

Proceedings of the  
Third National Symposium on Challenges and Opportunities for Sustainable  
Management of Groundwater Resources of the Kathmandu Valley, Nepal  
22 March 2012



Organized by



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**Kurita Water and Environment Foundation**





**Proceedings of the  
Third National Symposium on Challenges and Opportunities for Sustainable Management of Groundwater Resources of the Kathmandu Valley,  
Nepal**

**22 March 2012  
Kathmandu, Nepal**

**Organized by**

Center of Research for Environment Energy and Water (CREEW)  
Environment and Public Health Organization (ENPHO)  
The Small Earth Nepal (SEN)

**Supported by**

Kurita Water Environment Foundation (KWEF), Asian Institute of Technology (AIT), International Research Center for River Basin Environment, University of Yamanashi (ICRE-UY), Resource Centre Network Nepal (RCNN), Centre for Affordable Water and Sanitation Technology (CAWST) and Guthi

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**CREEW, ENPHO and SEN**

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## INTRODUCTION

### Background

On the occasion of World Water Day and World Meteorological Day, Government of Nepal in association with government agencies, INGO, NGOs, CBOs, civil societies have been organizing a week long program as Nepal National Water Week (NNWW) since 2008. This year the program was organized from 17-23 of March. The theme of World Water Day of the year 2012 was *Water and Food Security*.

As a part of the NNWW, Center of Research for Environment Energy and Water (CREEW) conducted the First Symposium on Groundwater in December 2009. Following the trend since then, CREEW in association with Environment and Public Health Organization (ENPHO), The Small Earth Nepal (SEN), Asian Institute of Technology (AIT), Thailand, International Research Center for River Basin Environment-University of Yamanashi (ICRE-UY), Japan, Resource Centre Network Nepal (RCNN), Centre for Affordable Water and Sanitation Technology (CAWST) and Guthi organized the Third National Symposium on Challenges and Opportunities for Sustainable Management of Groundwater Resources of the Kathmandu Valley on 22nd March 2012.

### Objectives

- To share the recent study and research work especially on quantitative, qualitative, management and legislative issues of groundwater.
- To discuss and interact on groundwater issues and opportunities among policy-makers, INGOs, NGOs and Civil societies, researchers, graduate students, and other concern stakeholders.
- To discuss and promote groundwater recharge and rainwater harvesting as one of the option of attaining water security in Kathmandu Valley.

### Theme of the Symposium

Call for the submission of papers for oral and poster presentations were made on the following themes;

- Quantitative issues of groundwater in the Kathmandu Valley
- Qualitative issues of groundwater in the Kathmandu Valley

- Water use and market of groundwater in the Kathmandu Valley
- Private-Public Partnership in water supply, groundwater recharge and rainwater harvesting
- Groundwater policy, regulations and institutions

## **Participants**

Researchers, experts, scholars, consultants and policy makers attended the symposium. All together 110 people, representing different professions participated the symposium. The list of participants is provided in Annex II.

## OPENING SESSION

### Inaugural and Welcome Speech

The program was inaugurated by Ms. Bindra Hada Bhattarai, Secretary, Ministry of Irrigation by lightening the “Panas” which was followed by the welcome speech of Dr. Suman Kumar Shakya, (Executive Director, ENPHO). Dr. Shakya highlighted on the program objectives. He also focused on some facts and figures relating the water source, groundwater demand and situation of water pollution. He addressed the symposium as a common space to share research findings on groundwater resources for its sustainable management. He concluded his speech by welcoming all participates and thanking partners/ stakeholders and organizers.



### Keynote Speech

Prof. Futaba Kazama from ICRE-UY Japan delivered her keynote speech on “Collective efforts for groundwater research in Kathmandu Valley: lessons learnt and ways forward”. She highlighted the research activities carried out by University of Yamanashi on groundwater of Kathmandu Valley. She mentioned that shallow aquifer which provides plenty of water to local inhabitant in the valley but water quality of the aquifer is badly contaminated by the septic and sewer leakage of the local area. She had further added that realizing the poor water treatment systems, University of Yamanashi has started research on water treatment since 2005. On her presentation she also highlighted the activities of the ICRE-UY in sector of capacity building / development of Nepalese researchers and attempt towards the knowledge generation. She illustrated the key research outcomes of University of Yamanashi. She opined the need for balance approach for top-bottom and bottom-up approach for sustainable development of groundwater.



