Special Issue

“Urbanization & periurbanization: Challenges for water governance in south Asia”
Guest Editor

Dr. Vishal Narain
Public Policy and Governance at MDI, Management Development Institute, Gurgaon.

Dr. Vishal Narain is Associate Professor, Public Policy and Governance, MDI, Management Development Institute, Gurgaon. He holds a PhD from Wageningen University, the Netherlands. His academic interests are in the inter-disciplinary analyses of water policy and institutions, urbanization and rural-urban transformations, water rights and irrigation reform. His research has been published in several peer-reviewed journals like Water Policy, Water International, Environment and Urbanization and Mountain Research and Development.

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Fluid Governance: water flows and rural-urban transformations in South Asia

Dr. Vishal Narain  
Public Policy and Governance MDI, Management Development Institute, Gurgaon.

Sumit Vij  
Public Administration and Policy Group, Wageningen University, The Netherlands

This special issue of the SAWAS (South Asian Water Studies) journal is devoted to the theme 'Urbanization and peri-urbanization: challenges for water governance in South Asia.' The contributions in this issue explore the various challenges that urbanization and peri-urbanization processes have posed for water governance in the region.

SAWAS, which is the flagship journal of SaciWATERs (South Asian Consortium for Inter-disciplinary Water Resources Studies) seeks to foster debate on critical water issues of contemporary relevance with a special focus on inter-disciplinary analyses. The journal aligns with SaciWATERs' mandate to challenge the technocratic focus of water management, while promoting junior researchers, especially women, to undertake research that integrates the physical with the social and institutional dynamics of water management and governance.

These aspects are reflected in the contents of this issue. There is wide geographical representation in the articles and contributions featured. While there are specific contributions from Bangladesh, Nepal, India, and Sri Lanka, several contributions draw on research projects that have a regional focus. At the same time, there are several contributions from junior researchers at doctoral or Masters' level, with a large number of them being women.

Over the years, there has been an upsurge of scholarship exploring rural-urban relationships and transformations around water. This research has served to challenge the conventional dichotomy between rural and urban water supply in water resources planning and research, urging researchers, policy-makers, and development practitioners to take a peri-urban conceptual lens, that is, looking at how urbanization reallocates water from rural to urban purposes.

Analytically, this research has come to be located in a wide range of intellectual traditions: political economy, urban political ecology, the institutional analysis and development framework, discursive analyses, and the analysis of rights, entitlements, and legal pluralism, which is reflected in the contents of this special issue.

Using these diverse intellectual traditions, this research has explored the reallocation of water from rural to urban purposes, raising questions about water rights, equity, and justice. These processes are seen as creating peri-urban water insecurity, often aggravated by other stressors and processes, such as climate change, globalization, and commodification. What is interesting is the regional scale of some of this research in which SaciWATERs itself has been involved in an intellectual leadership role, while catalyzing support for policy reform and institutional innovation.

Several contributions in this volume -by Dik Roth, Leon Hermans & Sharlene Gomes, and Anushiya Srestha and Rajesh Sada- explore the issue of peri-urban water security in the context of rapid urbanization. Coupled with other stressors like climate change and earthquakes, this process leads to a deepening of differential vulnerabilities, as demonstrated in the work of Anushiya and Rajesh.

A peri-urban context is fertile ground to study institutional transformation. Both statutory and non-statutory institutions co-exist. Social transition and heterogeneity mean that groundwater management institutions can be in flux. Sharlene Gomes and Leon Hermans use the New Institutional Economics framework to explore these interactions in the Gangetic deltas of India and Bangladesh. Dik Roth's contribution
points to the need for understanding the ways in which issues of urbanization, climate change, and water security are framed.

Hita Unnikrishnan and her co-authors explore the implications of the disappearance of urban water commons around Bangalore, while Prakash Nelliyyat explores the dimensions of rural-urban water transfers in Chennai. Both these processes highlight the relationship between land ownership and water access, and human security and well-being.

In some cases the relationships are more subtle. This is brought out in Anushree Singh’s analysis of the demise of traditional water harvesting systems in Bikaner. With the onset of modern technologies and urbanization, the relationship between ecology, technology, and institutions was eroded. Anushree's analysis suggests a close relationship between ecological, technological, and institutional dimensions of water commons, and how urbanization can erode this coherence.

Two papers located geographically at the ends of a spectrum -on Mumbai in Western India and Darjeeling in the North-East- explore issues of marginalization within cities. Nidhi Subramanyam and Charlotte MacAlister look at such issues within informal settlements in Mumbai, focusing on the high vulnerability of these communities to climate change and urban flooding. The lack of a formal tenurial status often keeps such settlements outside the purview of formal planning and disaster preparedness. Gopa Samanta and Kaberi Koner take a political ecology perspective to see how social and economic relations shape access to water. Gopa and Kaberi take a more explicitly gendered lens to look at these transformations, filling an important gap in the literature on urban water supply. Not only do people differ in their endowments of water, but also in their ability to negotiate this. They are also located differentially in social networks that shape their differential access to water.

The processes of urbanization and peri-urbanization are not only stretching the infrastructure of cities, but also the imagination of researchers, scholars, and development practitioners. Amid contemporary discourses on network governance and pluralization of the state, Kala Bada and Sahil Patni make a case for a framework of polycentric governance to address issues of urbanization and peri-urbanization. They see this as a process unfolding parallel to the commodification of water.

Sunil Thrikawala and his team suggest changes that are desired within the infrastructure of sewage treatment plants - especially on the lines of institutional challenges in Sri Lanka. Fiona Marshall raises the level of the debate and redefines the peri-urban discourse arguing that there is a need to re-imagine the peri-urban not only as a heterogeneous mosaic of ecological, institutional, and social transition, but as a context for studying technological and institutional innovation as well.

The three book reviews presented in this special issue are by junior researchers –re-enforcing the growing interest in the subject among future water professionals. Nihar Gokhale's ‘A review of conflicts over natural resources in the global South: conceptual approaches’ provides an exposition of the growing literature on conflict and cooperation over natural resources. It points to the wide diversity of conceptual and theoretical approaches used by scholars to study these dynamics, and the continuum between conflicts and cooperation. Aditya's review of ‘Neoliberalism and water: complicating the story of reforms in Maharashtra’ is a timely critique of neo-liberalism, since it has impacted urban water governance.

