



urbanWASH

South Asia Research Notes

Safe Water for South Asia

Spring 2013

Without water, life would not exist. It is a prerequisite for all human and economic development. Yet today, 780 million people – about one in nine – lack access to clean water. More than twice that many, 2.5 billion people, don't have access to a toilet. There has been significant public attention paid to the issue of water scarcity lately, and for good reason. Although water is a renewable resource, it is also a finite one. Only 2.53 percent of earth's water is fresh, and some two-thirds of that is locked up in glaciers and permanent snow cover. But despite the very real danger of future global water shortages, for the vast majority of the nearly one billion people without safe drinking water, today's water crisis is not an issue of scarcity, but of access.

(From <http://water.org/water-crisis/water-facts/water/>)

urban WASH, a new urban water initiative launched in Spring 2012 by the Center for South Asia Studies (CSAS), is designed to address this critical need to improve not only the current inadequate water supply and sanitation services but also plan and meet future demand in South Asia.

This special issue of South Asia Research Notes is dedicated to the multi-faceted research on South Asia related water issues that is being carried out by faculty experts and graduate students at UC Berkeley as well as past and upcoming events organized under this initiative.

SUMMARY

- More than 3.4 million people die each year from water, sanitation, and hygiene-related causes. The water and sanitation crisis claims more lives through disease than any war claims through guns. Nearly all deaths, 99 percent, occur in the developing world.
- 780 million people lack access to an improved water source; approximately one in nine people. Of the 60 million people added to the world's towns and cities every year, most move to informal settlements (i.e. slums) with no sanitation facilities.
- An American taking a five-minute shower uses more water than the average person in a developing country slum uses for an entire day.
- It is estimated that nearly 10% of the global disease burden could be reduced through improved water supply, sanitation, hygiene, and water resource management.
- Many cost-effective methods exist for safe water treatment; the challenge is taking some of these solutions to scale in low-income regions.

(Graphics and bulleted text from <http://water.org/water-crisis/water-facts/water/>)



196 MILLION WITHOUT SAFE WATER IN SOUTH ASIA

WATER



More than 3x more people lack water than live in the United States

CHILDREN



Every 21 seconds, a child dies from a water-related illness

WOMEN



Women spend 200 million hours a day collecting water

South Asia Research Notes is published by the Center for South Asia Studies at UC Berkeley to promote dialogue and exchange between scholars who work in inter-disciplinary fields related to South Asia, as well as to convey to the wider public the variety of exciting projects going on at Berkeley. South Asia Research Notes is published annually every Spring and is available at southasia.berkeley.edu under publications

Sanitation

- Sanitation and proper hygiene are crucial to diarrhea prevention. It is estimated that improved sanitation facilities can result in an average reduction in cases of diarrhea of more than one-third. Washing hands with soap has been found to reduce diarrhea by more than 40%.

- Halving the proportion of those globally without access to safe drinking water and adequate sanitation by 2015 is estimated to result in 272 million more school attendance days a year. The value of deaths averted, based on discounted future earnings, would amount to US\$ 3.6 billion a year

- Only 63% of the world's population has access to improved sanitation - defined as a sanitation facility that ensures hygienic separation of human excreta from human contact.

- Improved sanitation facilities are estimated to result in an average reduction in cases of diarrhea of more than 33%.

- 2.5 billion people lack access to improved sanitation; 1.1 billion still practice open defecation.
- Of the 60 million people added to the world's towns and cities every year, most move to informal settlements (i.e. slums) with no sanitation facilities.

(From <http://water.org/water-crisis/water-facts/water/>)

SANITATION



More people have a mobile than a toilet

Past events held under urbanWASH

LECTURE: Urban Water Futures: Can India's Small Towns Show the Way



Rohini Nilekani, Founder-Chairperson of Arghyam, a foundation she set up with a private endowment, to work on water and sanitation issues in India, delivered our 2nd Sarah Kailath Memorial Lecture on "Women and Leadership," on October 30, 2012. Arghyam is a funding

...one of the most valuable things Arghyam can give to a community is a new sense that it can find its own water solutions — even a system as small as a single schoolhouse rainwater collecting device.

— Rohini Nilekani, Arghyam

agency based in Bangalore which facilitates implementation and

research to support evidence-based advocacy and influence policy in cities and towns in 3,000 villages across India.