## Introduction about the Book

Dr. Sangam Shrestha, Asst. Prof. of AIT, Thailand introduced book entitled “Kathmandu Valley Groundwater Outlook” (published jointly by AIT, SEN, CREEW and ICRE-UY). He mentioned the need of the book as several institutes and organizations are working on water issues, however the information are scatter and there is lack of



proper documentation. There is need of collection of entire database related to the groundwater and other issues to advocate scientific foundations working in water sector. He suggested the book would be useful for the high level policy makers in government, organization, NGOs, INGOs, practitioner, professional, students, and researchers. Dr. Shrestha acknowledged all the authors, advisory editors, reviewers, research associates involved in the publication.

## Launching of the Book

Chief Guest of the symposium Ms. Bindra Hada Bhattarai, Secretary of Ministry of Irrigation launched the book “Kathmandu Valley Groundwater Outlook” and the Proceeding of the Second National Symposium on Challenges and Opportunities for Sustainable Management of Groundwater Resources of the Kathmandu Valley. The Groundwater book was published jointly by AIT, SEN, CREEW, ICRE-UY.



## **Remark by Chief Guest and Guests**

**Chief Guest Ms. Bindra Hada Bhattarai**, Secretary of Ministry of Irrigation was highly impressed with the efforts of young researchers on holding the symposium and bringing out a book on groundwater research in Kathmandu Valley. She added that the whole world is thinking for future use of water in sustainable way. Some other countries have already done works on sustainable use of water resources; whereas Nepal is facing challenges due to huge difference in many aspects in rural and urban context and population. We have to work jointly combining our efforts from different stakeholders and Government should help these efforts by making and implementing rules and regulations on sustainable use of water resources. Regulation and control acts are required to manage water sources in Kathmandu. She said that the ministry would be very much looking towards utilizing the research outputs of the young researchers. She gave her special thanks to Prof. Kazama for her support for conducting various researches and Dr. Sangam Shrestha for his continuous work on groundwater aspect and also said she is willing to talk with the whole team of researchers studying on groundwater.



Likewise, **Joint Secretary of Ministry of Irrigation Mahendra B. Gurung** emphasized the need to work in a coordinated manner so that the efforts of all concerned would be materialized. He also hoped secretaries at the ministries of irrigation, energy and WECS would do all their best for the same.



**Dr. Rabin Malla, Executive Director of CREEW** delivered the vote of thanks to all the dignitaries on the dais. He thanked Prof. Kazama for sharing the research work and for her future research work in Kathmandu Valley. He thanked Ms. Hada as she told “Integrated program should be done in near future by government and other body”. He also appreciated Mr. Mahendra B. Gurung’s word. He concluded his speech by thanking the invited guests, dignitaries, participants, media, organizations involved in holding the symposium and the organizing committee.



**Chairperson of the symposium Sriranjjan Lacoul, Joint Secretary of Water and Energy Commission Secretariat (WECS)** emphasized the need to recharge groundwater, as the extraction of groundwater is 5 times more than the its recharge rate. He stated that monitoring and recharge are good options and he showed hope that this symposium will direct a lot to secure the groundwater.



## ORAL PRESENTATION SESSION

### Groundwater Quantity

Chair: Prof. Khem Raj Sharma, Professor, nec-CPS

Rapporteurs: Ms. Manisha, Sthapit, Ms. Sangita Maharjan

### Groundwater Storage Potential in Kathmandu Valley's Shallow and Deep Aquifers

Vishnu P. Pandey, ICRE-UY, Japan

This study delineates spatial distribution of thickness and estimates groundwater storage potential of shallow and deep aquifers in the Kathmandu Valley. The 'groundwater storage potential' refers to the volume of groundwater that can theoretically be extracted if the aquifer were completely drained. The potential is calculated by multiplying aquifer volume with storage coefficient. GIS is used for calculating spatial variation of the storage potential. The study results show that total storage potential of the shallow aquifer is high (1.5 Billion-Cubic-Metres, BCM) compared to the deep (0.6 BCM). Spatial variation of the potential in the shallow aquifer is in a range of less than 100 to 6,800m<sup>3</sup>/400m<sup>2</sup>, which is higher than that of the deep aquifer; in which, the potential is less than 1,000m<sup>3</sup>/400m<sup>2</sup> in most parts of the aquifer. If the groundwater reserve is used at the same rate as in 2001 (i.e., 21.56 Million m<sup>3</sup>/year), the reserve would be emptied in less than 100 years. Furthermore, empty space above groundwater level in shallow aquifer can store 226.5 Million m<sup>3</sup>/year (at maximum) of groundwater. If the space could be filled by artificial and/or managed aquifer recharge for future use, it could play a significant role in augmenting water supply in the valley.



## Recharge Groundwater, Reduce Water Scarcity

Suresh Das Shrestha, Invaluable Drops Recharge Kathmandu, CIUD



Municipal Water Supply in Kathmandu Valley barely manages to fulfill 25-30% of water demand of about 320 MLD. About 40 % of this supply comes from deep groundwater sources. To cope with the shortage, most residents rely on additional sources of water such as; dug wells, tube wells (borings), stone spouts ( dhunge dharas), and all tapping shallow aquifer system ranging in depth from few meters to about 20m. The number and total output of such sources are unknown.