Denise Fernandes' review of ‘New slow city - living simply in the world’s fastest city' provides pointers to what would be an alternative vision of a city. A slow city would perhaps shape an alternative urban metabolism and reduce the ecological footprint of urbanization. Perhaps then the real solutions lie not in governance, institutional reform, or technological innovation, but in reimagining the city itself. Whether the 21st century will embrace such a vision, is, of course, a moot point!!!
Abstract

In recent years, scientific awareness of the radical changes in peri-urban areas has been steadily growing. One dimension of these changes concerns the access, use, and control of water. Water insecurity and water-related conflicts in peri-urban areas are now becoming a serious scientific concern. However, more reflection on how this scientific knowledge can be applied is badly needed, for the relationship between knowing and intervening is not unproblematic.

In this commentary, I reflect on some of the challenges inherent in combining knowledge and policy agendas. This is one of the ambitions of the project 'Climate Policy, Conflicts and Cooperation in Peri-Urban South Asia: Towards Resilient and Water Secure Communities', which is part of the programme 'Conflict and Cooperation in the Management of Climate Change' (CCMCC). I will argue that attempts to bridge the knowledge-policy gap are relevant and necessary, but may also be prone to forms of simplification that reproduce the very framings of processes of socio-environmental change needing to be opened up for more debate.

Key words

Urbanization, peri-urban areas, water security, climate, community, resilience, policy

Introduction

The project 'Climate Policy, Conflicts and Cooperation in Peri-Urban South Asia: Towards Resilient and Water Secure Communities' is part of the research programme Conflict and Cooperation in the Management of Climate Change (CCMCC). The project deals with water (in-)security, conflict and cooperation in relation to urbanization and climate change. CCMCC aims to understand better the dynamics of cooperation and conflict, to explore options for increasing the resilience of poor communities, and to consider what this means for climate policies and programmes (NWO/DFID 2012). Thus, a major ambition is to move beyond generating scientific knowledge and understanding of the processes involved.

This, then, is its first objective: the production of robust evidence on the dynamics of cooperation and conflict over natural resources in relation to climate change and climate change policies (the knowledge, research, and innovation perspective). As second objective, it stresses the development of tools and perspectives for conflict-sensitive climate change policy development and financing mechanisms that effectively contribute to the resilience of poor communities in developing countries (the development perspective). The third objective deals with the development of capacities of institutions, groups, and individuals to investigate, provide advice on, and implement tools for conflict-sensitive climate change policy development and financing mechanisms (the capacity development perspective). (NWO/DFID 2012; see Kessler et al. 2014).

These are highly relevant and challenging ambitions, but they are not unproblematic, especially in relation to each other (see Cleaver & Franks 2008). In this commentary, I present some short reflections on these problems, which may also emerge in the project on peri-urban water security. I set out from the premise that the ways in which social-environmental processes like climate change and peri-urban water security are framed in scientific discourse (Schön & Rein 1994), deeply influence the relationships constructed between scientific knowledge and policy-making to create 'solutions' (see Owens et al. 2006).

Different ways of knowing water or climate change result in different definitions of the problem and what should be done to solve it (for

¹ Jointly funded by the Netherlands Organization for Scientific Research (NWO) and the Department for International Development (DFID) of the United Kingdom.
water, see Zwarteveen 2015). Especially in case of the uncertainties, unknowns, and multiple stakes and values that characterize ‘wicked problems’ (Rittel & Webber 1973) related to water and climate change, there is considerable scope for differential (often conflicting) framings of issues, causalities, and solutions. Through the storylines created in processes of framing, meanings are constructed and related to worldviews and societal values. By paying attention to such framings we can better relate issues like climate change and water insecurity to the various and conflicting ways in which differently situated actors give meaning to them, construct causalities, select out elements regarded as important and discard others, and define risks, opportunities, and potential solutions (see Schön & Rein 1994; Lewicki et al. 2003; Dewulf 2013).

Thus, neither scientific framings of water security in relation to climate change and urbanization, nor relationships between such scientific understandings and policy processes are pre-given or self-evident. Therefore, ongoing critical engagement with the scientific assumptions and framings that are to form the basis of policy agendas is crucial in research programmes like CCMCC.

In this short commentary I discuss two related issues of concern more specifically: First, I argue that, though a ‘community resilience’ focus of the programme fits neatly within a mainstream climate change and development discourse, ‘resilience’ is not necessarily the most appropriate scientific language to make sense of the processes of socio-environmental change at stake and to devise ways of influencing them. Its link to ‘community’ also raises critical questions, not only about that concept itself but also about its selection as the target social unit of attempts to ‘create’ resilience. Second, I critically look into how policy processes at the knowledge-policy interface are conceptualized, arguing that much of what we know about policy processes risks getting lost in the instrumental focus of seeking developmental impact. I conclude this commentary with some additional remarks.

‘Community resilience’: why resilience? Why community?

‘Community resilience’ is a logical choice from an instrumental and interventionist perspective. This is so because it defines a clear object and target for climate-change related interventions. Yet, it is questionable whether it is the most suitable scientific language to make more general sense of processes of peri-urban change. Actually, both 'community' and 'resilience' are quite problematic as scientific concepts. Nevertheless, they are combined into a hegemonic developmental narrative of creation of community resilience as a manageable process.

The climate change focus of the CCMCC programme introduces this specific discursive framing of socio-environmental problems (in this case related to peri-urban water insecurity) and potential solutions in terms of resilience. However, rather than taking framing in terms of these concepts at face value and using them as the basis for development programmes, they need to be unpacked. A political ecology lens on water and climate change (e.g. Swyngedouw 2004; Taylor 2014) might have much more to offer in terms of the analysis of scaled socio-environmental changes, power relations and forms of social differentiation, and discursive frameworks and practices that define problems and solutions. However, such work may be hard to reconcile with the framings and language of adaptation and resilience, currently very powerful in the world of development policy.