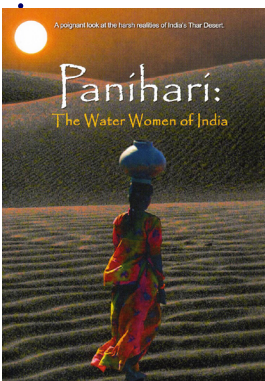
CONFERENCE: urban WASH: Paradigms for Water, Sanitation & Hygiene for the 21st Century South Asian City

— a graduate student symposium held on April 25, 2012, which focused primarily on urban water management. Papers presented covered a diverse range of topics related to the theme of urban water and sanitation, such as integrated water management, improved water supply and/or sanitation, governance and institutions, equitable access, and environmental regulations and compliance. Presentations both addressed new and existing challenges in the 21st century as well as involved creative approaches to planning and implementation.

DOCUMENTARY SCREENING: Panihari—The Water Woman

Indian-American filmmakers **Abi Devan** and **Sudhi Rajagopal** return to their parents' homeland to document life in the desert communities of Rajasthan.

Their journey leads them to the Panihari (women who fetch water). The film centers around one of these women, Paru, a shoemaker's wife, as she struggles against nature and society to attain self-reliance for her family and herself. Paru's story conveys the richness and complexity of desert life, as well as the extreme obstacles women in India still face today.



The film beautifully depicts the cultural interpretations of water and matters that revolve around this essence of life. With primarily a south Indian perspective (rather than an Indian American view point), the directors portray the contrasts in people's experiences with water. Scenes of heavy downpours, plastic pots filled with water, and hoses supplying water to apartments

or houses in crowded Chennai, India are juxtaposed against scenes of creaking water pumps filling beautifully decorated earthen pots and carried across foggy but dry and sandy desert on camel carts. Interestingly the imagery of water as captured in this film also seemed to be real (brown and muddy) and not ideal (blue and crystal clear).

The DIRECTORS

Abi Devan and Sudhi Rajagopal

Health

- More than 3.4 million people die each year from water, sanitation, and hygiene-related causes. Nearly all deaths, 99 percent, occur in the developing world.
- 2.5 billion people lack access to improved sanitation; 1.1 billion still practice open defecation.
- Diarrhea is more prevalent throughout the developing world largely due to the lower levels of access to safe drinking water and sanitation, along with poorer overall health, hygiene, and nutritional status.
- Half of the hospital beds in the world are occupied by patients suffering from diseases associated with lack of access to safe drinking water, inadequate sanitation and poor hygiene.
- It is estimated that nearly 10% of the global disease burden could be reduced through improved water supply, sanitation, hygiene, and water resource management.
- Diarrhea is the second leading cause of death among children under five in the world. Around 1.5 million deaths each year - nearly one in five - are caused by diarrhea. It kills more children than malaria, AIDS, and measles combined.

DISEASE



The majority of illness caused by fecal matter

(From <http://water.org/water-crisis/water-facts/water/>)

I HEART TAP WATER

CAL CAMPUS CAMPAIGN

I Heart Tap Water is a collaborative CAL Campus campaign to promote the drinking of tap water as the preferred beverage of choice.

Your Campus Consumption

- During the 2009-10 school year, the Berkeley campus sold over 17,000 cases of bottled water, translating to 430,630 individual plastic bottles. Thanks in part to the **I Heart Tap Water** campaign and most students now carrying a refillable water container, this is a 48% decrease in campus bottled water sales since 2005-06. However, we still have a long way to go to eliminate the wasteful habit of purchasing water in disposable plastic bottles.

Your Safety

- Tap water at UC Berkeley is sourced from the Sierra Nevada snowmelt and then further filtered by our water district East Bay Municipal Utility District (EBMUD) before it reaches campus water fountains. Water quality is determined through rigorous testing for contaminants and results must meet or surpass federal and state drinking standards. As such, the water UC Berkeley receives from the tap is very high quality.
- Results from a campus water fountain assessment in the Fall of 2009 by the Community Nutrition class, revealed that in over 450 water fountains located all over campus, only 21 fountains were rated unacceptable. The follow-up to these fountains included repair or removal. Over 220 of the fountains received an excellent rating and 203 received acceptable.
- Fountains on campus are cleaned daily by our campus facilities staff. Given that fountains may or may not be used on a daily basis, it is recommended to run the water for a several seconds prior to drinking from them.