Thus both deep and shallow groundwater system in the valley are highly stressed with the abstraction surpassing the recharge. In spite of the above shallow groundwater system is a dependable source and has the potential to be recharged. At present shallow groundwater system gets only partially recharged due to increased surface sealing activities. However, there is possibility to enhance the water storage in the shallow aquifer with the installation of efficient and proper plans rainwater harvesting system. This can only be achieved through formulation and implementation of the rainwater harvesting policy, proper incentives, massive awareness, application of appropriate technology and intensive research works.

### *Open Discussion*

Dr. J.K. Gurung raised a question to Dr. Pandey whether the geology of the valley was studied in details during his study and is there any difference between deep north stream and south stream. Dr. Pandey replied that the shallow and deep aquifers were identified based on the geological map of Kathmandu Valley.

One of the participants put concerned that if the increasing housing decreases in recharging capacity and black top suitable for Kathmandu Valley. Dr. Suresh Das Shrestha replied that the black top on the road has definitely affected groundwater recharge, beside that the extraction of groundwater is also increasing. Development work cannot be interfered hence alternatives need to be sought. Construction of recharge pits at households can be a good alternative. The dominance of gravel on un-

derlying sediments favors the recharge, whereas, northern part of Kathmandu Valley consists of gravel. Besides that, majority population resides at the northern side of Kathmandu Valley. So if we could focus on this side and construct household recharge pits it would be beneficial.

Similarly, another participant asked about the number of households that have installed rainwater harvesting system till today and reason behind the Kathmandu Valley still facing the water scarcity. Dr. Shrestha pointed out the main reasons are information gap and lack of coordination. Kathmandu Metropolitan City (KMC) is not able to disseminate the information about the rainwater harvesting system in the community. KMC had also provided 10% rebate on the building permit fee from the current fiscal year for houses that install rainwater harvesting system but till now no one had acquire it. To solve this problem, he stressed on need of the Information Dissemination Center needed in local areas. Materials for construction of rainwater harvesting system should make easily accessible. Though there are 2 such centers exists in the valley but there is only limited person who knows about it indicating the lack of dissemination. It will require another 1-2 years for mass awareness. Regarding the question on the sand mining in Bagmati River and the institutional mechanism, Dr. Shrestha answered that the Bagmati Action Plan has address sand mining at northern part, as shallow aquifer is disappearing here. But according to that plan, no action has been taken to save the Bagmati River.

## Groundwater Quality

Chair: Dr. Sangam Shrestha, AIT

Rapporteurs: Ms. Monica Maharjan, Ms. Manisha Joshi

### Overview of Chemical Quality of Groundwater in Kathmandu Valley

Saroj K. Chapagain, CREEW

This study was carried out to assess the overall quality of groundwater in the Kathmandu Valley, Nepal. Samples from deep and shallow groundwater were collected and analyzed for the major physicochemical parameters. The water quality variables such as;  $\text{NH}_4^+-\text{N}$ , Fe, Pb, Cd in most of the groundwater samples exceeded the WHO guideline levels for drinking water. Arsenic concentration was  $<10 \mu\text{g/l}$  (i.e. WHO standard) in shallow groundwater; whereas, in deep groundwater, 52% ( $n=42$ ) exceeded the WHO standard. Arsenic varies spatially with higher concentration towards the central part of the valley. Water quality of deep groundwater is influenced by natural hydrogeochemical environment. Unlike deep groundwater, the shallow groundwater is influenced by local contamination from anthropogenic sources such as domestic wastewater.



### Scenario of Kathmandu Valley Groundwater Quality

Padmaja Shrestha, ENPHO

Kathmandu Valley suffers a severe drinking water supply crisis, particularly in the dry seasons of every year. Apart from quantitative shortage, the quality of drinking water is also becoming a serious public health issue in Kathmandu Valley.



In such circumstances water quality monitoring is utmost important for safe drinking water. Nearly 200 public groundwater samples representing the different areas of Kathmandu Valley (Kathmandu, Lalitpur and Bhaktapur) were analyzed at ENPHO Laboratory in the year of 2010 - 2011. Water quality parameters such as pH, turbidity, total hardness, chloride, ammonia, nitrate, iron, manganese, arsenic and coliform were tested.