The concept of resilience originates from ecological systems analysis. It has often been defined in terms of system capacities to maintain or regain their structure in the face of disturbances as also to resist, absorb, cope, or recover from such disturbances. In short, to 'bounce back'. Gradually the concept became less 'ecological' and more 'social', incorporating more social-institutional understandings as well as notions of flexibility, diversity, and adaptive learning (Cote & Nightingale 2012; Leach 2008). There was an increasing focus not only on function-maintaining and adaptive capacities, but also on transformative capacities or 'bouncing forward' (see Cutter et al. 2014; Keck & Etzold 2013).

An example of a more sociological definition is Adger’s one in terms of 'the ability of groups or communities to cope with external stresses and disturbances as a result of social, political, and environmental change' (Adger 2000, in Brand & Jax 2007: 23). This way, the concept is notably expanded to the social and political; at the same time it sees these stresses as ‘external’ – a heritage of the systems ecological roots of the concept. But does this all add to conceptual clarity? Brand & Jax (2007) are critical: the descriptive value of the resilience concept is weak, and its normative content high (see also Leach 2008). Besides, the ‘boundary’ character of the concept (a concept sufficiently flexible and
open to multiple uses and interpretations for a variety of users to embrace it; see Star and Griesemer 1989) makes it inherently ambiguous and open to multiple interpretations.

Thus resilience has become a perspective, a way of thinking, and an approach to address social processes, or even just a metaphor for flexibility rather than a well-defined concept (Brand & Jax 2007). Moreover, its ecological origins tend to make it less suitable for asking critical questions about power, culture, and politics (Cote & Nightingale 2012; Leach 2008). Many notions of resilience are mainly systemic and still tend to stress the capacity of systems to restore initial equilibrium conditions (Keck & Etzold 2013) and have a rather instrumental institutional design focus on 'social resilience' (Cote & Nightingale 2012). Specific instrumental approaches in a neoliberal political environment may actually make people responsible for their own resilience, or the lack of it (see Frerks et al. 2011).

We might conclude here that the broader the meaning of the concept, the greater the risk of 'generating a concept that by attempting to mean everything ends up meaning nothing of analytical value' (Boyden & Cooper 2007: 12).

Important recent criticism of resilience approaches can be found in political ecology. Taylor (2014: 53) criticizes the hegemonic scientific and developmental framing of climate change in terms of vulnerability, adaptive capacity, and resilience the 'holy trinity' of climate change adaptation. For political ecologists like him, concepts like 'adaptation' and 'resilience' are not neutral scientific concepts but infused with power issues that tend to be excluded from critical scientific scrutiny. They are central to a 'common-sense default assumption' based on the ontological separation of nature and society. Instead of being used without further reflection, according to Taylor, conceptualization in this way needs to be analysed as a discourse, 'a set of relations between forms of knowledge, structures of power, and institutional practices that together produce specific ways of thinking about and acting upon processes of social and ecological change' (Taylor 2014: 10).

Talking about resilience, at least the concept of 'community' has proven highly resilient to the long-standing history of scientific criticism of its use in development policies and policy-oriented literature. This is so at least since the 1990s (e.g. Agrawal & Gibson 1999; Amit & Rapport 2002). Agrawal and Gibson have taken the scientific understanding of community (e.g. Cohen 1985) one step further into development studies by focusing on its role in community-based conservation and natural resource management. Their phrasing of the problematic sides of community thinking –characterized by ideas of communities as small spatial units, homogeneous social structures, and common interests and shared norms– is still as relevant as before. A vision of community as unified and organic 'fails to attend to differences within communities, and ignores how these differences affect resource management outcomes, local politics, and strategic interactions within communities, as well as the possibility of layered alliances that can span multiple levels of politics' (Agrawal and Gibson 1999: 633).

In the light of such criticism, a rethinking of this default community focus might be badly needed in relation to resilience as well (see also Frerks et al. 2011). This is even more relevant in the highly dynamic contexts of peri-urban areas, where social relationships and livelihoods are changing, in- and out-migration are increasing, and people become increasingly oriented towards the outside world.

Aside from this criticism of community thinking, why is 'community' seen anyway as the ideal social unit or level for 'creating resilience'? 'Community resilience' has become the default framework –and especially discursive framing– of issues of disaster preparedness, response and recovery, as well as climate change adaptation (see Cutter et al. 2014). There may be good reasons for this, for instance in the case of disasters (see Frerks et al. 2011). However, the drivers of peri-urban social-environmental problems have important scalar dimensions that transcend 'the community'. The political, scalar and flow –rather than local adaptational–dimensions (see Swyngedouw & Heynen 2003) of many water problems would not automatically lead to the conclusion, that 'the community' is the place to focus on to create or strengthen resilience (irrespective of what 'resilience' may mean in such a context).

How can this community bias be explained? It may have to do with the objective of making climate change manageable as part of wider development agendas. Adaptation and resilience thinking has come to pervade the world of development. In view of the community-oriented history of development policies, this community focus is not surprising. More so, however, it is perhaps the unspecified character of 'community' that makes this concept fit climate change
governance agendas best. If climate (change) is framed as an external force rather than one element in complex co-produced lived environments, and adaptation as a governable social and developmental goal applied to a stable community, adaptation and adaptive capacity can be assessed, engineered and managed through interventions leading to the ideal 'resilient community'.

According to Taylor, as new objects of development, adaptation and resilience have become the basis of a 'technocratic politics of intervention' (Taylor 2014: 62) to build adaptive capacity and resilience. These are normative goals that have come to form the basis of planning, organization, and legitimation of technologies of governing climate change. This depoliticized universal toolbox for governing climate change adaptation, abstracted from any specific context and applicable to any scale or social unit, from the household up (Taylor 2014; see Stripple & Bulkeley 2014), needs much more critical attention.

Policy processes and the knowledge-policy interface

This brings me to a discussion of the ways in which policy and the relationships between knowledge generation and policy processes are approached. There is a basic tension in programmes like CCMCC that claim the development of state-of-the-art scientific knowledge as well as direct applicability of that knowledge for policy purposes. One major problem is that, to reach scientific and more instrumental policy objectives, such complex programmes would need to start from widely diverging conceptions of policy processes. While the first requires a full acknowledgement of the emergent, contingent, and 'messy' character of policy processes, the latter requires simplification, a reduction of complexity, a focus on what seems to be manageable, and a belief in the ability to bring about desired changes and pre-designed order.

