

Proceedings of the  
“Water for Cities: Responding to the Urban Challenges”  
Second National Symposium on Challenges and Opportunities for Sustainable Management of  
Groundwater Resources of the Kathmandu Valley, Nepal  
22 March 2011



Organized by



WECS



Supported by

**Kurita Water and Environment Foundation**



**Proceedings of the**  
**“Water for Cities: Responding to the Urban Challenges”**  
**Second National Symposium on Challenges and Opportunities for Sustainable Management of**  
**Groundwater Resources of the Kathmandu Valley, Nepal**

**22 March 2011**

**Kathmandu, Nepal**

**Organized by**

Water and Energy Commission Secretariat (WECS)

Center of Research for Environment Energy and Water (CREEW)

The Small Earth Nepal (SEN)

**Supported by**

Kurita Water Environment Foundation (KWEF), Asian Institute of Technology (AIT), Institute for Global Environmental Strategies (IGES), International Research Center for River Basin Environment, University of Yamanashi (ICRE-UY), United Nations Human Settlements Programme (UN-Habitat-Nepal), Environment and Public Health Organization (ENPHO), United Nations Educational, Scientific and Cultural Organization- International Hydrological Programme (UNESCO-IHP)

## **Editors**

Sangam Shrestha, PhD  
Rabin Malla, PhD  
Saroj K. Chapagain, PhD  
Manisha Sthapit

Responsibility for statement made and opinions expressed in the contributions included in the proceedings rests entirely with their respective authors.

Copyright © WECS, CREEW & SEN, 2011

Cover Photo: Prajwal Bhattarai

Back Cover Photo: Manisha Sthapit

Layout by: Milan Khadgi-Naturals graphics, 4220796

Citation: WECS, CREEW & SEN (2011). Proceedings of the “Water for Cities: Responding to the Urban Challenges” Second National Symposium on Challenges and Opportunities for Sustainable Management of Groundwater Resources of the Kathmandu Valley, Nepal, 22 March, 2011, Kathmandu, Nepal.

## **ACKNOWLEDGEMENTS**

We take this opportunity to highly appreciate and thank the oral presenters and the authors for sharing their study and research work. Likewise, this year for the first time poster session was held. We are very much thankful for nicely made posters and wonderful presentations by all the poster presenters and authors.

We would like to thank Dr. Bhanu R. Neupane (UNESCO) for his keynote speech. We are grateful to Dr. Ravi Sharma Aryal (WECS) and Dr. Sangam Shrestha (AIT) for chairing the first session: Urban Water, and Dr. Rajendra Shrestha (AIT) and Er. Gautam Rajkarnikar (WECS) for chairing the second session: Groundwater. We would also like to thank Er. Adarsha Pokhrel (IHP-Nepal) for moderating the session: Open Discussion.

We are also thankful to all the participants of the symposium for making their time to attend the symposium, raising queries, making valuable comments and positive criticisms that helped to make the symposium interactive.

Lastly, we would like to thank all the volunteers and personnel involved during the symposium who have worked hard for the success of the symposium and preparing this proceeding.

**WECS, CREW & SEN**

## TABLE OF CONTENT

	PAGE NO.
<b>Background</b>	1
<b>INAUGURAL SESSION</b>	
<b>Welcome note</b> , Dr. Ravi Sharma Aryal, Joint Secretary, Water and Energy Commission Secretariat (WECS)	2
<b>Keynote speech</b> , Water and Cities: <u>time for a SWITCH?</u> Dr. Bhanu R. Neupane, Regional Programme Specialist for South Asia, UNESCO, New Delhi	3
<b>Remark by Chief Guest</b> , Er. Ganesh Shah, Former Minister of Environment Science and Technology Nepal	4
<b>Vote of Thanks</b> , Mr. Dhiraj Pradhananga, President, The Small Earth Nepal (SEN)	4
<b>Closing Remarks</b> , Mr. Shyam P. Mainali, Secretary, WECS	5
<b>URBAN WATER SESSION</b>	
<b>Oral Presentation 1:</b> Community based water management in urban city Kathmandu Er. Gautam Rajkarnikar, Sr. Divisional Engineer, WECS, Nepal	6
<b>Oral Presentation 2:</b> Challenges of urban water management in Kathmandu Valley Mr. Padma Sundar Joshi, Programme Manager, UN-Habitat, Nepal	8
<b>Oral Presentation 3:</b> Urban water management at community level: A case study of <i>Alko hiti</i> drinking water system of Patan Ms. Shreya Bajimaya, Nepal Engineering College, nec-CPS	10
<b>Oral Presentation 4:</b> River degradation and livelihood impacts: analysis of solid waste disposal in Hanumante River in Bhaktapur Ms. Rabi Wenju Affiliation, Nepal Engineering College, nec-CPS	12
<b>GROUNDWATER SESSION</b>	
<b>Oral Presentation 5:</b> Groundwater management in Asia-Pacific and sharing AIT's experience Dr. Sangam Shrestha, Asst. Prof., Asian Institute of Technology (AIT), Thailand	14
<b>Oral Presentation 6:</b> Groundwater recharge from rainwater - a sustainable solution for urban water scarcity Dr. Suresh Das Shrestha, Assoc. Prof., Central Dept. of Geology, Tribhuvan University	16
<b>Oral Presentation 7:</b> Ownership and Groundwater Issues Dr. Ravi Sharma Aryal, Joint Secretary, WECS	17
<b>Oral Presentation 8:</b> Assessment of Drinking Water Quality of Sub-Urban Regions of Kathmandu Srijana Manandhar, Central Department of Environmental Science	20
<b>Oral Presentation 9:</b> Decentralized wastewater treatment to reduce contamination of groundwater – examples from Nepal Dr. Suman K Shakya, Executive Director, Environment and Public Health Organization (ENPHO)	22
<b>POSTER SESSION</b>	
<b>Poster 1:</b> Pharmaceutical wastewater management practices and livelihood impacts in Kathmandu valley Bhintuna Shrestha, Nepal Engineering College, nec-CPS	24
<b>Poster 2:</b> A Study of Small Scale Informal Water Vendors Serving the Low Income Consumer Groups in the Kathmandu Metropolitan City Kripa Shrestha, School of Environment Science and Management	24
<b>Poster 3:</b> Assessment of groundwater contamination at the periphery of Bagmati River in Kathmandu valley Ramesh Gautam, Central Department of Environmental Science, TU	25
<b>Poster 4:</b> Analysis of the physicochemical and bacteriological parameters of bottled water available in Kathmandu valley Ranjana Budhathoki, Central Department of Environment Science, TU	25
<b>Poster 5:</b> Groundwater quality assessment along Dhobikhola River and its share in domestic use Shovana Maharjan, Nepal Engineering College, nec-CPS	26
<b>CLOSING SESSION</b>	
<b>Open discussion session</b> Moderator: Er. Adarsha Pokhrel, Co-chair, Nepal National Water Week (NNWW) 2011	27
<b>Session close with remarks:</b> Dr. Ravi Sharma Aryal, Joint Secretary, WECS	28
<b>ANNEX</b> : Schedule of the program	29

## **BACKGROUND**

Second National Symposium on Challenges and Opportunities for Sustainable Management of Groundwater Resources of the Kathmandu Valley, Nepal was held in Kathmandu at the Hotel Everest on 22 March, 2011 as part of the Nepal National Water Week (NNWW), 2011 to commemorate the World Water Day. This year UN-Water has dedicated World Water Day 2011 to the theme *Water and Urbanization*, with slogan *Water for Cities: Responding to the Urban Challenges*.