Water quality of groundwater is being deteriorated as result of human activities such as improper waste disposal/ management and unsystematic settlement with high population in the valley. The results of water quality analysis show that groundwater is contaminated with coliform bacteria (90% of samples), iron (68% of samples), ammonia (51% of samples) and manganese (51% of samples), turbidity (40% of samples), nitrate (27% of samples), hardness (2% of samples) and chloride (1% of samples). The maximum value of iron was found 41.1 mg/l in Bhotebahal area of Kathmandu. Similarly, the maximum values of ammonia and nitrate were found as 112.7 mg/l and 309 mg/l respectively in Swoyambhu area of Kathmandu. Likewise, the maximum value of turbidity and manganese were found as; 170 mg/l and 27.6 mg/l respectively in Baneshwor area of Kathmandu. Balkumari area of Lalitpur had the maximum value of total hardness (552 mg/l) and chloride (275 mg/l). The highest value of pH (9.5) was observed in Thankot and arsenic (0.03 mg/l) in Sinamangal area of Kathmandu. The results indicated that groundwater quality is not safe for direct drinking purpose. It is recommended to treat the water using appropriate technique to ensure quality of drinking water.

## **Ecological Sanitation: Closing Water, Sanitation and Agriculture Loop**

Prajwal Shrestha, ENPHO

Hydrology is a basic science which has its role increasing day by day for the sustainable development of social institutions. The present growth of urbanization associated with population growth has made water to find scarce to satisfy growing water demand as well as less utilization of water resources in a sustainable way. The growth and development of urban areas is changing physical and ecological



properties of land use significantly. This change in land use and its associated ecological cycle is making inhabitants more vulnerable due to lack of clean water.

The conventional water cycle now needs a sort of paradigm shift as many components of water cycle have been changed in the process of development. Rapid urbanization is blocking the water to infiltrate to groundwater sources, manmade structures like dams, canals are diverting water from its original pathways and discharge of untreated wastewater directly into water bodies without any treatment is destroying the ecological system of water bodies.

Also with the agriculture sector, the current agriculture practices are only transferring the nutrients from land to food products. The use of chemical fertilizers is only providing temporary solution to produce foods but also degrading the soil composition. There are very limited cases where the use of organic fertilizers is being practiced to sustain the ecological properties of soil.

For the better water management and utilization of the limited water resource, there is need to integrate water cycle with sustainable sanitation as well as agriculture. The integration of water, sanitation and agriculture cycle with each other will give a holistic approach which is now terms as “Ecological Sanitation”. Ecological sanitation is the approach which uses the concept of reduce, recycling, reuse of nutrients. The challenges in urban water management include adaptation and development of ecological sanitation solutions which are available globally; these solutions should be sustainable so that present problems can be turned into future opportunities. The current challenges and emerging sustainable sanitation technologies are discussed in the paper: delivery of drinking water using rain water harvesting, groundwater recharge to feed depleting aquifers, sanitation without less/no water, recycling and reuse of wastewater.

### ***Open Discussion***

Dr. Jaya Kumar Gurung asked question to Dr. Saroj Chapagain regarding the collection of water samples whether they were from production well or observation/monitoring wells. How do the samples represent the aquifers properties? In response to his query Dr Chapagain mentioned that there is no doubt that the well designed and built for the monitoring purpose is the best representative for water quality and water level monitoring but in absence of such monitoring well in the valley, the sam-

ples for the research were taken from the production wells. However, lithological description of production wells were tried to collect as possible as and all the wells mentioned here as deep wells were greater than 50 meters deep. The chair of session Dr. Sangam Shrestha added that if the lithological information could have been correlated, it would have imparted better and more reliable results. He then suggested Dr. Chapagain to present it as the limitation of the study.

Dr. Suresh Das Shrestha raised his query to Ms. Padmaja Shrestha about the arsenic concentration. The results were whether from shallow or deep tube wells. Ms Shrestha replied that since water samples brought to ENPHO Lab for testing were basically for drinking purpose, hence the presented arsenic concentration must be of shallow tube well. Dr. Madhav Narayan Shrestha also suggested her to compare the water quality results with national drinking water quality guidelines, and categorize the water samples based on depth of wells. Similarly Dr. Sangam Shrestha inquired about the location and possible reasons of having the higher concentration of manganese in particular well.

Following the presentation made by Prajwal Shrestha, one of the participants expressed that the rain water harvesting technology as an expensive technology from his own experience. If the technology intends to only for rich people, and how general people be encouraged to use such technologies. Mr. Shrestha said that the problem is not with the technology but with the perception and behavior of the people. He further added that shallow aquifer of the valley is highly potential to recharge, and we can simply adopt rainwater harvesting system by making recharge pits and with construction of some sort of reservoir.