With the emergence of a variety of strands of critical policy studies in the last decades, scientific approaches to policy processes have undergone radical changes. Here are some of these contributions. Anthropological work on the ethnography of aid and development policies (Lewis & Mosse 2007; Mosse 2004) has laid bare the inherent tensions and contradictions between policies and the practices they claim to steer (Mosse 2004). They also pointed out such disharmony between the manageable and policy-determined order on one hand, and the disjunctures created by policy processes on the other. Wedel et al. (2006) have also argued the importance of the anthropological study of policy for a better understanding of the political and discursive dimensions of policy processes. Policies are no longer the objective and bounded entities shaped by 'authoritative instrumentalism' (Shore et al. 2011). When policy becomes an object of analysis itself, notions and images of policy as rational and neutral, and apolitical agendas for action can be unpacked.

This has cleared the ground, among others, for criticism of linear conceptions of policy and for more attention to the role of the (human) agency, the role of power relations, and to discursive framings in defining problems, solutions, actors, and actor networks (Shore et al. 2011). According to Wedel et al., key tasks of the anthropology of policy are to understand 'how policy narratives mobilize the language of science, reason, and 'common sense'' and to 'expose the political effects of allegedly neutral statements about reality' (2006: 37; see also Shore et al. 2011). Adding to this, Boswell (2009) has pointed out the importance of looking beyond the instrumentalities to understand better the symbolic uses of knowledge in policy processes: to legitimize or substantiate policy intentions, decisions, and claims to resources or authority. In these approaches, policies have become 'windows onto political processes in which actors, agents, concepts and technologies interact in different sites, creating or consolidating new rationalities of governance and regimes of knowledge and power' (Shore et al. 2011: 2).

However, the danger of combining research agendas with policy-driven ones is that some of these highly relevant insights are sacrificed to the very instrumentalities, normativities, and simplistic 'gap' approaches that have been identified as problematic in policy analysis. The complex relationships between knowledge and policy then tend to be reduced to a communication problem in a policy world generally imagined as orderly, rational, and manageable (see Lewis & Mosse 2007; Owens et al. 2006).

Owens et al. (2006) have described some of the problematic dimensions of these imaginings of the knowledge-policy interface in urban environmental issues. Policy-driven knowledge production often means a reversion to outdated 'gap' models of knowledge transfer guided by a linear policy model. These mainly lead to
prescriptions for 'how to reach policy-makers'. There tends to be a strong focus on 'tools and tricks' for a smooth policy uptake to guide 'evidence-based' policy decisions, such as simplified messages and briefs with clear 'to do's' (see also Boswell 2009; Lewis & Mosse 2007). Thus we end up with a rationalist-managerialist and one-dimensional problem-solving view of policy processes. It disregards the extensive knowledge of policy processes generated over the last decades and does not fit the messy policy world related to the 'wicked problems' of urbanization, water and climate change, and the fluidity of peri-urban waterscapes.

Concluding remarks

The peri-urban areas where CCMCC research is going on – Khulna in Bangladesh, Gurgaon and Hyderabad in India, and Kathmandu in Nepal – show a mixed bag of issues related to water insecurity, conflict and cooperation, and climate change. To mention just a few: peri-urban groundwater and surface water resources are over-exploited, polluted, privatized, and transferred to commercial uses. Water becomes saline, surface water bodies are disappearing, and increased building activities driven by urbanization disturb existing canal infrastructure for irrigated agriculture. Farmers experience gradual changes in monsoon periods, rainfall patterns, and temperature, leading to uncertainties about cropping seasons and increased risk of crop failure.

These can be seen as complex processes of co-production at various scales of what Taylor (2014) calls 'material climates', lived environments in the production of which the social, the natural-physical, the material, and the discursive are intertwined. The language of vulnerability, adaptation, and resilience hides the diversity of issues and processes involved here. When not explicitly linked to questions about the socio-political and historical processes that (re)produce vulnerabilities in specific contexts and dynamics of knowledge, agency and power, this language even risks becoming rather conservative and depoliticized. A language that stresses adaptation to current conditions rather than explores alternatives (Cote & Nightingale 2012; Frerks et al. 2011; Swyngedouw 2010; Taylor 2014).

In addition, it becomes rather meaningless, where a concept like 'creating (community) resilience' would primarily seem to refer to socio-political processes across scales. For the analysis of such processes we have other, and much more suitable, terms like political organization, political influence, empowerment, resistance, or contestation. Notwithstanding its changes in meaning since it first came to be used, 'creating resilience' still has the flavour of 'getting the institutions right'. This may be the wrong message, though.

At the end of the day, can we answer crucial questions like: what is a resilient community? Is it a community that swallows adaptation projects, or one that has the capacity for putting up political protest or resistance against water-related injustices? Can such resilience be 'created', planned at a specific 'level' (household, community etc.)? How to make sure that a 'community resilience' focus does not create 'solutions' that benefit some while marginalizing or excluding others? This requires a critical scientific engagement with those structures and processes that produce, reproduce, or bring about changes in peri-urban areas (for urbanization, see Bickerstaff et al. 2009). Policy processes are undoubtedly an important dimension of this, but an understanding of their role requires an approach that moves beyond apolitical views of policy institutions as rational and instrumental problem solvers.

References


Down the drain: the tragedy of the disappearing urban commons of Bengaluru

Hita Unnikrishnan
Ashoka Trust for Research in Ecology and the Environment (ATREE), Royal Enclave, Sriramapura, Jakkur PO, Bengaluru – 560064, and Manipal University, Manipal, Udupi – 576104
email: hita.unnikrishnan@atree.org

Seema Mundoli
Azim Premji University, Pixel Park B, PES Institute of Technology Campus, Hosur Road, Electronics City, Bengaluru – 560100

B. Manjunatha
Azim Premji University, Pixel Park B, PES Institute of Technology Campus, Hosur Road, Electronics City, Bengaluru – 560100

Harini Nagendra
Azim Premji University, Pixel Park B, PES Institute of Technology Campus, Hosur Road, Electronics City, Bengaluru – 560100

Abstract

India’s growth in size, population, and urban footprint has been accompanied by rapid urbanization and changes in the condition of urban ecological commons. In Bengaluru, as in many other parts of India, lakes and their surrounding ecosystems, including village forests, sacred groves, and pastures, constituted interconnected commons within a larger community-managed landscape. Transformations in land use and governance due to urbanization have ruptured the once integral connections between communities and commons landscapes. These changes have also influenced the relations people build or are indirectly allowed to build with these important commons.