The first symposium was held in December, 2009. With the continuation of the symposium organizers hope to further build on knowledge, information and experiences gained in the previous symposium. The symposium focused on quantity and quality, managerial and policy, law and institutional framework of surface water and groundwater, and impact of global change on water resources. Objectives of the symposium are to;

- share the knowledge on quantity and quality, managerial and policy, law and institutional framework of surface water and groundwater, and impact of global change on water resources in the Kathmandu Valley
- identify remedial measures to improve quality of groundwater in the Kathmandu Valley
- raise awareness on significance of groundwater and its current status in the Kathmandu Valley among high level policy-makers in government, affiliates of INGOs, NGOs and civil societies, researchers to graduate students from universities and academic institutions, and other concern stakeholders.

## **INAGURAL SESSION**

### **Welcome Note**

*Ravi Sharma Aryal, WECS*

Dr. Ravi Sharma Aryal, joint secretary of WECS welcomes all the participants, presenters, session chairs, keynote speaker, media personnel, invited guests and representative from different NGOs and INGOs to Second National Symposium on Challenges and opportunities for Sustainable Management of Groundwater Resources of the Kathmandu Valley, Nepal.



According to him, the first symposium was held in December, 2009 and with the continuation of the symposium the major objectives is to further build on knowledge, information and experiences gained in the previous symposium. The symposium will focus on quantity and quality, managerial and policy, law and institutional framework of surface water and groundwater, and impact of global change on water resources. During the speech, an example of the similarity of water and purity with regard to human health and river and cities was provided to link them as to be the mirror images. Further, he provided that during the symposium, different challenges and the respective solutions would be discussed.

## **Keynote Speech**

### **Water and Cities: time for a SWITCH?**

*Bhanu R. Neupane, UNESCO*

Dr. Bhanu R. Neupane, UNESCO has a serious concern for the groundwater and the activities required for its sustainable use. During his speech, some flaws were pointed out in the municipal water cycle management, water abuse in terms of per day capita, sewage disposal practices and the approach of the Millennium Development Goal in case of our country.



He provided the fact that groundwater has been the ultimate fate because of its substitute nature, popularity in use and the easy availability. However, he argued the absence of the custodian of the available groundwater resources in the country like ours. Furthermore, he brought out the lights on the wrong coping mechanisms, policies that undifferentiated the surface water and groundwater sources, and the common nature of acknowledging the Integrated Water Resources Management as the surface water management tool and not including the holistic approach in dealing the groundwater resources. At the end of the speech, different way forward solutions and the gist of the terminology SWITCH: Sustainable Urban Water Management Improves Tomorrow's Cities Health was provided.

### **Remark by Chief Guest**

*Ganesh Shah*

*Former Minister of Environment, Science and Technology*

Er. Ganesh Shah, Former Minister focused on the implication of Polluters Pay Principle. According to him, this principle needs to be emphasized in paying for the amount of water used to view groundwater application tomorrow excluding the fact of overexploitation of the resources. He also notified that groundwater policy that is being compiled and documented should be enforced immediately to solve groundwater declination.



### **Vote of Thanks**

*Dhiraj Pradhananga, SEN*

On behalf of organizing committee, Mr. Dhiraj Pradhananga thanked all involved in the symposium. He thanked all the oral and poster presenters, participants and the volunteers involved in making symposium a grand success. He expressed appreciation to WECS, CREEW and SEN for organizing the program.



## **Closing Remarks**

*Shyam P. Mainali, WECS*

According to Mr. Shyam P. Mainali, we have flaws in our management system to deal with the enough water. He pointed out a very critical case of land use scenario in Nepal by providing the fact of less availability of water recharge zones and national flexibility to allow the plotting of land even in areas as less as 2 and half *anna*.



**URBAN WATER SESSION** (Chairs: Dr. Ravi Sharma Aryal and Dr. Sangam Shrestha)

**Oral Presentation 1**  
**Community Based Water Management in Urban City Kathmandu**  
*Gautam Rajkarnikar, WECS*

The study has primarily shown, how water shortages can be tackled on the community level, citing an example from *Gaja Laxmi Drinking Water System* from ward no. 9, Chyasal, Lalitpur sub metropolitan city. In 2007, a community-scale groundwater treatment system was established jointly by Urban Environment Management



Society (UEMS) and United Nations Human Settlements Program (UN-HABITAT) with the objective of providing safe and adequate drinking water to some 319 households (with approximately 1,953 people) in the Chyasal, Lalitpur Municipality, Nepal. To overcome the water shortage, community dug a well in the area. But the water from dug well was found out be unusable due to its turbidity and high iron concentration. Then UEMS with the help of UN-Habitat initiated a safe drinking water bottling and distribution system in Chyasal to supply safe drinking water to people.

The system had the equal opportunities provided to the female considering their knowledge and times spent for the water resources collection and management. Different technologies like aeration and bio-sand filtration were used to improve the quality of available water resource. Regular water quality monitoring was being done by Centre of Research for Energy Environment and Water (CREEW) and University of Yamanashi. The present number of household using the water has now increased to 500 with target to reach to 1000 households in the near future.

The existing system can remove iron from groundwater perfectly; however, ammonia concentration in the filtered water remains higher than the WHO standard for drinking. To improve the overall technical efficiency of the treatment system, CREEW has installed ammonia removal unit. This unit consists of an “attached growth system” which is an energy-efficient and low cost technology suitable for ammonia removal from that system.

The gender inclusive nature of the water management committee and stated that system exhibit good water pricing and system management. The eagerness of the community to manage domestic solid waste after realizing the success they have achieved in water management.

The drinking water system collects contaminated water from the dug well, treats it and distributes it to those who contributed to the system’s construction for the minimal cost of Rs. 3 for 20 liters jar for school, pro-poor and marginalized people and to others for Rs. 5 for 20 liters. During the rainy season, rainwater is harvested for recharging the water level of the dug well. The capacity of dug well is about 20,000 liters. The system has already drawn the interest of other poor urban communities, where water scarcity is prevailing.

The system is providing easy access of drinking water to marginal group and is very gender friendly. The conservation and preservation of the historical stone spouts and rainwater harvesting need to be stressed. Water related issues should be included into the integrated water resources management policy to address the water owes of the cities especially in the city like Kathmandu where water is a valued commodity.

## **Oral Presentation 2**

### **Challenges of Urban Water Management in Kathmandu Valley**

*Padma Sundar Joshi, UN- Habitat, Nepal*

Water management is the major challenge in the urban cities like Kathmandu Valley where there is intense and unchecked urbanization. As per Census 2001 and CBS projection, the population of Kathmandu Valley (both urban and rural) in 2011 is ~2,200,000 and it is expected that this number will swell after the Census 2011. From 1969 this valley is trying to



follow planned development. There are almost a dozen of plans prepared for the development of the valley. Which however failed and even today the development is unplanned and unmanaged. Kathmandu 2020 (published in 2002) projected that the population of Kathmandu will be 2,020,404 in 2011 and 2,597,238 in 2021. But many believe that it has already crossed 2,500,000 in 2011. The KSUT suggest that it will be 4 million+ in 2021. Therefore, population growth is rampant in this valley, perhaps the first and foremost challenge to address.