Your Health

- US calorie consumption per person per day has increased by over 500 calories since the 1970s.
- Sweetened beverages intake nearly tripled during that same time period. Sweetened beverages account for a large portion of the total increase in calorie intake. These extra empty calories are a contributing factor to the obesity epidemic and associated complications such as diabetes, heart disease and some cancers.
- We need to select more calorie-free beverages and water is a great healthy, accessible, and refreshing choice!

Your Planet

- Each year about 50 billion plastic bottles of drinking water are purchased in the United States, requiring the energy equivalent of more than 17 million barrels of oil - enough to fuel more than one million vehicles for a year and produce more than 2.5 million tons of carbon dioxide.
- For each gallon of water bottled in a PET container, two gallons are wasted in the making of the plastic bottle and the bottling process.
- Transporting bottled water across hundreds and sometimes thousands of miles spews carbon dioxide into the air and contributes to climate change.
- Campus Recycling estimates less than half of the plastic bottles purchased on campus are recycled.

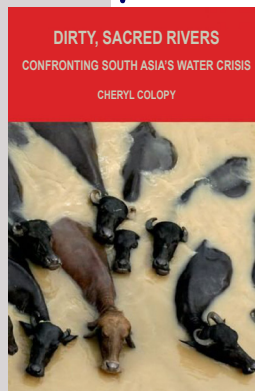
Your Action

- TAKE THE PLEDGE!** be a part of the vision.
- If you need to purchase bottled water, please be sure to recycle the bottle.



AUTHOR EVENT: Dirty, Sacred Rivers: Confronting South Asia's Water Crisis

Dirty, Sacred Rivers explores South Asia's increasingly urgent water crisis, taking readers on a journey through North India, Nepal and Bangladesh, from the Himalaya to the Bay of Bengal. The book shows how rivers, traditionally revered by the people of the Indian subcontinent, have in recent decades deteriorated dramatically due to economic progress and gross mismanagement. Dams and ill-advised embankments strangle the Ganges and its sacred tributaries. Rivers have become sewage channels for a burgeoning population.



To tell the story of this enormous river basin, Cheryl Colopy treks to high mountain glaciers with hydrologists; bumps around the rough embankments of India's poorest state in a jeep with social workers; and takes a boat excursion through the Sundarbans, the mangrove forests at the end of the Ganges watershed.

She lingers in key places and hot spots in the debate over water: the megacity Delhi, a paradigm of water mismanagement; Bihar, India's poorest, most crime-ridden state, thanks largely to the blunders of engineers who tried to tame powerful Himalayan rivers with embankments but instead created annual floods; and Kathmandu, the home of one of the most elegant and ancient traditional water systems on the subcontinent, now the site of a water-development boondoggle.

Colopy's vivid first-person narrative brings exotic places and complex issues to life, introducing the reader to a memorable cast of characters, ranging from the most humble members of South Asian society to engineers and former ministers. Here we find real-life heroes, bucking current trends, trying to find rational ways to manage rivers and water. They are reviving ingenious methods of water management that thrived for centuries in South Asia and may point the way to water sustainability and healthy rivers.

The AUTHOR

Cheryl Colopy researched and wrote *Dirty, Sacred Rivers* during seven years of travel and residence in South Asia. With the help of a Fulbright fellowship she undertook her exploration of the looming catastrophes in the Ganges river basin. She is an award-winning reporter, formerly with NPR affiliate KQED in San Francisco.



Allan H. Smith

RESPIRATORY SYMPTOMS IN BANGLADESHI CHILDREN AFTER ARSENIC EXPOSURE, AND A PROGRAM TO PROVIDE SAFE, ARSENIC-FREE DRINKING WATER

Drinking water tainted with arsenic causes many serious health effects, ranging from cancers to cardiovascular disease. Here we present some recent findings of childhood disease after arsenic exposure, and a program we started to provide safe drinking water in the region.

Allan H. Smith is Professor of Epidemiology in the School of Public Health and studies the health effects of arsenic in drinking water. In 1995, following the arsenic catastrophe in West Bengal and Bangladesh, he commenced several research projects in rural West Bengal, concerning arsenic in drinking water, and is currently conducting a study of children exposed to arsenic in Bangladesh. His current projects include a pilot dugwell program to provide arsenic-free water in India.