## Groundwater Use, Market and Institutions

Chair: Prof. Ashutosh Shukla, nec-CPS

Rapporteurs: Mr. Phurba Sange Moktan, Ms. Merina Kayastha

### Overview of Water Markets in Kathmandu Valley

Robert Dongol, nec-CPS



The Kathmandu Valley has seen a long history of civilization starting from the prehistoric dependency on water. In due course of time, haphazard urbanization and population growth beyond the carrying capacity of the valley has resulted in pollution of surface water, which was the major source for quenching the thirst of the valley denizens. This ultimately led to the extraction of the hidden resources

- groundwater - in a massive quantity, both at the individual and commercial levels, creating a good avenue for the water markets in the valley. Lack of regulation mechanisms is helping it to flourish further. This chapter describes the current status of water markets, which is basically based on groundwater, and the facts and figures through recent research. Along with this, the chapter also deals with the role of evolving water market operators in the valley in addressing the water needs through their services in terms of water quality and quantity.

### Groundwater Development and Management Institutions and Policies in Nepal

Bhintuna Shrestha, SEN

The existing groundwater development and management institutions in the Kathmandu Valley and Nepal were reviewed. Similarly, the institutional setups at different levels were identified and their key roles and working objectives were also discussed emphasizing the groundwater development and



management. In addition, the presentation also provided a review of existing policies on groundwater development and management in the Kathmandu Valley and Nepal.

## **Groundwater Use in Kathmandu Valley: An Analysis of Pre- and Post-Melamchi Cases**

Madav Narayan Shrestha, Environmental Water Resources Expert

Water supply services in urban and semi-urban areas of the Kathmandu Valley are being provided by only one water supply operator, Kathmandu Upatyaka Khanepani Limited (KUKL), using 35 surface sources and 57 deep tube wells. The portion of groundwater contribution in the total production of KUKL is an average of 35% in dry season and 11% in wet season with an annual average of 19% in 2011. Total KUKL supply accounts for 22.5% (in March) and 37.8% (in September) of water demands only. To deal with the increasing water supply deficit and water scarcity in the valley, Melamchi Water Supply Project (MWSP) is underway to bring water from off-the-valley sources. After completion of the project, water supply quantity is expected to be improved with increasing consumption rate from 41 litres/capita/day (lpcd) in 2011 to 126 lpcd in 2025; however, groundwater contribution in total KUKL production is expected to be decreased to 7%, 4%, and 3% in 2016, 2019 and 2025, respectively. If supply system is managed with projected demand of 135 lpcd, the average supply duration is expected to increase from 7 hours/day in 2011 to 23 hours/day in 2025. Other alternate options to minimize the gap between demand and supply of the valley and consequently stress on groundwater resources could be development of urban centers outside the valley, optimum planning of land use for potential recharge, introducing micro to macro level rainwater harvesting programs and riverhead forest protection.



## **SmartPaani, Conserve Every Drop**

Bijay K. Sharma, One Planet Solution

Potable water is one of the major problems in the world and Kathmandu valley is no exception to it. People have to sacrifice too much to meet their daily need. Government, NGOs or INGOs are doing great job by creating a buzz in the society and making people aware of water conservation and the ways to do. But to meet the demand of personalized services, customized solution and market demands are difficult rather impossible by them.



So a need of private company becomes need of the hour. A private company like SmartPaani of One Planet Solution Pvt. Ltd. which focuses only on Rainwater Harvesting along with groundwater recharge, Bio Sand Filtration and Grey Water Recycle, can play a major role in fulfilling the above need of individual and institutions. On top of the above after sales services and maintenance could only be satisfactorily provided by a private entity.

Till date in a short span of 6 months SmartPaani has successfully installed close to 20 installations. This includes households and institutions. In the two major institutions (Adarsha Kanya School, Mangal Bazar and Saraswati School, Techo) where rainwater harvesting along with groundwater recharge and bio sand filtration, has been installed would be recharging 3.9 million and 2.4 million liters of water every year. This would be major contribution and help rise the groundwater table which presently is in depleting stage.

### ***Open Discussion***

Dr. Jaya Kumar Gurung was interested to know the basis of the classification of groundwater development and management institutions into formal and informal categories in response to Ms. Bhintuna Shrestha presentation. It was mentioned that the categorization is basically based on the mandate given by the government. The categorization of the formal institutions in perspective of service is provided to the local as well as community level and informal institutions do not provide services to the community level.

## POSTER SESSION

### **Depletion of Groundwater in Kathmandu Valley: Extent of Problem and Resulting Consequences**

Sachin Shrestha, nec-CPS

Over extraction of groundwater has resulted the depletion of groundwater level in the Valley, the overall objective of the study is to assess the extent of groundwater depletion and the resulting consequences on local livelihood. There are semi-structured interview and key informant's interview as well as literature review to identify the actual scenario of groundwater depletion, impacts and consequences, livelihood, and people's concerns emerging from groundwater depletion. Local People perception is that there have to go much down for extraction the groundwater as comparison to before, groundwater level decline successively by increasing number of deep boring by housing companies, hotels, water tanker suppliers, bottled water company and other institutions.