The *hities* and wells were the traditional water sources in the cities of Kathmandu Valley. The Ranas started piped water system in the valley at the beginning of 1900. Piped water supply came to the reach of common people only after 1960s through *Pani Gwoswara*. In 1974 the water sector got its first IDA loan and changed the outfit to Nepal Water Supply and Sewerage Development Committee. IDA II and III continued until 1990. In 1989, the committee is converted into Nepal Water Supply Corporation (NWSC). Few additional sources extended to meet the water demand until 1993. In 1993 WB supported Kathmandu Valley Urban Water Supply and Sewerage Rehabilitation Project. This project failed after its attempt for 5 years. Except JICA support to add few deep tube wells and water treatment plants, 1993

onwards Kathmandu Water Supply is waiting for Melamchi. A twice a day supply reduced to daily, daily to alternate day and now once in five days. In 2000 NWSC claimed that they produce 80 MLD in dry season and 115 MLD in wet season. Now in 2010 KUKL claims that they produce 68.8 MLD in dry season and 118.4 MLD in wet season. Water quality is yet another concern, which general public neglect in the search of quantity. The distribution system is yet another challenge; institutional reforms are yet in the 'testing' phase, where people have not gained hope.

But people are fighting this shortage by going deeper in the wells, exploiting fossil water particularly by industries and housing colonies and buying tanker water those who can afford to store. The urban poor are paying the most i.e. Rs. 5/ bucket of water (~15 lit) and Rs. 40~60/ jar of water. Therefore water for sanitation is a serious issue here.

Urban poor are quenching their thirst and some minor challenges like conflict for water accessibility, unproductive time loss for water collection were also provided out. The calculated unproductive hours spent to fetch a bucket of water and burden the children bear in supporting their parents in collecting water. Quick upgrade of the urban water management policies and regulations and the urgent need of the dialogue between the respective stakeholders at the national level instead of doing blame game with the persons dealing with the management is recommended.

### Oral Presentation 3

#### Urban water management at community level: A case study of *Alko hiti* drinking water system of Patan

Shreya Bajimaya  
Nepal Engineering College, nec-CPS

A community led water supply scheme utilizing the untapped flowing water of traditional stone spouts is the main theme of *Alko hiti* (stone spout) drinking water supply scheme. *Alko Hiti* is situated in *Ikhachhen*, ward no. 22 of Lalitpur Sub-Metropolitan City. The approximate area of *Ikhachhen* is 37,500 sq. meters that includes clustered households and stone-paved pathways with slightly inclined topography.



The people of *Ikhachhen* community relied on *Alko hiti* since the time of its establishment during Malla period in 1415 AD. Despite of its continuous discharge, the provision of municipal water supply at the doorsteps, led this traditional *hiti* to be left unattended for years, ultimately the stone spouts slowly degraded and converted to local dumping site. While, the pipeline supply of water also gradually diminished with increasing urbanization and population growth thereby leading to water scarcity in the locality.

During those days of water stress, *Alko hiti* was the only option for local people but even the *hiti* had started discharging less water as the system deteriorated due to lack of proper care and maintenance. To address the issue, some of the active youths of *Ikhachhen* community came up with an idea to revive the traditional stone spout and distribute free flowing water to the households with the help of pipeline network. Following series of community consultation, a seven member's committee *Alko hiti* Conservation and Water Supply User's Committee (AHCWSUC) was formed in October 2003 in order to develop the mini drinking water supply project. The User's Committee began implementing the project once they got approval from the majority (51 %) of households in the community. And, in the due course of construction of the system, almost all the households contributed either in the form

of cash or in the moral support. Eventually, the project was completed in four months period by local youths of the community.

Alko *hiti* has five taps among which four are in use for tapping water for distribution and left for the public collection when unused for pumping. The tapped water is collected in a tank, which is then pumped to overhead tank of 10,000 liters installed on the top of the AHCWSUC building. The reserved water is distributed under gravity flow through different distribution points located at major junctions of the street. Each household gets approximately 200 to 500 liters of water per day in dry and monsoon season respectively. People collect water from the water points strategically placed at several places by means of their private pipes during the time of water distribution. The duration of water supply ranges from 40 minutes to 1 hour depending on the proximity of households to the reservoir tank. The entire service area is divided into 7 zones with different time schedule for each zone. The User's Committee has also set a rule of not using electric pump for drawing water as it decreases the water pressure in the pipe networks.

Discharge of stone spouts depend on groundwater recharge and with this concept, the committee has constructed two soak-pits at few meters distance from the stone spouts. These soak-pits are constructed with layer of gravel and sand for filtration, which is assumed to augment the discharge of stone spouts in future. In addition, a pond of 1440 sq. ft has been constructed to store extra water diverted from the stone spouts after water distribution to the households. For dry season, when discharge from stone spouts is not enough for target households, the committee has constructed two wells for emergency supply of water. The reserve tanks are placed inside Alko *hiti* ground for storing water from these wells that always act as standby. The water thus stored is filtered and is distributed via pipelines to the households. Likewise, the practice has also encouraged the users for conserving the water source and maintaining the cleanliness of *hiti* area.

The total capital cost of the project was NRs. 8,20,000. More than 90% of the capital cost was borne by the community itself and the rest was by Lalitpur Sub-metropolitan City in the form of 10,000 liter tank. Each household made a contribution of NRs.4000 and the remaining amount was borrowed from the bank with zero interest. At present, the system is functioning solely on its income from different sources that include monthly water tariff, fine and penalty, rent from the building of users committee, connection fee and bank interest rate. Among these income sources, water tariff accounts for the major income source. The monthly charge for water supply to the residents of *Ikhachhen* community is NRs.125 while for nearby area *Nagbahal* is NRs. 150. The households also pay additional NRs. 50 per month for generator use. As far as expenditure is concerned, it includes staff salary, day-to-day operation and maintenance expenses. The 40 percent of the tariff is spent in the salary of the four staffs and the rest goes to maintenance fund.

Overall, the system has net income of NRs.15,000 per month which is saved in the bank account and is utilized for the benefit of system and the community.

The Alko *Hiti* Conservation and Water Supply User's Committee (AHCWSUC) was formed with a dual purpose: i) to conserve and maintain the traditional *hiti* and ii) to build a system that supplies water to the residents through a pipeline network. The system is the amalgamation of traditional sources and the pipeline networks that is operating successfully since its operation period of 7 years and has been able to address critical water deficit condition of more than 200 households of the community. It has not only satisfied the water need of consumers but has also been able to conserve the isolated Alko *hiti* in addition to promoting cleanliness of the *hiti* complex. The key strength of the system lies in the leadership and the intact community support which is the reason for its sustenance till date. The community is now equipped with adequate water supply and it has directly benefitted lives of people in terms of their time and energy. It has become a demonstration site for community based water resources management. The success also lies in the innovative and active minds of the User's Committee that has been implementing different ideas into the project to make it sustainable. As such, groundwater recharge mechanism has been added in the system that aids to promote rainwater flow to the aquifer and prevent the source of stone spouts from drying. Overall, a complete water cycle picture can be observed in the scheme that promotes sustainability and conservation of water resource and it also proves to be exemplary site as a smart alternative affordable for the implementation in small scale to meet the growing water demand of Kathmandu valley.

## **Oral Presentation 4**

### **River degradation and livelihood impacts: Analysis of Solid Waste Disposal in Hanumante River in Bhaktapur**

*Rabi Wenju, Robert Dongol  
Nepal Engineering College, nec-CPS*

Degradation of river stands as the prominent problem in most of the urban areas in Nepal. Among the various causes for the degradation, disposal of solid waste along the banks of river is one. Haphazard and rampant disposal of solid waste along the river banks have become the common picture in most of the urban areas in Nepal. This study was carried out to examine the disposal of solid waste along the banks of Hanumante River as



one of the causes of its degradation and its effect on the livelihood of the people. Hanumante River originates from Mahadev Pokhari at Nagarkot and passes through Bhaktapur and Madhyapur-Thimi municipalities. It then merges with Manohara River at Jadibuti Kathmandu that eventually joins Bagmati River. The Hanumante is an important tributary of the Bagmati River with a catchment area of 143 km<sup>2</sup>. Hanumante River has been the major source of water for the people of Bhaktapur. People rely on the river water for domestic, irrigation, cultural and religious purposes. But due to the disposal of solid and liquid wastes the river has turned into dumping site and a mere sewerage line. The methodologies in the study involve physical and chemical water quality analysis from five different location, walk through and mapping of river reach degraded from continued solid waste dumping , semi- structured interview, and key informant interview.