Zachary Burt

CONTINUOUS (24/7) PIPED WATER: A PUBLIC PRIVATE PARTNERSHIP PILOT PROJECT IN HUBLI-DHARWAD, INDIA

Intermittent piped water systems compromise water quality and require that time and money be spent on waiting for deliveries, collecting, storing and treating the water. In 2008, an upgrade to continuous (24/7) water services was provided for 10% of the twin cities of Hubli-Dharwad, India. Clearly, everyone benefits from cleaner water, and a tap that doesn't run dry, but the question is, at what price? Access and affordability are always key concerns when talking about something as essential as water.

Zachary Burt is a PhD student at the Energy & Resources Group, he focuses on drinking water access in both rural and urban areas of developing countries. In particular he is interested in user preferences, willingness-to-pay and net-benefits for end users, whether for POU's or piped drinking water.



Caroline Delaire

TOWARDS A SUSTAINABLE SOLUTION TO ARSENIC CONTAMINATED DRINKING WATER IN RURAL SOUTH ASIA

Tens of millions of people in rural communities of Bangladesh and India are exposed to high levels of naturally occurring arsenic in groundwater used for drinking. In order to be sustainable and scalable, a water treatment solution needs to have mechanisms for maintenance and cost-recovery. One promising model consists of community-scale micro-utilities selling treated water at a locally affordable price. For this model to be successful, strategies to induce behavior change towards consumption of safe water need to be developed, possibly including information campaigns, reminders, commitment devices, micro-savings options and leverage of aspirational products like mobile-phones.

Caroline Delaire is a 2nd year PhD student in Environmental Engineering at UC Berkeley. Her scientific research focuses on simultaneous removal of arsenic and pathogens from groundwater by iron electro-coagulation. She is also passionate about the issues of behavior change and technology impact in poor communities.



Emily Kumpel

PROVIDING SAFE WATER WITH AN INTERMITTENTLY SUPPLIED PIPED WATER DISTRIBUTION SYSTEM IN HUBLI-DHARWAD, INDIA

For almost all residents of towns and cities in India, piped water supply is intermittent. Intermittent water supply leaves pipes vulnerable to contamination and forces households to store water or rely on alternative unsafe sources. Through data we collected on pressure and water quality over 14 months in Hubli-Dharwad, India, we explore the mechanisms influencing water quality when piped water is provided for only a few hours every 3-5 days and compare water quality in intermittent supply with that provided in a continuous supply. Strategies that improve intermittent piped water systems can help urban residents gain access to safe water.

Emily Kumpel is a Ph.D. student in Civil and Environmental Engineering. In addition to dissertation research on drinking water quality in Hubli-Dharwad, India, she co-founded NextDrop, a social enterprise currently operating in Hubli, and was project director for the Engineers for a Sustainable World project "Haath Mein Sehat" in Mumbai.



Ayse Ercumen

UPTAKE OF CHLORINE TREATMENT AND SAFE STORAGE OF SHALLOW TUBEWELL WATER IN RURAL BANGLADESH: A PILOT STUDY

For almost all residents of towns and cities in India, piped water supply is intermittent. Intermittent water supply leaves pipes vulnerable to contamination and forces households to store water or rely on alternative unsafe sources. Through data we collected on pressure and water quality over 14 months in Hubli-Dharwad, India, we explore the mechanisms influencing water quality when piped water is provided for only a few hours every 3-5 days and compare water quality in intermittent supply with that provided in a continuous supply. Strategies that improve intermittent piped water systems can help urban residents gain access to safe water.

Ayse Ercumen is a PhD student in the School of Public Health who studies the impact of drinking water quality on child health, with a focus on India and Bangladesh.

An estimated seven million people live in the slums of Mumbai, India. Residents of these underserved communities suffer from a high incidence of enteric dysentery largely on account of contaminated drinking water, poor hygiene habits and amenities, and a lack of adequate sanitation. In response, the HMS team has been working since the summer of 2004 to help improve livelihoods through health and hygiene education and practical, low-cost water treatment methods.