There were already insufficient of municipality supply line, because of excessive depletion of groundwater, there were drying up the dug well and stone spouts and most of them are trends of drying up. Due to the massive infrastructure construction coupled with groundwater extraction from shallow and deep aquifers, the dug wells, stone spouts and ponds are badly affected also the surface flow of water has been reduced because of the deep boring being constructed along the river corridor. Thereto resulting in decline water table below the surface water level hence the river water goes down to compensate the water table. Land subsidence will occur in that place where the groundwater extraction is excessive so far no such cases have been reported in Kathmandu valley according to study. Southern groundwater districts may be susceptible for land subsidence because many large housing complexes are located there and the requirement for water will increase tremendously in the future.

Groundwater level is steadily going down resulting higher pumping cost, deepening of the existing dug wells and bore holes, abandonment of the current water sources; in dry season water scarcity which directly impacts the livelihood. The local people especially female spent their most of their productive time in search of drinking water from nearby sources. Local people in the study area were found reluctant to use the groundwater because of persistent smell and odor which might be the resultant of

the sewerage intrusion either from the nearby septic tanks or from the river water. Inadequate water availability had forced people who are dependent on cash crop farming to seek for other alternatives, there was low agriculture production, insufficient to meet local demand hence price of the vegetables increases making it unaffordable for the poor people that ultimately impact on the health. There were compulsory to buy tanker water for their domestic use by spent their high amount of income which directly impact livelihood. Lack of good quality water and the intrusion of the wastewater in the ground reservoir, people are suffering from different diseases specially skin diseases like rashes, hair fall.

The depletion of groundwater is taken as a first indicator of water scarcity hence the regular monitoring of groundwater quality and the quality, awareness regarding water misuse and environment protection, maintenance of the local recharge areas nearby the sources are essential.

### **Rainwater Harvesting Potential in the Housing Colonies of Urban Valley of Nepal**

Manisha Sthapit, CREEW

With data compiled by Comfort Housing, by 2030 Nepal urban populations will sooth up by double the current population i.e.15%. Land constraint, social insecurity and high living quality are attracting people towards the community living rather than stand alone houses. With growing modern living style, water demand in these housing are also rising. As the KUKL water supply demand gap is widening i.e.175 MLD the alternative sources to meet the increased water demand have been always been matter of concern.

The study was carried out to estimate Rainwater Harvesting (RWH) potential meeting the daily water demand in the housing colonies. Among 12 registered colonies in Kathmandu district 6 housing colonies were surveyed which revealed that RWH had potential to fulfill water demand of the colonies i.e. 251.37 L per average family of four. For storage, all studied colonies have potential of average capacity 4000 L for underground storage and 1000 L for overhead storage. As the storage system had constructed to store groundwater, if RWH system is installed, storage would not be the problem. From the water quality analysis, the physical and chemical parameters of the tested rainwater were below the guidelines given by NDWQS, but there is presence of fecal coliform. Therefore it can be directly used for the non-consumptive purpose and by treating can be used for consumptive purpose. Household percep-

tion survey revealed that 100% residents of colonies are satisfied with the quantity of water they are receiving but 4 out of 6 colonies were not satisfied with water quality. It was found that 80% respondents had any knowledge about the rainwater harvesting system whereas only 75% of the respondents are willing to install RWH system in their houses. About 25.45% considered that RWH system is expensive process where as only 9.09% found it is cheap. The detailed cost benefit analysis revealed that rainwater cost around NRs. 0.83/liter which is cheaper than jar water but expensive than city water supply, tanker water and deep tube well. Sustainability, environment conservation, water availability, reduction of mental stress makes rainwater stand better than other water sources.

Thus this research indicates that rainwater harvesting can be the reliable, independent and complementary water source in these housing colonies.

### **Invaluable Drops-Recharge Kathmandu**

#### **CIUD**

Centre for Integrated Urban Development (CIUD) is undertaking the initiative to recharge Kathmandu's groundwater by harvesting every drop of rainwater through the project "**Invaluable Drops-Recharge Kathmandu**" with funding assistance of the United Nations Development Programme (UNDP) and Coca-Cola. UN-Habitat Nepal and Clean Energy Nepal are the technical associates where UNDP GEF Small Grants Programme (SGP) provides support in the project monitoring and supervision. This project is mainly designed to mobilize local community in harvesting of rainwater and recharging Kathmandu's groundwater which can contribute effectively in climate change adaptation and water resources management. It also demonstrates the use of wells and recharge pit for groundwater recharge.