The water quality analysis of the Hanumante River was done at five different locations- Sudal Village, Hanumanghat, Chupinghat, Sallaghari and Srijananagar. These were the sites where the trend of solid waste was observed. The water quality analysis shows that the level of pollution has been progressively increasing from upstream to downstream. The pattern of variations of water quality parameters clearly follow the intensity of solid waste dumping along the river course from upstream to downstream. The analysis of water quality parameters from the five sampling locations clearly revealed Sallaghari and Srijananagar to be the most polluted sites compared to other sites as Srijananagar is currently being used for the

dumping after Sallaghari. Apart from the water quality, perception analysis of people on the degradation of the river and its impact on their livelihood were carried out in four clusters of settlements along the river course. These included Tinkune, Libali, Hanumanghat and Bhelukhel. According to the people lack of municipality concern on haphazard dumping of solid waste along the bank is one of the major causes of river degradation. Apart from that the mixing of untreated sewage in the river is another reason for the degradation of the river.

The degradation of the Hanumante River has negatively affected the livelihood of the people. The pious river has turned to a mere dumping site. Due to the disposal of waste the river has congested increasing the incidences of flooding during rainy season. The foul smell from the dumped waste has impaired the aesthetic environment making the area unhygienic. The foul smell became excruciating in the evening with the blow of winds. People feel uncomfortable to carry out their daily work. Health of the people deteriorated. Headache, vomiting and dizziness are some of the health problems people face due to the bad smell. People might also get mentally disturbed when they feel a foul smell around them. People living close to the river frequently face floods during monsoon and foul smell during the dry season. The place has been the vector breeding ground specially mosquitoes and flies creating nuisance to the local homestead. To overcome this problem people were seen using mosquito nets, coils and mats which have threats on the health of the people. Apart from that, the monthly average cost of the family has also increased which is Rs.152, resulting from the disposal of waste. The respondents, in general, identified increased incidences of four diseases- diarrhea, skin diseases, headache/dizziness/vomiting and fever and believed that the cause of increase in the incidences of these diseases has been increased solid waste disposal along the river course.

The Hanumante River needs prompt attention from all sectors. The concerned authorities should have a proper arrangement for the collection and disposal of solid waste. The river banks should not be used for the disposal of waste. This study pointed to the need of further assessing the sources and reasons resulting in to the degradation of river and formulate suitable methods for the disposal of wastes.

**GROUNDWATER SESSION** (Chairs: Dr. Rajendra Shrestha, Er. Gautam Raj Karnikar)

**Oral Presentation 5**  
**Groundwater management in Asia-Pacific and sharing AIT's experience**

*Sangam Shrestha*  
*Asian Institute of Technology, Thailand*

Groundwater is a source that is easy to use but difficult to manage. It is especially alarming and difficult to manage when rate of extraction is more than rate of recharge. It is a major source of water for drinking, irrigation and equally important for urban and industrial development. In Vietnam, groundwater use and regional GDP are found to be correlated. The recent challenges related with the groundwater management are depletion of groundwater table, land subsidence, groundwater contamination and salt water intrusion.



In Bangkok, among 8 aquifer layers, aquifer no. 1 is already used so they are going deeper. The groundwater extraction was increased since 1950s for industrial use. Industries are the major sector to extract groundwater. But after 2008, groundwater extraction by industries decreased. Land subsidence by 1 cm/year was observed and this land subsidence was found to be correlated with the groundwater extraction. The land subsidence reached up to 5-10 cm/year from 1979-1981 in some areas. Other groundwater issues in Bangkok are decline in piezometric level, salinity intrusion, insufficient surface water supply coverage, no alternatives to groundwater availability, cost of groundwater compared to piped water supply, role and responsibilities of related agencies and their coordination, awareness in policy-making level, groundwater preservation charge and illegal use of groundwater.

Mixture of policy instruments were developed and adopted to manage groundwater in Bangkok one after another. Due to land subsidence, government brought Groundwater Act in 1977, which provided the basis of groundwater management including organizational arrangement. The law also introduced a licensing system of

groundwater drilling and abstraction, but it did not have any working measures to control groundwater abstraction. Then in 1983 Cabinet resolution formed 'Mitigation of Groundwater Crisis and Land Subsidence in Bangkok Metropolis' followed by the Ministerial Decree in 1985 which included the designation of critical area and introduction of tighter control measures to the area, reduction of groundwater use as a source of water supply by MWA and introduction of groundwater charge. The charge was not sufficient, so they started to increase the charge in stepwise manner. Initially it was Rs 20/cubic meter charge but now it is Rs 40/cubic meter which include preservation charge as well. The groundwater extraction has been decreased since 2003.

The case study from Bangkok can be a good lesson for Nepal that groundwater charges can be incentives for users to reduce groundwater use especially inside Kathmandu Valley where the groundwater extractions are increasing rapidly. Alternative source are needed to control groundwater extraction and its charge. Groundwater preservation charge is useful to promote groundwater management and next challenge will be from groundwater control for mitigation of land subsidence to sustainable groundwater use.

## **Oral Presentation 6**

### **Groundwater recharge from rainwater - a sustainable solution for urban water scarcity**

*Suresh Das Shrestha*

Central Department of Geology, TU

Groundwater is a major source of water supply in Kathmandu valley. Large scale groundwater abstraction started in early 80's from well fields in the north of the valley. In last 10-15 years, water has changed from a free commodity to scarce commodity and now fast turning into a commercial commodity which is imposing water stress in the valley. However, Kathmandu Valley is not the only water stressed urban centre, Banepa, Dhulikhel, Pokhara and Dharan are soon catching up with the similar problem. Terai for now is free from this problem, due to availability of groundwater in most parts.



Shallow unconfined aquifers are the principle source of domestic water supply. Water from about 35m unconfined aquifer is abstracted through numerous points as most of the households have some means to tap this aquifer. While deep confined aquifer are principle source for industrial municipal and community water supply in Kathmandu which goes deeper more than 250 m. at places. The hydro-geological cross-section of Kathmandu Valley shows unconfined shallow aquifer composed of sandy gravel is found in the northern part especially in the northeastern part. The exposure of bed rock at places suggest number of hydro-geological sub-basins in Kathmandu Valley which may be isolated or partially connected to each other.. Urban growth with haphazard groundwater abstraction has resulted drying up of wells immediately after monsoon. Excessive lowering of piezometric level in deep wells by approximately by 2.5m/ yr has been reported in various reports.

The problem is bound to be more acute in future; however there is some hope from shallow aquifer. Shallow aquifers were and are still being naturally recharged though the natural infiltration has decreased in recent years. The recharge from surface can however be enhanced artificially. Near surface water table reported in the past suggest the aquifer storage capacity, and with adequate rainfall, Rain Water Recharge (RWR) is an attractive option. A pilot study in Lalitpur Sub-metropolis

consisting of 25 wells and 25 recharge pits contributed 9650.5 m<sup>3</sup> of water in one year which is only 0.6% of the total theoretical volume available (1513283.069 m<sup>3</sup>) for recharge in the area. If massive RWR programs can be carried out in various parts of the sub metropolis, groundwater augmentation can be quite substantial. Water quality in many wells show higher concentration after installation of RWR facilities which may be attributed to transportation of contaminants during recharge,

Rainwater recharge in Kathmandu Valley is an attractive option. All the necessary components i.e. rainfall, storage capacity already exists what is required is the awareness and strong initiative from the government/public.