Haath Mein Sehat (HMS), Hindi for “Health in Hands,” project began in 2004 in as a collaborative effort between students from the University of California at Berkeley and the community’s Mahila Mandals (women’s groups). The community’s estimated 175,000 residents, living on less than 2 km²

of land, obtain their water mostly from public taps spaced along lanes. These water pipes run through sewers and drainage canals, leading to contamination. The project has evolved into a comprehensive intervention that includes low-cost water treatment technologies and complimentary hygiene education programs. Now in its third year of operation, HMS is expanding its outreach in collaboration with the NGO SAHAS to another slum, Panchsheel Nagar, located in Sion, Mumbai, and exploring how the program can be adapted to Hubli, a city in the state of Karnataka, with support from the Deshpande Foundation. While each of these communities varies significantly in their demographic, infrastructure, and environmental conditions, HMS is using the processes of creating and implementing its programs to develop a model for scaling interventions in urban slums in India.

Team Members: Jasmine Wang, Jin Liu, Chris Anderson, Vaibhav Birda, Kara Nelson, Isha Ray.

Project Contact: hmsindia@lists.berkeley.edu



Kara L. Nelson is an Associate Professor in Civil and Environmental Engineering at UC Berkeley. Her research areas include mechanisms of pathogen inactivation, optimizing treatment processes, water reuse, and challenges with providing safe drinking water and sanitation in the developing world. She leads the Research Thrust Area on Safe Water and Sanitation at Berkeley Water Center, as well as a large multidisciplinary Safe Water and Sanitation Initiative funded through UCB's Blum Center. Dr. Nelson was awarded the Presidential Early Career Award for Scientists and Engineers, the nation's highest honor for scientists in the early stages of their career, in 2004.



Kara L. Nelson



Ashok Gadgil

Ashok Gadgil is Professor of Civil and Environmental Engineering and Director of the Environmental Energy Technologies Division of Lawrence Berkeley National Laboratory.

He is the brains behind UV Waterworks (UVW), an innovative water disinfection unit, that kills bacteria, viruses and parasites in water from any source, using nothing more than UV light from a fluorescent lamp powered by a 40-watt power source. Treating approximately 15 liters a minute, each unit can deliver safe drinking water for a village of 2,000 for under US\$2 per person per year, including amortized capital costs. Dr. Ashok Gadgil is the recipient of the 2012 \$100,000 Lemelson-MIT Award for Global Innovation in recognition of his steady pursuit to blend research, invention, and humanitarianism for broad social impact.

ARSENIC REMOVAL FROM GROUND WATER IN SOUTH ASIA — Dealing with the largest mass poisoning in the history of mankind

Over 60 million people in Bangladesh and West Bengal (India) drink groundwater contaminated with naturally occurring arsenic. Although the WHO's recommended maximum limit for arsenic in drinking water is 10 parts per billion (ppb), the arsenic levels in Bangladesh, in some cases, exceed 1000 ppb. Forty thousand people in Bangladesh are already showing signs of arsenic poisoning, in what is rightly called the largest case of mass poisoning in history. A recent 10-year long cohort study published in *The Lancet* showed that 1 in 5 of all adult deaths in Bangladesh are now due to arsenic.

Although there are numerous proposed solutions to this devastating problem, many of them are expensive and/or ineffective at decreasing arsenic in drinking water to acceptable levels. Scientists at Lawrence Berkeley National Labs have developed two methods to affordably and effectively remove arsenic from drinking water. The first method is called Arsenic Removal Using Bottom Ash (ARUBA). Bottom ash, a widely available waste material from coal-fired power plants, is coated with iron rust, which binds to arsenic. The arsenic can then be removed from the water through settling and/or filtration. The second method is called ElectroChemical Arsenic Remediation (ECAR). This method uses a small amount of electricity to create rust in contaminated water. The rust binds to arsenic, which can then be removed from the water through settling and/or filtration.

Our goal is to design a water treatment system that utilizes LBNL technology to effectively remove arsenic from drinking water within a sustainable business model. Therefore alongside the scientific and engineering development, the team is developing a business model for system implementation. This solution will take into account economic costs/benefits, social acceptability, affordability, and sustainability. In addition, we are now exploring the socioeconomic and public health implications of arsenic remediation using ARUBA and/or ECAR.

This project is funded by the National Collegiate Inventors & Innovators Alliance, the UC Berkeley Blum Center for Developing Economies, the Haas School of Business Sustainable Products & Solutions (SPS) Program, the UC Berkeley Bears Breaking Boundaries Contest, the Marin San Francisco Jewish Teen Foundation and the EPA P3: People, Prosperity, and the Planet Program.