Using Bengaluru as a case study, we examine the processes of transformation of commons landscapes around lake systems, as a consequence of rapid urbanization. Urbanization influences the ecosystem services provided by these resources, affecting poor and marginalized communities especially vulnerable to the processes of urban change. Inequities in the access to the commons are in danger of being exacerbated by urban policies. This is in particular so for the emphasis on public-private partnerships, and the framing of ‘smart cities’ that seem to prioritize non-consumptive uses of the commons such as recreation and pollution control over consumptive uses such as livelihood use, food, water, and foraging supply for marginalized users of commons. As the dependency on urban commons such as lakes has reduced, the social-ecological commons landscapes around these water bodies have been re-imagined for primarily aesthetic utilities and ecological support.

Policy framings must re-conceptualize the urban commons to account for their multifaceted nature, and their importance for increasing urban resilience, in particular for the most vulnerable of urban residents. The ongoing alienation of communities who value and use urban commons has serious implications on the sustainability of lakes, the ecosystem services they provide, and the vulnerability of the social-ecological system at large; not just for Bengaluru, but for cities across India.

Keywords

Urban commons, lakes, Bengaluru, smart cities, exclusion

Introduction

Urbanization in Asia has been unprecedented in recent years (UN-HABITAT 2010), raising concerns for the environmental sustainability of cities, and the quality of life of urban residents. Urban ecosystems are particularly threatened by urbanization. They play an important social and ecological role in cities, supporting subsistence...
use and livelihoods for marginalized urban residents, supporting biodiversity, and acting as cultural and recreational nodes (Nagendra et al. 2013).

Water constitutes arguably the most important and threatened natural resource in cities, yet water bodies are heavily affected by urbanization in India (Planning Commission 2013). Once considered common-pool resources, water sources such as lakes and wells are being transformed into private or state property, reducing the capacity of the urban poor and marginalized to access this most basic of resources. As lakes and wetlands disappear, other urban commons connected to water sources, including wooded groves and grazing lands, have also been affected by urbanization.

Bengaluru, one of the fastest growing megacities in India, is no exception to this trend. Located at a distance from major rivers, the city has historically depended on a rain-water harvesting system of interconnected tanks or lakes providing water, functioning in association with open wells and smaller water reservoirs called kalyanis. Over time, the dependence on these local water resources declined as Bengaluru began to import water from nearby tributaries of the river Cauvery. This change led to the eventual decline of traditional water bodies, via their conversion to built spaces (Unnikrishnan et al. “in press”), privatized recreational spaces (Unnikrishnan & Nagendra 2015), and to gated restored lakes, distanced from the local communities that once maintained them (D’Souza & Nagendra 2011).

Based on research in 97 peri-urban villages near Bengaluru we found that the decline of water bodies is linked to the demise of entire commons landscapes. These peri-urban landscapes included lakes, village forests (gunda thopes), cemeteries, and grazing lands, described further below.

Lakes provided water for agriculture, and grass growing on the wetlands adjacent to the lake generated fodder for cattle and livestock. In summer, when the water levels were low, the dry lakebed was used for cultivation, and to organize local gatherings such as cattle exhibitions and village fairs. Local festivals celebrated the arrival of the monsoon.

Large open wells around lakes provided water to different caste and livelihood groups living there. Gunda thopes (village groves), adjacent to lakes, were planted with mango (Mangifera indica), jamun (Syzgium cumini), tamarind (Tamarindus indica), and various species of Ficus to meet village needs of wood and fruit. Wood from the thope was used for village development and festivals or sold to raise funds. Individual households were allowed to access fuel wood from the thopes for important occasions such as cremations and marriages.

Village groves provided shade and fodder to pastoralists, and sheltered nomadic communities. They were sites for communal gatherings and feasts for the village. These groves were protected by communities as places of worship, and served as habitats for biodiversity. Strict rules regulated access to and appropriation from these groves. Cemeteries were found close to lakes and village forests, and common grazing lands adjacent to the lake provided fodder for the village.

Complex community dynamics characterized the management of these commons. While bureaucratic control over management rested with the ruler, via the village headman (patel) and village accountant (shanabhoga), the daily monitoring and maintenance of these commons rested in the hands of the tank guard (nirganti) and the village guard (talari). The nirganti assisted by the talari attended to the general maintenance of the tank and its sluices. He was also responsible for opening and closing sluice gates to provide the requisite amount of water for irrigation as well as to optimize water use during drier spells. These were hereditary positions typically occupied by caste groups at the lower end of the power hierarchy, providing checks and balances against the sometimes hierarchical and iniquitous management of these common pool resources. Village residents contributed labour for maintenance of both the lake and the storm water channels. Protection of these commons was a community effort. Lakes provided important livelihoods to many traditional groups. Fishing was conducted by the

Lakes and their surrounding commons in a rural era

Lakes in peri-urban Bengaluru formed part of a larger social-ecological system that included agriculture, pasturelands, and village forests. In this context, ecological commons constituted important locations of biodiversity, and performed critical ecosystem functions such as groundwater recharge and local microclimate regulation (Kiran & Ramachandra 1999; D’Souza & Nagendra 2011). They were also integral to traditional cultural belief systems (Rice 1905).
bestharu group, while laundering of clothes was done by the agasaru, each of whose use of the resource was also regulated by traditional rules as well as religious custom.

It is clear, therefore, that village commons were an integral part of the city. Being so integral to lives and livelihoods, they also became critical ecological resources providing a measure of resilience to the city.

Over time, with rapid urbanization, migration of people both into and out of it, demand for land, and associated land use changes, this tightly woven social-ecological system saw many drastic changes in both form and governance. These changes have affected the relations people build with ecological commons. This process is aided by contemporary governance regimes that seek to reduce community rights to the management of ecological resources.