## **Oral Presentation 7 Ownership and Groundwater Issues**

*Ravi Sharma Aryal, WECS*

Groundwater is water that is found underground, in cracks and spaces in soil, sand and rocks. The top of the area where water fills these spaces is called the water table. Heavy rains or melting snow may cause the water table to rise, or an extended period of dry weather may cause the water table to fall. Groundwater supplies are replenished, or recharged, by rain and snow melt. In



some areas of the world, and even in Nepal, people face serious water shortages because groundwater is used faster than it is naturally replenished. In other areas, groundwater is being polluted by human activities. Like any renewable resource, groundwater could be consumed indefinitely as long as the rate of withdrawal did not exceed the rate of replacement. Over pumping of an aquifer occurs when groundwater is withdrawn faster than nature can replace or recharge it.

Therefore, groundwater depletion is a growing problem, not just in the Nepal but also world-wide. Many parts of the globe face serious fresh water shortages, which have resulted from groundwater depletion and water quality problems. Many communities obtain their drinking water aquifers. Water suppliers drill wells through soil and rock into aquifers to reach the ground and supply the public with drinking water. Many homes also have their own private wells drilled on their property to tap this supply.

High rainfall totals generally give rise to abundant water supplies, at least seasonally, and surface water and groundwater are both important sources for domestic, industrial and agricultural use. Groundwater is abundant in the aquifers of the Terai and the Kathmandu Valley. About 50% of the water used in the city of Kathmandu is derived from groundwater. Despite abundant rainfall, agricultural development is restricted by the limited development of irrigation. There is an overall lack of water-quality data for Nepal and hence assessment of the main quality problems is difficult. Many of the documented problems are related to

pollution of both surface waters and shallow ground waters from domestic, agricultural and industrial wastes. Much of the Nepalese population uses surface water for potable supply which is most vulnerable to pollution. Hence only 34% of the populations are thought to have access to safe drinking water.

Historically, rights and ownership issues concerning ground water have never been viewed seriously. However, no such regulatory framework concerning the rights of ground water by its users as well as the stakeholders exists. It is not even considered as a similar activity like mining, that many other countries consider. Thus, there is ambiguity in defining the ground water resource and the rights over it in Nepal. Similarly, overlapping authority of different institutions working on ground water shows institutional problems for regulating ground water. Ground water Management Committee is formed by an order but hardly could regulate ground water as Kathmandu Upatyaka Khanepani Limited, Drinking Water Supply Authority and Department of Irrigation are using ground water on its own way and lacks coordination.

Confusion at the conceptual level also lends itself to field levels as we see the case of ground water in Nepal. It is neither in the private domain, nor entirely in the public domain. As far as its extraction and use in agriculture, industry, or domestic sectors is concerned, both the private and public sector are involved. However, extraction of water for selling to other users is not possible by the private sector, which would have resulted in its being an extractable commodity because all sub-soil products are, by law, under the government's jurisdiction. But in reality there is lot of violation on use of ground water uses. Such activities are in operation in a huge scale especially in Kathmandu Valley and water table level has been decreasing day by day. Experts say this might create natural disaster and could convert our land into desert if water extraction is continued in unmanaged way.

National Water Plan 2005 provides importance on ground water uses together with National Water Resource Strategy 2002 but less priority is given to it in the regulatory framework. There is no special act to regulate ground water in Nepal except an order which created the Committee for Underground Water in 1975. This Committee is chaired by the Secretary of Ministry of Irrigation. The mandate provided to this Committee is to survey, study, innovate, supervise and monitor on ground water. Together it could develop information system and develop plans and utilization strategy on ground water. This Order only provides a board formation mandate to work in this sector. But this order is not sufficient to regulate ownership and other ground water issues.

Conflict on ground water in our neighboring country like India could be a good example to point out here. Activist says an ongoing drought has threatened groundwater supplies across India, and many villagers in rural areas are blaming

Coca-Cola for aggravating the problem. Coca-Cola operates 52 water-intensive bottling plants in India. In the southern Indian village of Plachimada in Kerala state, for example, persistent droughts have dried up groundwater and local wells, forcing many residents to rely on water supplies tanker in daily by the government.

Competition over ground water resources between mechanically powered Deep Tube wells (DTW) and manual hand pumps for drinking water supply are forcing communities and authorities to think about instituting regulations over the use of ground water. However, as conflicts are increasing, people and communities are beginning to develop local level controls and self-management of this critical open access resource. Unlike the other major open access resource--surface water of rivers--whose use faces some regulations in terms of diversion or lessening of flow, as well as fishing rights, the ground water resource is still very much in a *laissez faire* state. It is also not a common resource for communities to regulate its use, as its extraction is dependent upon technologies without which it is not available unlike forests and pastures, which are there for people to use.

Water resource management is increasingly assuming a critical role for the growing population of Nepal due to burgeoning demand and increasing conflict between alternative uses. Water is both a public and private good and therefore the allocation system must take into account the needs of all users, particularly the poor. It is also an economic and a scarce commodity and therefore its use should be determined by opportunity cost pricing. However, that should not ignore such basic needs as access to safe drinking water, sanitation and hygiene practices. As water is a common resource and has wide ranging uses, its development and management should involve all users and beneficiaries. Consequently the planners and managers of water resources operate with a segmented approach and is target oriented. Efforts are usually disjointed and supply driven and are usually detrimental to national interests, ignoring such important principles as equity and sustainability in water harvesting, water balance, conjunctive use of water, and efficient utilization of an unitary economic resource.

Finally, groundwater is a common resource, neither under complete state authority nor in the private domain. It is now increasingly being used for productive purposes (mainly irrigation). It is also facing intense demand from other conjunctive uses such as drinking water, domestic use, and fisheries. Narrow sectoral development approaches exacerbate the conflicts arising out of conjunctive use of this resource, while the absence of a comprehensive water policy only furthers the sub-sectoral orientation to water use policies. Therefore, time has come to prepare a proper policy on ground water uses together to regulate competitive extraction of ground water, ownership issues with bringing a special law in Nepal.

## **Oral Presentation 8**

### **Assessment of Drinking Water Quality of Sub-Urban Regions of Kathmandu**

*Srijana Manandhar\**, *Tista Prasai\*\**, *Kayo Devi Yami\*\**

*\* Central Department of Environmental Science, Tribhuvan University, Kirtipur, Kathmandu*

*\*\* Nepal Academy of Science and Technology, Khumaltar, Lalitpur*

Access to safe drinking water has always been considered an essential factor for health and is also a basic human right. But often the drinking water is the most intermittent and one of the exploited sources. People often face chronic shortages due to growing imbalance and the major problems arising can be attributed to inadequate treatment facilities, lack of awareness among people, inefficient management of natural resources, haphazard disposal of



wastes, the ever growing population and other related socio-economic factors. Safe drinking water and sanitation facilities are the basis for health to fight against poverty, hunger, child deaths as well as gender equality. Safe and adequate supply of water for proper sanitation is also the key to assess the socio-economic status as well as living condition of the community. Access to safe drinking water and proper sanitation facilities is also given priority by Millennium Development Goal.