Isha Ray

Isha Ray is Associate Professor in the Energy and Resources Group.

Her interests are water and development; technology and development; common property resources; and social science research methods. Her research projects focus on access to water and sanitation for the rural and urban poor, and on the role of technology in improving livelihoods. She and her students work on water access in India, Mexico, Tanzania, the Philippines and California's Central Valley. She has received the Prytanean Faculty Award as well as the Hellman Family Faculty Award at UC Berkeley.

FROM INTERMITTENT TO 24x7 WATER IN HUBLI-DHARWAD—a Research Project on Water Quality, Urban Planning, Household Coping, and Health

Research Leaders: **Isha Ray**, Associate Professor at the Energy and Resources Group; **Jack Colford**, Professor in the School of Public Health; & **Kara Nelson**, Associate Professor in Civil and Environmental Engineering.

The twin cities of Hubli-Dharwad in Karnataka together have a population of just over 1 million. 80% of this population has access to piped water, but, as is common in most of India, this water is supplied to households every 2 – 5 days. Not every day, all the time (or 24x7) as it is in most of the developed world. What do people do when they need water but the tap brings forth nothing? Or if they have no tap at all? They rely on storage vessels, borewell water (reliable but often of poor quality) and on tanker trucks (expensive). Anyone familiar with Indian city life is familiar with these multiple sources of “drinking” water.

Since 2007, a World Bank funded project has been upgrading the water supply infrastructure to 24x7. It's a pilot project, with only 70,000 people currently served in this new way. Plans (and funding) for upgrading all the city wards are already under way. We ask: should they be? Hubli-Dharwad is one of the first “test” cases, based on which many similar cities will consider 24x7 upgrades. With drinking water system reform high on the Indian urban planning agenda these days, our research team believes that a careful and comprehensive study of the costs and benefits of 24x7 is necessary to evaluate whether, and for whom, 24x7 is worth it. And that this is best done before billions of borrowed dollars are spent on the upgrade.

Such a question is inherently cross-disciplinary. The ultimate goal of water supply reform is better health for the population (at a reasonable cost for the utility and for households). Why, you might ask, would 24x7 lead to better health? It's because when pipes are empty a lot of the time, sewage and other contaminants can leak into them through cracks and fissures – and thus degrade drinking water quality. Children and sick people are especially vulnerable: if they drink contaminated water they tend to fall sick with diarrheal diseases. But if these same pipes are always full and always under pressure, dirty stuff can't leak in. So the first part of our research asks: is 24x7 working effectively where it has been installed, and has water quality along various points in the system really improved?

Is 24x7 water effective?

Is 24x7 water effective?

This work is being led by Emily Kumpel, a PhD student in Civil and Environmental Engineering. Her research supervisor, Prof. Kara Nelson, has also visited the Hubli site to guide the research and to strengthen our ties with our fabulous collaborators from the Centre for Multi-Disciplinary Development Research (Dharwad). Emily and her team tested the water quality at the tap and in the home of over 1500 samples over nearly a year. They found that samples from intermittent supply are indeed more likely to have contamination than those from 24/7; however, the water quality in intermittent supply varied between days and between streets, suggesting it may be possible to improve even the current distribution system to protect against contamination. These results, after analysis, will help to develop practical recommendations for improving existing intermittent systems and to improve scale-up of 24x7 to protect water quality.

Sharada (with the collaboration of John, pictured above), a Masters' student in the Energy & Resources Group, is trying to model the risks around intermittent systems, using GIS. He aims to validate existing models that predict such risks by correlating model results to actual water quality data. Sharada is working on developing simpler risk assessment models for intermittent water distribution systems. These models attempt to rank the quality of pipes and thus help the city to prioritize the replacement of specific (vulnerable) pipes in the distribution system.

Is 24x7 water healthier?

