overexploited, polluted and pose risk to human health. It is therefore very important to have measures for managing groundwater that pertain to the local needs of that region. The Terai and the valleys present very different situations to managing groundwater, because the levels of development of the resource are quite different. There is no doubt about the need to expand the existing store of information as far as the geology and resources are concerned, but it is also very important to keep in mind the cultural conditions, prevailing political climate and socioeconomic conditions of the people while suggesting measures to manage groundwater.

This initial meeting in Kathmandu was able to bring together the wide diaspora involved in groundwater management. One positive aspect was the initiative taken by Kathmandu University towards coordinating activities of the group. Along with similar groups in the other project countries, there is good possibility of sharing of experience across the region on issues of groundwater management.

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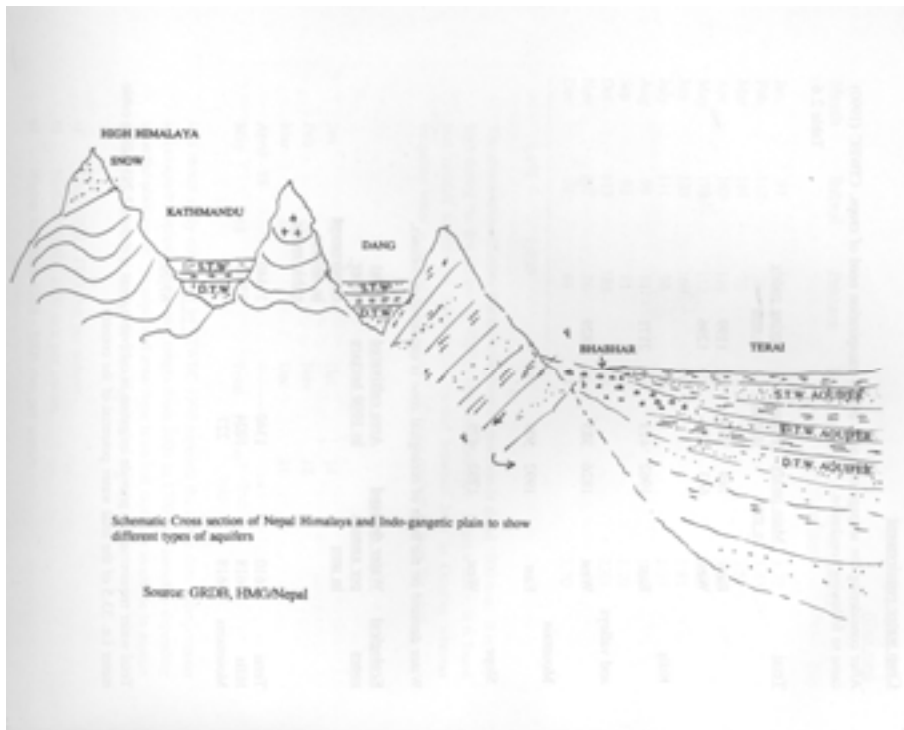


Figure 1: Cross-section of Nepal cutting across Kathmandu valley: Source Sharma(1995)

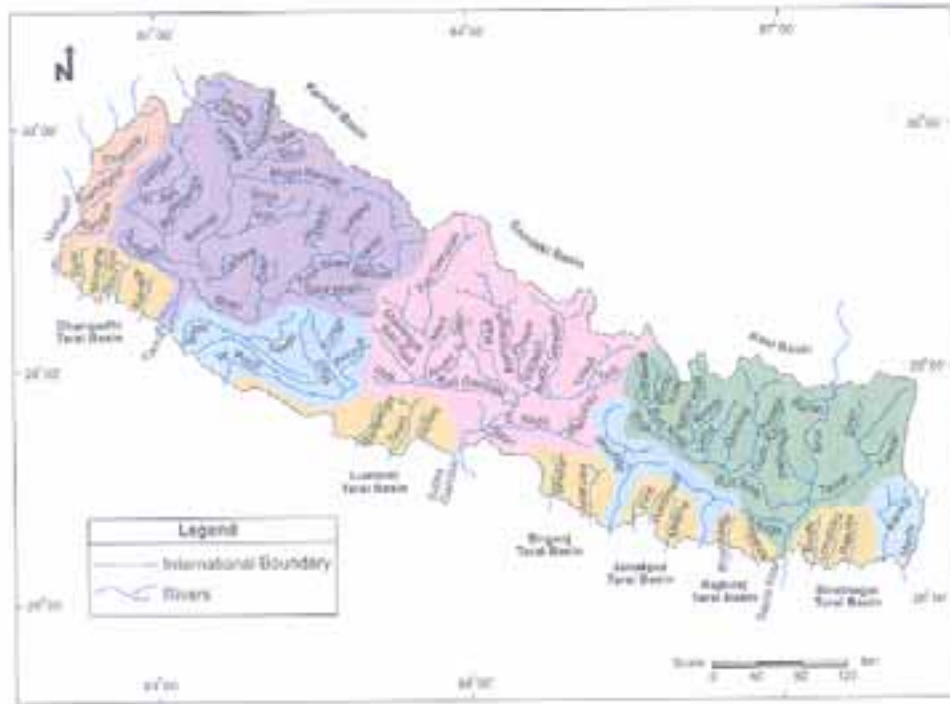


Figure 2: River basins of Nepal: Source Gyawali(2003)



Figure 3: Storage structure to collect spring water in Nagarkot hills close to Kathmandu valley area (from field visit during sensitization trip)



Figure 4: Step well located in Bhaktapur, Kathamdu valley (from field visit during sensitization trip)