The major objectives of the research work were:

- To compare drinking water quality between winter and rainy season.
- To compare the quality of drinking water among various sources within VDCs.
- To assess use of water sources, storage and accessibility of water along with sanitation conditions.
- To access socio-economic indicator of sub urban population of Kathmandu.

The study was carried out in three VDCs: Machhegaon, Matatirtha and Mahadevsthan, situated to west of Kathmandu Valley at the distance of about 10 km from the centre city. A total of 102 samples were collected for the study in dry and wet season which consisted of 40 tap water samples, 57 well water samples including both tube wells and dug wells and 5 stonespouts in each season. Physicochemical and microbiological quality of the drinking water was assessed. Analysis of the physio-chemical parameters were done by following APHA (1998).

Membrane filter (MF) technique was used to enumerate total coli form as described by APHA (1996).

A total no. of 200 households was selected randomly for the socio-economic survey from these three VDCs and the data were collected with the help of questionnaire survey. A structured questionnaire was prepared covering different relevant parameters of socio-economic condition including annual income, source of drinking water, walking distance to drinking water source, consumption of water per household, adequacy of drinking water, water treatment methods, storage of drinking water, sanitation options, waste disposal or management, fuel consumption for household cooking and boiling water and other various factors directly related to sanitation.

The pH of 3.5% of water samples were found to below WHO guideline value (GV) while in wet season there the value percentage decreases to 1.75%. Similarly, 10% and 20% of public tap and stone spout samples were found to exceed WHO GV for pH in dry season. 6.86%, 13.72%, 1.96% and 52% of the water samples were found to exceed WHO GV for conductivity, turbidity, chloride content and iron respectively in dry season. 3.92%, 8.82% and 39.21% of water samples exceeded the WHO GV for conductivity, turbidity and iron content in wet season. Hardness, ammonia, nitrate, orthophosphate and fluoride content of all water samples were within permissible level given by WHO. Similarly, 2 well water samples (1.75%) from Machhegaon VDC exceeded the WHO GV for arsenic level in dry season. The microbiological analysis of water revealed the presence of coliform in 97.05% of the samples so tested for both dry and wet seasons. The seasonal comparison of physico-chemical parameters showed significant variations in parameters like temperature, hardness, nitrate, fluoride and phosphate. Physico-chemical parameters like conductivity, hardness, chloride, nitrate, fluoride and phosphate vary significantly in different water sources.

The boiling of the water for drinking purpose was not so observed in the studied three VDCs the water was consumed without pre treatment however some were conscious about the necessity of the pre-treatment. There was a significance difference in the availability and use of tap water in the three VDCs in both the seasons. However there was a significance difference in the use and accessibility of the dug wells and spout water as drinking water sources. About 43% of population in the locality don't have easy accessibility to the water sources and have to walk long distances to get supply of drinking water. Very few percentages about 12% have supply of drinking water source in their own house in the form of tube well or dug well or VDC tap water supply. About 18% of the respondents complained about inadequacy of the drinking water. The water consumption pattern including drinking water in most of houses (48.5%) demanded drinking water about 50-100 liters per day.

Most of the household (96%) in the study area had well-built toilets with septic tank system while only few had pit latrine and pour flush latrine systems. An analysis was performed so as to observe whether the washing of hands before eating or serving of the food was dependent on the age group. The study revealed that most of the people ( 95.1%) between age group 30-50 were aware about washing hands before eating and serving food which is the most simple and effective method to prevent water related diseases. 95.5% of the population in the locality used soap and water for washing hands while very few percentages of population ( 4.5%) used regular water. The use of ash and water for washing purpose was also observed in considerable percentage of population (11.5%).

51.5 % of the total households so surveyed had negative response towards water treatment i.e. they consumed their drinking water directly from the sources without prior treatment of any kind while 48.5 % of the population applied water treatment before consumption. The most applied treatment was filtration method and 18.5% of the population used it; about 17% of the population boils water before consumption while some families (11%) reported the use of chemical treatment of drinking water.

#### Recommendations

- Proper Piped water supply system with proper maintenance and
- Improvements in the availability, quantity and quality of water along with proper sanitation
- Safeguard the raw water source and its watershed with frequent toxicity testing
- Provision of simple and cheap drinking water treatment facilities like boiling, filtration, solar disinfection, etc.

## **Oral Presentation 9**

### **Decentralized wastewater treatment to reduce contamination of groundwater – examples from Nepal**

*Suman K Shakya, Rajendra Shrestha, Yasoda Shrestha*  
Environment and Public Health Organization (ENPHO)

Human civilization started from water. In Kathmandu also, people started their settlement from the river bank of Bagmati. Urbanization rate in Kathmandu valley is 6.64% which is highest in Asia. Kathmandu valley covers more than 31% of urban population. Priority is given to drinking water and sanitation only, but no one has thought about the management of wastewater.



What will be the condition of waste water after 20 years, no one has thought about this.

There is currently only one operating conventional wastewater treatment plant in Kathmandu Valley, treating less than 5% of a population of 2.6 million (GHD 2010). Several decentralized wastewater treatment systems (DEWATS) have been installed in Nepal since 1997, as an alternative to conventional treatment. With an increase in toilets, particularly flush toilets, the need for improved wastewater treatment is critical to protect surface and groundwater supplies from further contamination.

As wastewater volumes have increased there is an increase in discharge into often overflowing septic tanks or leaking pipes which lead to open channels and waterways. Many towns in Nepal are now densely populated urban areas with high groundwater tables, making the conventional septic tank and soak pit less suitable as there is insufficient dry ground to filter the discharge. Due to limited water supply many household in Kathmandu and Nepal rely on private wells to augment provided supply. As many of these private wells are very shallow, they tap into this high water table which has been contaminated by direct and indirect wastewater discharge. This paper details the DEWATS approach to protect ground and surface

waters from wastewater contamination including their existing use and opportunities in Nepal.

A Decentralized Wastewater System can be described as a low maintenance treatment system, treating small volumes (<1-1000m<sup>3</sup>/d) of wastewater for reuse or discharge within National standards. DEWATS generally treats domestic wastewater originating from individual or groups of dwellings businesses or institutions that are located in close proximity to each other and the treatment site. Unlike conventional wastewater treatment plants, DEWATS promotes technologies that use natural processes and are simple in operation and maintenance. In DEWATS, natural treatment processes are achieved through methods that make use of physical principles combined with biological activities of microorganisms.

There are many phases in a treatment system, dependent on volume, type and quality of wastewater, and the discharge quality requirements. The DEWATS modules commonly used by ENPHO, to meet the Nepal wastewater discharge standards are as follows:

- Settler and Sedimentation Tank: Primary treatment though a multi chambered tank designed to settle large solids and allow dissolved and suspended solids to discharge;
- Biogas: another form of primary treatment to settle solids, however as the sludge decomposes and produces gas, this gas is trapped in the dome and piped for reuse.
- Anaerobic Baffle Reactor – Very effective secondary treatment approach pushing fresh wastewater down into an active sludge blanket causing anaerobic degradation.
- Anaerobic Filter – Similar to ABR however with a layer of filter media to increase contact area between wastewater and active sludge, also with very high efficiency.
- Horizontal Flow Constructed Wetland – A tertiary treatment that treat the flow passing horizontally through gravel filter media through biological conversion, physical filtration and chemical adsorption.
- Vertical Flow Constructed Wetland – A similar system however flow is loaded on top of the bed and flows down, often reducing required surface area but also required intermittent loading.
- Polishing Pond – Final stage generally allowing for aeration to reduce color and odour.