#### **The objectives of the project are**

- To increase access to water and reduce people's vulnerability to climate change impacts
- To demonstrate rainwater harvesting and recharge as an appropriate measure for climate change adaptation in urban areas
- To motivate local communities to set up similar systems
- To support government and municipalities to formulate policies and programmes to further promote groundwater recharging
- To increase awareness and knowledge on rainwater harvesting and recharging system

### **The demonstration site of the project includes**

- 2 communities in the city core
- 5 educational institutions
- 1 public historic pond/rain garden
- 1 Industrial estate
- 1 residential colony

**Public Awareness:** Promotional materials will aid in conducting awareness for people, especially focusing on students and housewives, about rainwater recharge system. The awareness programs will embed climate change, its impact, and how recharging groundwater can contribute effectively in climate change adaptation.

**Capacity Building:** Capacity building of plumbers will be done by training them with certified vocational courses on RWH. RWH service delivery outlets will be established and will be capacitated. Also capacity building of community and institutions will be carried out by conducting trainings on rainwater harvesting and recharge.

**Knowledge Management:** Knowledge dissemination will be done by establishing a resource center and by producing “**Do it Yourself**” RWH technical manual. Learning seminars will be conducted and several learning documents and reports on the project outcomes will be produced. **Water Blue Print** for a community college will also be prepared and executed.

**Expected Outcomes:** This project will help to recharge **5,000,000** liters of water through established rainwater recharge demonstration sites. It will also create public awareness regarding RWH and adaptation to climate change to more than 500,000 populations, 5000 housewives, and 20,000 students through news/ articles, promotional materials, audio/video, trainings, etc. RWH service outlets will be established in association with sanitary hardware stores which will provide all the necessary accessories for installing RWH system. RWH users’ friendly technical manual will also be produced along with promotional brochures/ pamphlets/ posters, bill boards, and audio/video materials.

**Project Duration and Budget:** The project duration is 12 months and is expected to be completed in September 2012. The total budget of this project is \$95000.

## Assessment of Shallow Groundwater Quality in Selected Areas of Kathmandu Valley

*The study is conducted as one of the event of NNWW-2012 entitled “Training on Water Research Techniques and Tools” organized by CREEW, ENPHO and SEN on 19- 20 March 2012*

Shallow groundwater is a major source of drinking water in Kathmandu Valley. The shallow aquifer is recharged mainly from rainfall of the surrounding locations. Hence, water quality of the aquifer is likely to be influenced with rain water quality and anthropogenic activities of local level. Whereas, the increasing human activities have increased the possibility of groundwater contamination in the recent year in the valley.



Therefore the periodic monitoring of shallow groundwater quality is considered important. The objective of the study is to assess quality of shallow groundwater from the selected areas of the Valley. The study was conducted to train Bachelor's level students in water sampling, water quality testing and interpretation of results. Four different sites namely Chyasal, Chahabil, Baluwatar and Baneshwor were selected for water sampling. In total 16 samples, 4 from each sampling sites were collected. The water quality parameters namely pH, water temperature, and electric conductivity (EC) were tested onsite using the field tester, whereas, ammonia (NH<sub>3</sub>), nitrate (NO<sub>3</sub>), iron (Fe), phosphate (PO<sub>4</sub>) and chloride (Cl<sup>-</sup>) were tested in lab using water test kit developed by ENPHO. The highest values of water quality parameters like EC, NH<sub>3</sub>, NO<sub>3</sub>, Fe were observed in Baneshwor area, where as PO<sub>4</sub> was higher in Chababil and Chyasal areas. In case of pH, 8 samples were below than lower limit of WHO guideline value i.e. 6.5, but none of samples exceeded the highest guideline value (i.e. 8.5). In case of chloride none of samples exceeded WHO guideline value (250 mg/l). The study revealed that water quality parameters are different among the sampling locations within the valley indicating the local influence on groundwater quality. The iron concentration exceeded the WHO guidelines in major locations (n=13) namely Baluwatar, Chababil, Baneshwor areas. The value of NH<sub>3</sub> observed higher than WHO guideline values (1.5 mg/l) in all samples of Baneshwor area.

## CLOSING SESSION

**Closing remarks** was made by **Mr. Sudarshan Rajbhandari, Vice President of SEN**. He highlighted that the groundwater symposium was one of the major event of Nepal National Water Week, 2012. He shared that increasing trend of groundwater extraction in the valley with increasing population can lead unimaginable consequences in future if it is not regulated in time. In this context, it has become very crucial for the sustainable and the scientific management of groundwater and the relevant rules and regulations to be designed and imposed by the government, he added. He further highlighted that the symposium became successful in sharing the overall scenario of the groundwater of Kathmandu Valley and providing scientific technique and tools for its sustainable management as well. He expressed sincere thanks to all participants on behalf of organizing committee for making the symposium to a big success.