The next question is: does 24x7 lead to measurable health benefits, especially for young children, compared to intermittent water supply? This part of the research is led by Ayşe Ercumen, PhD student in the School of Public Health, under the supervision of Prof. Jack Colford. It's hard to measure health impacts – so many factors can



Collecting water, Hubli



Emily, Kara, and John at work

affect health! It's essential to sample rigorously in order to achieve a credible comparison, and to follow health indicators for a full year, through multiple seasons. It's essential to take account of all the other factors that could explain any health differences we might see between the 24x7 and the intermittent zones. Ayşe and the research team, along with several local enumerators trained by our researchers, surveyed 4000 households in selected 24x7 and intermittent wards. Each family was visited many times over fifteen months. We collected data on health outcomes, specifically diarrheal illness in children under the age of five, as well as weight measurements at the final visit. The researchers also conducted spot-checks to observe water handling habits and hygiene conditions in the household, and water quality testing to explore how continuous water delivery may lead to any (observed) health benefits. We're still working on these data to see if we can say anything definite about 24x7 and child health.

Is 24x7 water affordable?

OK: what's next? All of these upgrades aren't exactly free. And so when costs go up, they need to be recovered, and (at least in part) recovered from customers. What are the coping costs (waiting / collecting / storing / other costs in health, money and inconvenience) faced by those who do not have 24x7? What are the monetary costs faced by those who have now been upgraded to 24x7? This piece of the research is led by my advisee, Zach Burt, PhD student in the Energy & Resources Group. Using the same household survey as Ayşe, his data consists of the cost of water under 24x7 and the costs without it, users' perceptions of the costs and benefits of whichever system serves them, and the affordability of 24x7 relative to the household's total budget. We found, for example, that though 24x7 was undeniably more convenient and saved time (because people did not have to wait for water and then rush to fill every container in sight when it finally came), many families were now paying about Rs. 300 / month compared to the previous cost of Rs 90 / month. This was a significant increment to many. We also found that households with 24x7 often continued to store water. This means that re-contamination in the home is still possible, even if water quality has improved. We hope that these socio-economic findings will inform the scale-up of 24x7 both with respect to user perceptions and user affordability, and with respect to water use practices in the home.

Fleshing out the work on user perceptions and affordability, Cleo Woelfle-Erskine, Master's student at the Energy and Resources Group, is developing a "typology" of water systems as a way to categorize patterns of water use. The typology described various infrastructure configurations (such as roof tank-underground tank-pump and shared tap-no pump-many storage containers inside). This is most relevant in the low-income, shared-tap neighborhoods, where many households lack storage infrastructure and also lack sufficient water for activities such as clothes washing on the day the water comes. Cleo conducted in-depth observations in both well off and low income households to understand how water use practices varied with type of infrastructure – including how much water people store and how much they throw away when the piped water arrives. All this work went to answer a deceptively simple question: How much water do people use in Hubli-Dharwad? The findings will shed light on the complexities and uncertainties in a shift to 24x7 supply.

Waste-water Re-use: Looking ahead?

We have more exciting and policy-oriented research planned for the future – on wastewater re-use in Hubli-Dharwad (Anne Thebo), and on institutional analysis of the relationship between the public sector and the private sector in water supply (Asavari Devadiga). Our research team has been able to accomplish all of this work (and more to come!) because of our wonderful local partners, including CMDR (we are especially grateful to Dr. Nayantara Nayak and Dr. Narayan Billava), SDM College of Engineering, and Mr Jayaram (Chief Engineer of Hubli's Water Board). We'd also like to acknowledge research support from several student fellowships, the Blum Center for Developing Economies, the National Science Foundation, the Deshpande Foundation, and the Tata Study Grants (administered by CSAS). We have developed a fantastic, multi-disciplinary, enthusiastic group of students, who have made Hubli their research "home", and are committed to water policy reform in India.



Zach in Hubli



Cleo measuring stored water



Part of the piped distribution system in Hubli

The Center for South Asia Studies (CSAS) at the University of California, Berkeley is one of the world's foremost centers for research and programs on South Asia. CSAS works with faculty members, graduate students, community members, private institutions, and non-profit organizations to deepen understanding of the region and to create new generations of scholars of South Asia. One key area of focus at CSAS is research about and programmatic activities on contemporary South Asia, examining closely issues like democracy and democratic reform, reduction of inequality, and social development.

UPCOMING FALL 2013 EVENT

Center for SOUTH ASIA Studies, Energy and RESOURCES Group & urbanWASH

at the University of California at Berkeley present
The 20th Annual Lecture on Energy and the Environment by



SUNITA NARAIN
**Reinvent Growth
without Pollution**
Can India do it?

Please check our Fall Calendar at
southasia.berkeley.edu
for further details about this event

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