Transformations in the commons landscape with urbanization

Our research has documented a systematic, widespread picture of change in the social-ecological systems surrounding lake-embedded landscapes in peri-urban Bengaluru. These changes have implications on efforts to create stewardship of resources as well as larger questions of equity and social justice.

Rapid urbanization has placed Bengaluru on the global map. However, it has also created a seemingly insatiable demand for land, water, and other resources. As water began being pumped into the city from the distant Cauvery River, and from bore wells dug deep into the ground, the apparent dependency on lakes and lake-based commons decreased. Several lakes have been converted into other built structures. Many of the lakes that remain are sewage filled, polluted shadows of their earlier selves.

Yet lakes continue to function as social-ecological systems to a marginalized but significant portion of the society. This includes the often-neglected traditional communities that constitute descendants of erstwhile village inhabitants as well as more recent, impoverished migrant labour.

Lakes are dynamic social spaces even today, and at any point in time one may observe myriad activities taking place on the banks or in the waters.

While agricultural practices have dwindled considerably, lakes still support cultivation in the peri-urban area. Grass and reeds from the lakebed and surrounding wetlands continue to provide fodder for livestock. Although traditional fishing has been discontinued, many lakes permit tender-based fishing that is an important source of income for some communities. Commercial laundering of clothes using water from lakes is another source of income for dhobi (washer) communities. The soil from many lakes at the fringe of the city is used for brick kilns for construction. Leafy vegetables growing on lake beds is an integral nutritional support for the diet of peri-urban residents, especially those of villagers living around these lakes. Many domestic activities such as washing clothes and utensils, and bathing are also supported by lakes.

The gunda thopes associated with most lakes have been converted to private and public uses like schools, housing, veterinary hospitals, community buildings, and roads. The few remaining thopes exist in a degraded state. Though still accessed as sites for grazing and collecting fuel wood, they have witnessed a decline in use and protection by villagers. In one instance, we also observed the protection of a village forest by conversion to an urban park, resulting in restoration at the expense of use, paralleling the trajectory we observe in many protected lakes in the city. Similarly, many open wells and kalyanis (temple tanks) have fallen into disuse, and several others have been closed or built over.

Converting the commons to state-managed resources: A shift in focus

Alongside the environmental and land use effects of urbanization on the commons, the changes in management have altered their perceived importance in the twenty-first century. The institutions of Patel, Shanabhoga, Nirganti, and Talari were abolished several decades ago. In many cases, the descendants of these families have been reduced to working as daily-wage workers or domestic help, facing challenges of water scarcity and food security in formerly productive landscapes where they once played a central role.

The peri-urban commons are today managed by different departments of the government. The complexity of multiple institutions for commons management has distanced local communities from their commons. In interviews, people often say that one of their biggest challenges lies in finding out which department or official is in charge of a lake or a village forest, and whom
they can approach for assistance. The collective management of commons by local residents has eroded, leading to a disconnection with resources that were once central to their lives and livelihoods.

Urbanization has also brought in an influx of migrants who have no historic connections or dependence on commons, contributing to their disinterest in the status of commons like lakes and gunda thopes (Mundoli et al. 2014).

The state vision of urban development has further contributed to the degradation of these commons, and the alienation of marginalized users. In fact, urbanization in India has been characterised by stark economic inequality (MHUPA 2011). The needs and aspirations of the poor, who possess limited bargaining power, are typically ignored while envisioning cities of the future. Planning tends to prioritize green spaces in cities as sites for recreation for upper and middle class urban residents. The fact that these green spaces continue to constitute common pool resources, on which people depend for consumptive uses that support their subsistence and livelihoods, is ignored in public discourse.

Erstwhile village commons such as lakes (in some instances, village forests as well) have been transformed into landscaped recreational spaces with pathways for jogging and walking, equipped with open air gyms, and designed with play areas for children. They are fenced and patrolled by security guards to control access (Nagendra 2013). Traditional uses like grazing, fishing, and agriculture are perceived as illegal, and so, traditional users are alienated from the resource (D’Souza & Nagendra 2011).

Privatization of lakes in Bengaluru and promotion of commercial activities are leading to the denial of access to traditional lake users (Unnikrishnan & Nagendra 2015). Contesting claims between the state, powerful individuals (Sundaresan 2011), and local communities result in encroachment and enclosure of urban commons. This is an increasing and worrying trend in cities across India (Baviskar 2011), raising concerns of urban segregation and equitable access to commons.

New visions of planned cities including the current discourse on 'smart cities' further contribute to the exclusion of traditional users. The conceptualization of a 'smart' environment describes the importance of green and open spaces for recreation, but fails to acknowledge their status as commons (MoUD 2014). Public-Private Partnerships (PPP) are favoured for financing development of cities, but these have proved to exacerbate problems of exclusion.

Conclusion

The model of urban development promoted today prioritizes the contribution of cities to economic growth and employment generation (MoUD 2014; NITI Aayog 2015). Urban commons in this vision are in threat of being seen as economic goods, accessible only to those who can pay for them; a view encouraged by actions of the state and the perceptions of wealthier urban residents.

The transformation of Bengaluru from a 'garden city' into a 'silicon city' has been marked by a large-scale conversion of natural spaces, including commons, to built-up areas (Nagendra et al. 2012). The ecological footprint of the city has been ever-increasing, consuming not just local and peri-urban commons but natural resources situated a hundred kilometres away.

The exclusion of commons by urban visions and the degradation of ecosystems due to urban growth will have differential impacts on marginalized urban groups. This is a special cause for concern as the locus of poverty in India appears to be shifting from the rural to the urban (MHUPA 2011). With global environmental and climate change, cities are also at risk from unprecedented weather events, as was seen in Bengaluru and Mumbai some years earlier and with devastating effects in Chennai recently.

The effects on the poor are compounded by unplanned urban growth that has compromised the ecological and social role of natural spaces including commons. So today, more than ever, it has become critical to recognize the multi-faceted importance of urban commons for the ecological and social resilience of cities.