Within Nepal there are approximately 20 existing DEWATS that have been constructed by private, community, public and industry groups to treat wastewater in order to protect community water resources and also provide reusable by-products such as treated water and biogas. A recent performance assessment of eight systems in the Kathmandu Valley showed that the systems are operating well, even up to 10

years since construction and are almost all meeting Nepal wastewater discharge quality standards.

DEWATS is a sustainable approach to wastewater treatment in Nepal and is able to achieve significant reductions in contamination through simple and low maintenance systems. As can be seen by the diverse locations in which the systems are used, there are many potential applications of DEWATS in Kathmandu and Nepal. In areas where there is high faecal contamination – such as dense urban areas, high water table and shallow well use; DEWATS should be promoted to improve wastewater discharge and reduce potential contamination of groundwater. Additionally as the systems can be installed in phases to meet demand or fund, are made of local materials and requiring local builders their implementation can be immediate. Due to the proximity of treatment to the user, the user will receive the direct benefits of reducing contamination of their own supply, as well as the opportunity to reuse water, biogas and fertilizers.

Limited wastewater treatment in urban areas is contributing to groundwater contamination and is getting worse. DEWATS uses low maintenance, no power, and local materials. Decentralized allows for user pays and manage, reuse of by-products and smaller/flexible site locations. There are more than 20 systems in Nepal, recent assessment of ten systems showed 8 performing well with 7 meeting discharge standards. DEWATS suits a variety of sites, volumes, wastewater quality.

**POSTER SESSION**

**Poster 1**  
**Pharmaceutical wastewater management practices and  
Livelihood impacts in Kathmandu Valley**

*Bhintuna Shrestha,*  
Nepal Engineering College, nec-CPS

Pharmaceutical residues are finding their path in groundwater, surface water and even in drinking water sources from different disposal practices. The study provides insights to pharmaceutical manufacturers' wastewater disposal practices, their compliance with management regulations and probable livelihood impacts. The study also analyzes wastewater and groundwater samples to understand potential linkage between water pollution and disposal practices.

The study consists of different research methodologies. Qualitative data analysis showed haphazard and rampant disposal of effluents and non-water pollutants among the factories studied. Liquid effluents were found being disposed in soak pits, or treated and recycled for washing and gardening purposes or were collected in soak pits and drained into local sewerage. Only one company was treating their effluent with alum and caustic dosing. Quantitative data analysis showed wastewater from the pharmaceutical industries' production and expiry soak pits were being heavily polluted with organic materials. Similarly, COD and BOD values from the expiry drugs soak pit were 766 times and 300 times more polluted than what is permissible in Nepal Government Standard. Adverse effects like drying of some patches of paddy due to accidental spill of the wastewater in one of the industry, and health impacts like headache and eye irritation due to the open incineration of the waste were observed.

Thus, the study showed that wastewater discharged from pharmaceutical factories does not comply with Nepalese Standard even for industrial wastewater. The study also indicates potential link between disposal practices and high chlorine in groundwater and wastewater practices of the pharmaceutical factories. Hence, the study strongly recommends that the regulation for pharmaceutical industrial wastewater disposal should be implemented in Nepal. Further investigation to determine the presence or absence of pharmaceutical residues in the ground water is also recommended.

**Poster 2**

**A Study of Small Scale Informal Water Vendors Serving the Low Income Consumer Groups in the Kathmandu Metropolitan City**

*Kripa Shrestha*

School of Environment Science and Management

The study was carried out to enumerate and map the informal water vendors in inner core and western wards of KMC. It identified 62 informal small scale water vendors in the studied wards. Notably, the water vendors along the 2.5 km length from Nardevi to Swoyambhunath were found to be 23. It was recorded that 12 sampled vendors were serving an average population of 37,590 per month. It is observed that about 41% of the water demand is being fulfilled by informal water vendors in the studied area.

The water quality analysis done for 15 samples from different vendors were found to be within the NDWQS for pH, hardness, chloride, nitrate and arsenic where as 20% of water samples showed high iron content, 13.33% of water samples exceeded ammonia standard value and 6.67% of water samples crossed the turbidity standard.

The capital investment for this business varied from Rs. 15,100 to Rs. 1,50,000 per vendor and their payback period also varied from 2 months to 2 years 10 months. The small scale water vendors were catering the water demand of the urban poor who were deprived of the piped water supply. It has opened up an avenue for KUKL itself to establish water vending points in the areas where it cannot extend its pipeline distribution network serving the urban poor communities.

### **Poster 3**

## **Assessment of groundwater contamination at the periphery of Bagmati River in Kathmandu Valley**

*Ramesh Gautam*

Central Department of Environmental Science, TU

This research was carried out for three seasons, viz. winter, monsoon, and post monsoon season (2009/10). For this five sampling stations along Bagmati River bank were selected viz. Gokarna, Tilganga, Sankhamul, Teku and Sundharighat respectively. From each station, six groundwater samples were taken three on each side of river on proportion basis by dividing the strata in such a way that within 50 m, 50-100 m, and 100-150 m distance from river bank. Overall 90 groundwater samples were taken and analyzed out of which; pH (48.33%), conductivity (2.5%), total hardness (2.5%), ammonia (2.5%), iron (91.16%), and coliform (88% out of 60 samples) crossed WHO Guideline (1993), and NDWQS (2062 BS) values for drinking water.

Groundwater quality analysis and regression analysis by means of dummy variables showed that the pollutant parameters like conductivity, chloride, carbon dioxide, ammonia, nitrate, phosphate were more towards downstream side of river bank than upwards and these values were more within 50 m distance of river bank than out ward. So that we can conclude that the pollutant source might be from intrusion of nearby Polluted River and dumping sites. Less pollution in groundwater along Sankhamul may be due to the fact that river was deeply incised at that station and its level was lower than groundwater levels.

#### **Poster 4**

### **Analysis of the physicochemical and bacteriological parameters of bottled water available in Kathmandu Valley**

*Ranjana Budhathoki*

Central Department of Environment Science, TU

In the context of growing health consciousness and chronic water shortages, most of the urban residents have switched to bottled water as a safe alternative. The public perception is that bottled water is regularly of high quality. However, many studies have shown that these beliefs need not always be true.

Samples of nine brands of jar water of 20 litre capacity were analyzed twice for various physicochemical as well as bacteriological parameters during January, February and March (2010). All the physicochemical parameters were within WHO acceptable limits. Ammonia was detected in some samples but is within the limits set by WHO. Iron and Nitrates were found in small quantities but within the limits set by WHO. Microbial analysis shows that, 77% of the total samples were heavily contaminated with total coliforms and 66% with fecal coliforms. Total coliforms as many as 1100 MPN/100mL and a maximum of 20 MPN/100 mL of fecal coliforms were enumerated.

Hence, it can be concluded that there is no assurance, since water comes out of a bottle does not mean it is free from contamination. Hence it is recommended to use disinfectants or boil water rather than rely on the belief of purity.

## **Poster 5**

### **Groundwater quality assessment along Dhobikhola River and its share in domestic use**

*Shovana Maharjan*

Nepal Engineering College, nec-CPS

The study was carried out along the Dhobikhola River, to evaluate its influence to the water quality of the nearby water sources. The major objectives of the study are to map the groundwater quality along Dhobikhola River and to document the pattern of groundwater use across different categories of households, and technology employed in developing groundwater sources. The river Dhobikhola has been divided into three zones based up on the social strata. The upper zone: Kapan-Chabahil, middle zone: Chabahil-Ratopul, and lower zone: Ratopul-Buddhanagar. Household Survey was carried out to see the groundwater use pattern. BOD and COD were found in all groundwater samples, which indicate some kind of organic waste leakage from septic tank, infiltration/percolation of leachates, disposed above surface into groundwater. More than 50% of the sampling sites show fecal coliform above 8000/ 100 ml. 10 samples have ammonia higher than WHO standard. While, nitrate, iron exceeds WHO water quality guidelines. About 50% of people use groundwater to meet their daily water demand, because KUKL is not being able to provide water both in terms of quality and quantity. Maximum use of groundwater is for washing, bathing, and toilet use, which do not require water to be chemically and biologically pure. 40% of the respondent uses dug well and 10% of houses use electric pump as supplementary technology as it is easy to use and have higher efficiency than other. The higher value of parameters like nitrate, ammonia, than WHO standard and presence of fecal coliform in water, indicates that water is not suitable for drinking without any prior treatment. Extraction of groundwater is increasing day by day but area for recharge is decreasing, due to which polluted river is becoming the source of recharge.