## ANNEX I: Program Schedule



राष्ट्रिय जल सप्ताह आयोजक समिति, नेपाल २०६८  
NEPAL NATIONAL WATER WEEK ORGANIZING COMMITTEE 2012



### THE THIRD NATIONAL SYMPOSIUM ON CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE MANAGEMENT OF GROUNDWATER RESOURCES OF THE KATHMANDU VALLEY

Symposium Program Schedule

Date: 22 March 2012

Venue: Indreni Complex (Maitri Hall), Opposite to Krishna Tower, New Baneshwor

Registration: 9:00-9:30

MC: Ms. Suchita Shrestha

INAUGURAL SESSION		
Welcome of dignitaries on dais		
9:35-9:45	Welcome address	Dr. Suman K. Shakya, Executive Director, ENPHO
9:45-10:10	Keynote speech: "Collective efforts for groundwater research in Kathmandu Valley: lessons learnt and ways forward"	Prof. Futaba Kazama, Professor, ICRE-UY
10:10-10:25	Introducing 'Kathmandu Valley Groundwater Outlook' and Proceedings of the 2 <sup>nd</sup> National Symposium on Challenges and Opportunities for Sustainable Management of Groundwater Resources of Kathmandu Valley	Dr. Sangam Shrestha, Asst. Professor, AIT
10:25-10:30	Launching book entitled "Kathmandu Valley Groundwater Outlook" and Launching Proceeding of 2 <sup>nd</sup> Groundwater Symposium	Ms. Bindra Hada Bhattarai, Secretary, Ministry of Irrigation
10:30-10:45	Remark by Chief Guest	Ms. Bindra Hada Bhattarai, Secretary, Ministry of Irrigation
10:45-10:50	Vote of thanks	Dr. Rabin Malla, Executive Director, CREEW
10:50-11:00	Closing of the session with concluding remarks by Chairperson	Mr. Sriranjana Lacoul, Joint Secretary, WECS
<b>Tea Break (11:00-11:15)</b>		

<b>ORAL PRESENTATION SESSION</b>		
<b>(1) Groundwater quantity</b>		
Chair: Prof. Khem Raj Sharma, Professor, nec-CPS Rapporteurs: Ms. Manisha Sthapit, Ms. Sangita Maharjan		
11:15-11:25	Groundwater storage potential in Kathmandu Valley's shallow and deep aquifers	Dr. Vishnu P. Pandey, ICRE-UY, Japan
11:25-11:35	Recharge Groundwater; Reduce water scarcity	Dr. Suresh Das Shrestha, Central Dept. of Geology, TU, Kathmandu, Nepal
11:35-11:50	Open Discussion	
<b>(2) Groundwater quality</b>		
Chair: Dr. Sangam Shrestha, AIT Rapporteurs: Ms. Monica Maharjan, Ms. Manisha Joshi		
11:50-12:00	Overview of chemical quality of groundwater in Kathmandu Valley	Dr. Saroj K. Chapagain, CREEW, Kathmandu, Nepal
12:00-12:10	Scenario of Kathmandu Valley groundwater quality	Ms. Padmaja Shrestha, ENPHO
12:10-12:20	Ecological Sanitation: Closing water, sanitation and agriculture loop	Mr. Prajwal Shrestha
12:20-12:35	Open Discussion	
12:35-13:15	Lunch	
<b>(3) Groundwater use, market and institutions</b>		
Chair: Prof. Ashutosh Shukla, nec-CPS Rapporteurs: Mr. Phurba Sange Moktan, Ms. Merina Kayastha		
13:15-13:25	Overview of water markets in Kathmandu Valley	Robert Dongol, Nepal Engineering College, Nepal
13:25-13:35	Groundwater development and management institutions and policies in Nepal	Dr. Sangam Shrestha, Asian Institute of Technology (AIT), Thailand
13:35-13:45	Groundwater use in Kathmandu Valley: an analysis of pre- and post-Melamchi cases	Dr. Madav Narayan Shrestha, Environmental Water Resources Expert
13:45-13:55	Public Private Partnership in Groundwater Recharge	Bijay K Sharma (Consultant, One Planet Solution)
13:55-14:20	Open Discussion	
<b>POSTER SESSION AND CLOSING</b>		
14:20-14:50	Poster Session	Moderator: Dr. Saroj Chapagain (CREEW), Ms. Padmaja Shrestha (ENPHO)
14:50-15:00	Closing of the session with remarks	Mr. Sudarshan Rajbhandari (SEN)

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