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References


Baviskar, A. 2011. What the eye does not see: The
Yamuna in the imagination of Delhi. Economic and Political Weekly 46(50): 45-53


MoUD (Ministry of Urban Development). 2014. Draft concept note on smart city scheme. New Delhi, India


NITI Aayog. 2015. Annual report 2014-15. New Delhi, India


Abstract

The combination of increase in frequency and intensity of heavy rainfall events due to climate change, and increase in surface water run-off due to rapid urbanization is exacerbating the risk of flooding in many cities in the global South. The urban poor residing in informal settlements are particularly vulnerable to the damaging impacts of flooding as they lack access to basic urban services and infrastructure that increase coping capacity. The global discourse on disaster risk reduction and climate change adaptation has stressed the importance of integrating the perceptions and needs of communities at risk in policies to better address development deficits that contribute to vulnerabilities.

This paper critically examines how flooding risk reduction unfolds at the grassroots level through the cases of Navi Mumbai and Kalyan-Dombivali – satellite cities on Mumbai’s periphery – to highlight the barriers for pro-poor, community-based adaptation through decentralized disaster governance in peri-urban municipalities. We discuss the gaps between community and local government perceptions of the drivers of and solutions to flooding risks in informal settlements. We find that local governments are constrained in integrating community-based approaches and implementing pro-poor risk reduction policies due to a lack of knowledge on the localized impacts of flooding in vulnerable communities. There is also apathy towards poor communities in flood-prone, informal settlements because of their ‘illegal’ status. Weak technical and human resource capacities at institutional level also play a part. All this is compounded by the absence of regulatory structures that incentivize and enable collaboration across departments as well as with elected representatives for disaster governance.

Introduction

A bulk of the world’s urban population lives in small and medium-sized cities with less than a million residents. This trend is expected to continue in the foreseeable future (UN DESA 2015). With their spatial concentration of population, built assets, and economic activities, the impacts of climate change such as heat stress, flooding due to extreme precipitation, drought, and water scarcity are particularly acute in urban areas. Within urban areas, especially in the global South, poor communities living in informal settlements (nearly 1 billion worldwide) are highly vulnerable to and disproportionately affected by climate change as they live in poor-quality housing in hazard-prone areas with inadequate or no access to basic services and infrastructure that help adapt to risks (e.g. Satterthwaite et al. 2007). Hence, reducing risks for the vulnerable, urban poor is crucial for effective adaptation to climate change in cities.

In India, many small and medium-sized cities are growing on the peripheries of megaregions such as Mumbai, Delhi, and Kolkata. This is due to a variety of reasons including the availability of cheaper land for development and a poorly regulated environment (e.g. Narain 2009). The urban poor in these smaller, peri-urban cities are vulnerable to the impacts of climate change due to a development deficit that has not kept pace with population growth, and a weak capacity for governance (Rumbach 2015).

There has been a growing body of scholarship on the impacts of climate change-related risks, vulnerability, and adaptation in Indian megacities (e.g. De Sherbinin, Schiller & Pulsipher 2007; Chatterjee 2010; Dasgupta et al. 2013). However, there has been little discussion on the drivers of risks, vulnerabilities, and adaptation strategies in small and medium-sized cities, or peri-urban municipalities. The work of the Asian Cities...
Climate Change Resilience Network (ACCCRN) (Brown et al. 2012), Rumbach’s study (2014) on Salt Lake City—a Modernist new town in Kolkata’s periphery, and Narain et al. (2013) are some notable exceptions. At the policy level, the National and State Action Plans on Climate Change, and the Disaster Management Act address risks in urban areas. But these, too, do not take into account differences in risk vulnerabilities and capacities for disaster governance as a function of city size in prescribing risk reduction approaches, which previous studies have established as an important factor (Cross 2001; Rumbach 2015).

This paper aims to contribute to this small but growing literature on vulnerabilities and adaptation to the risks exacerbated by climate change in small and medium-sized cities located on the peripheries of megaregions. We study adaptation to the increasing risk of flooding in the municipalities of Navi Mumbai and Kalyan-Dombivali in the Mumbai Metropolitan Region. Specifically, we examine the drivers and impacts of flooding in vulnerable, poor communities, their coping strategies as well as the role of local governments in supporting community-based adaptation. We also discuss current municipal risk management measures to highlight the unique barriers that local governments in such medium-sized cities face in taking a pro-poor, community-based approach to disaster risk reduction.

**Local governments and autonomous adaptation strategies in poor urban communities**

Since the late 2000s, there has been an increasing body of work on the coping and autonomous adaptation strategies adopted by vulnerable, poor urban households in response to climate change-related risks such as flooding in the global South (Douglas et al. 2008; Adelekan 2010; Chatterjee 2010; Jabeen et al. 2010; Porio 2010). These coping strategies include preventive measures to avoid impacts such as structural modifications to one’s house and built environment, and / or impact-minimizing measures such as accumulating assets or diversifying one’s sources of income to help reduce losses and speed up recovery (Wisner et al. 2004; Jabeen et al. 2010).

However, various studies have since recognized and articulated that coping and adaptation measures at the household level are shaped by factors such as secure tenure (Roy, Hulme & Jahan 2013), access to financial capital in the form of wealth and income (Linnekamp et al. 2011), quality of housing and the built environment (Jabeen & Guy 2015), and access to human as well as social capital (Chatterjee 2010; Jabeen et al. 2010; Braun & Aßheuer 2011). Additionally, coping strategies are also shaped by perceptions of flooding risk, which depends on past experience of flooding incidents (Grothmann & Reuswigg 2006; Fatti & Patel 2013; Qin et al. 2015), and information from public authorities (Hung et al. 2007). Thus, the ability to perceive, and cope with or adapt to flooding risks is contingent upon access to assets, resources, and information, which are distributed at different scales beyond the household such as the neighbourhood or city scale. For example, income, education, and housing quality are household scale factors. Infrastructure and services such as drainage or waste disposal systems, and access to help are neighbourhood scale factors, whereas land use and early warning systems are usually city-scale factors that affect coping capacity and strategies (Romero-Lankao et al. 2014).