**OPEN DISCUSSION (Moderator: Er. Adarsha Pokhrel, Co-chair, NNWW 2011)**

The open discussion floor was open for the participants in the moderation of Er. Adarsha Pokhrel. Dr. Suman Shakya, ENPHO answered the questions of DEWATS. According to him unlike centralized system the decentralized water treatment systems require less land and construction cost, less land. It is estimated NRs 10,000 is required to treat 1 m<sup>3</sup> of waste, which is less compare to centralized water treatment system. The management of sludge under this system is done in dry bed, until pathogen will be killed. However, this is not satisfactory process so research is being carried out to improve the sludge management of this system.



Dr. Sangam Shrestha from AIT talked about the situation of groundwater management in Bangkok. According to him, incidence of land subsidence in Bangkok was related to the rate of groundwater extraction. The heavy extraction of groundwater causes the void between soil/sediment pores, and thereby increases the chance of land subsidence. He mentioned that AIT has attempted towards the artificial recharge, but it was not successful and the further investigation on recharge is underway. Comparing the situation of Kathmandu seems to be similar to Bangkok. The extraction of groundwater is higher in Kathmandu Valley, and thus the area possesses the threat of land subsidence. In case of Bangkok, the government has imposed the groundwater regulation policy strictly. Furthermore, Bangkok has adopted good technology for groundwater extraction and management of available groundwater resource.

Dr. Suresh Das Shrestha, highlighted on the possibilities of increasing the groundwater level through rainwater harvesting, and thereby fulfilling the increased water demand of the Kathmandu Valley. He suggested that the rain water which usually gets flow through sewerage, can be tapped and collected in pit. However, the collection of rainwater depends on the geological condition of area and varies with sites. Recharging of groundwater is usually hinder usually in presence of thick clay. But there are several areas / locations suitable for rainwater harvesting in the valley.

Dr. Rajendra Shrestha from AIT, suggested that groundwater management can be started from small scale (roof top) to basin level. It is an individual responsibility and there is a need of awareness in people for changes in their behaviors. Policy should be amended, should be favorable for groundwater management. He stressed on the need of starting work from individual level.

## **CLOSING SESSION**

*Ravi Sharma Aryal, WECS*

Dr. Ravi Sharma Aryal also Vice-Chair of NNWW 2011 in closing session remarks appreciated all the work presented and anticipated that all the work may serve to disseminate knowledgeable information to curb the acute water crisis as well as to address the solid waste management problem that are hampering our river system.



## Annex

### Symposium Program Schedule

Date: 22 March, 2011

Venue: Hotel Everest, New Baneshwor, Nepal

#### Inaugural Session I

13:00-13:10	Welcome address and objectives of the symposium	Dr. Ravi Sharma Aryal, Joint Secretary, WECS
13:10-13:20	Keynote speech: Water and Cities: Time for a SWITCH?	Dr. Bhanu R. Neupane, UNESCO
13:20-13:30	Remark by Chief Guest	Former Minister of Environment, Science and Technology, Er. Ganesh Shah
13:30-13:40	Vote of thanks	Mr. Dhiraj Pradhananga, SEN
13:40-13:55	Session close with concluding remarks by Chairperson	Mr. Shyam Prasad Mainali, Secretary, WECS

#### Tea Break (13:55-14:10)

#### Urban Water Session II

Chair: Dr. Ravi Sharma Aryal		Co-chair: Dr. Sangam Shrestha
Rapporteurs: Ms. Manisha Sthapit, Ms. Sangita Maharjan		
14:10-14:25	Community based water management in urban city Kathmandu	Er. Gautam Rajkarnikar, WECS
14:25-14:40	Challenges of urban water management in Kathmandu Valley	Mr. Padma Sundar Joshi, UN-Habitat
14:40-14:55	Urban water management at community level: A case study of <i>Alko hiti</i> drinking water system of Patan	Ms. Shreya Bajimaya, Nepal Engineering College
14:55-15:10	River degradation and livelihood impacts: analysis of solid waste disposal in Hanumante River in Bhaktapur	Ms. Rabi Wenzu/ Mr. Robert Dongol, Nepal Engineering College
15:10-15:20	Discussion	
15:20-15:30	Session close with remarks by Session Chair	Dr. Ravi Sharma Aryal

#### Tea Break (15:30-15:45)

#### Groundwater Session III

Chair: Dr. Rajendra Shrestha		Co-chair: Er. Gautam Rajkarnikar
Rapporteurs: Ms. Shovana Maharjan, Ms. Maneesha Shakya		
15:45-16:00	Groundwater management in Asia-Pacific and sharing AIT's experience: Dr. Sangam Shrestha	Dr. Sangam Shrestha, Asian Institute of Technology
16:00-16:15	Groundwater recharge from rainwater - a sustainable solution for urban water scarcity	Dr. Suresh Das Shrestha, Central Dept. of Geology, TU
16:15-16:30	Assessment of drinking water quality and socio-economic status of sub-urban regions of Kathmandu	Ms. Srijana Manandhar, Central Dept. of Environment Science, TU
16:30-16:45	Decentralized wastewater treatment to reduce contamination of groundwater – examples from Nepal	Dr. Suman Kumar Shakya, ENPHO
16:45-16:55	Discussion	
16:55-17:05	Session close with remarks by Session Chair	Dr. Rajendra Shrestha

#### Poster Session IV

17:05-17:30	Presentation of posters	Facilitator: Dr. Rabin Malla, Dr. Saroj K. Chapagain, CREEW
-------------	-------------------------	---

#### Closing Session V

17:30-18:00	Open discussion	Moderator: Er. Adarsha Pokhrel, Co-chair, NNWW 2011
18:00-18:15	Session close with remarks	Mr. Ravi Sharma Aryal, Joint Secretary, WECS



**Water and Energy Commission  
Secretariat**  
Singha Durbar, Kathmandu, Nepal  
Tel : 4211415,  
4211416,4211417,4211418  
Fax: 4211425  
E-mail: [info@wec.gov.np](mailto:info@wec.gov.np)  
[www.wec.gov.np](http://www.wec.gov.np)

**Center of Research for Environment  
Energy and Water**  
259, Chandramukhi Galli, Baluwatar,  
Kathmandu-4  
G.P.O. Box 25563  
Tel: 977 (1) 4411918  
E-mail: [info@creew.org.np](mailto:info@creew.org.np)  
[www.creew.org.np](http://www.creew.org.np)

**The Small Earth Nepal**  
626 Bhakti Thapa Sadak  
New Baneshwor  
P. O. Box 20533, Kathmandu, Nepal.  
Tel: 977-1-4782738  
E-mail: [info@smallearth.org.np](mailto:info@smallearth.org.np)  
[smallearth@wlink.com.np](mailto:smallearth@wlink.com.np)  
[www.smallearth.org.np](http://www.smallearth.org.np)