As a lot of risk-reducing resources are only accessible at the community or city scale, government or state institutions and civil society actors have a key role to play in helping poor households adapt. Additionally, in decentralized states, local governments are well-positioned to foster community-based adaptation, because they are in charge of providing and maintaining a majority of the infrastructure and basic services necessary for risk reduction at the local level. If institutional (particularly local government) adaptation measures are informed by a deep understanding of household and community-based coping strategies and needs, it ensures that the stresses and risks associated with climate change are considered in an integrated manner alongside other development issues that affect these households and communities, and contribute to their vulnerabilities (Archer et al. 2014). Such an integrated, community-based approach not only helps build diversity and flexibility into the local government’s adaptation

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1 According to the Intergovernmental Panel on Climate Change (IPCC), coping refers to ‘the use of available skills, resources, and opportunities to address, manage, and overcome adverse conditions, with the aim of achieving basic functioning of people, institutions, organizations, and systems in the short to medium term.’ Autonomous adaptation, also referred to as spontaneous adaptation is ‘adaptation in response to experienced climate and its effects, without planning explicitly or consciously focused on addressing climate change’ (IPCC 2014).
or risk reduction plans but also augments any lack of governance capacity in local governments (Archer et al. 2014; Wamsler & Brink 2014).

**Challenges faced by government institutions in implementing community-based risk reduction and adaptation**

Despite the benefits of an integrated approach to adaptation and risk reduction, supporting grassroots strategies, and taking into account vulnerable communities’ perceptions and needs requires a government with a pro-poor perspective (Jabeen et al. 2010). An increased understanding or knowledge of community-based strategies alone does not necessarily translate into integration of the adaptation responses by multiple actors at different scales. This is because government institutions’ decision-making is affected by various factors (Fatti & Patel 2013). Broadly speaking, these include factors that are endogenous to local governments as well as those that are exogenous, which depend on higher scales of government and the developmental context (Malalgoda et al. 2013).

Endogenous factors that affect the adoption and successful implementation of disaster risk reduction or adaptation measures include knowledge of risks, vulnerabilities, and impacts at the local scale (Measham et al. 2011; Malalgoda et al. 2013; Lehmann et al. 2015). It includes recognizing that there are multiple drivers of vulnerability beyond risk exposure (Lebel et al. 2011). Knowledge, in turn, is affected by certain actor-specific characteristics such as their risk perceptions, preferences for certain strategies, and past experiences of hazards and risk mitigation or adaptation (Fuchs et al. 2011; Lehmann et al. 2015; Pasquini et al. 2015). Specifically, in the case of the urban poor, perceiving them as ‘encroachers’ or ‘illegal’ prevents local governments from gathering their inputs in the planning process, or extending risk reducing infrastructure or services in flood-prone informal settlements (Mustafa 2005).

In addition to knowledge and perceptions, the institutional structure of local governments, especially opportunities for inter-departmental coordination on cross-cutting issues such as disaster risks and climate change, and enabling bureaucratic structures that promote participation and information exchange facilitate better risk governance (Romero-Lankao et al. 2013; Lehmann et al. 2015). Often, differences in disciplinary backgrounds, departmental silos, and rigidity in approaches (e.g. reactive or emergency management approach) with an unwillingness to learn and change prevent adoption of holistic, long-term risk reduction measures (Fuchs et al. 2011; Measham et al. 2011; Lehmann et al. 2015). Cases from Durban (South Africa), and Mexico City (Mexico) have shown that the presence of influential champions or political leaders, who are strong advocates for adopting adaptation measures, can offset some of these institutional silos or rigidities (Romero-Lankao et al. 2013).

Local governments are also unable to take proactive adaptation or risk mitigation measures due to a lack of financial, time and/or qualified human resources. The absence of stable leadership (administrative or political), and a high rate of turnover in staff make it difficult to achieve any continuity or coherence in adaptation planning (Malalgoda et al. 2013; Romero-Lankao et al. 2013; Lehmann et al. 2015; Pasquini et al. 2015). Exogenous factors such as the regulatory or legal frameworks for policy implementation, opportunities for collaboration with the city administration or with state actors at higher scales, as well as policy incentives also affect adaptation strategies by the local government (Measham et al. 2011; Malalgoda et al. 2013; Romero-Lankao et al. 2013; Lehmann et al. 2015). For example, in the Indian case, climate change adaptation has not yet been devolved below the subnational state governments. At present, disaster management plans are the only available policy structures for flooding risk reduction at the city or local scale.

In the Indian context, specifically in the case of disaster risk governance in small cities, Rumbach (2015) finds that decentralization of disaster management to the subnational state and local governments has failed to reduce risks because of lower capacity for governance in smaller cities as well as a lack of redundancy in core physical as well as social infrastructure. Smaller cities lack a robust civil society or research community that can complement local government’s efforts by generating knowledge and raising public awareness. Additionally, many of these newly formed or rapidly growing smaller cities lack the environmental experience and learning from past disasters that help shape adaptation strategies at the household or city scale.

Biesbroek et al. (2013) note that these institutional challenges are not particularly unique to the process of climate change adaptation or risk reduction, but some aspects of climate change do pose distinct decision-making challenges. Since the localized impacts of climate change are often localized as well, and the key actors at each level are different, it is necessary to incorporate risk management with a pro-poor perspective in a participatory, inclusive manner that promotes inclusive risk governance and strengthens institutional capacities.
change are both difficult to predict and spread over a longer time frame, local governments with constrained capacities tend to focus their limited resources on solving more immediate, pressing problems (Fuchs et al. 2011; Fatti & Patel 2013; Archer et al. 2014).

Finally, contextual factors such as local government’s relations with communities at risk, and the political context within these cities affect how disaster risk governance unfolds at the local level. Urban poor communities themselves are heterogeneous, which makes designing inclusive or participatory processes a big challenge for local governments with constrained capacities, and risks elite capture (Measham et al. 2011). Within the Indian urban context, too, studies have shown that the poor largely tend to mobilize through political structures rather than through civil society or administrative bodies (Harriss 2007). Therefore, in the absence of political support for adaptation planning, it becomes difficult for local governments to adopt pro-poor, community-based approaches to risk reduction.

With this overview of the different factors that affect coping at the household level, and the challenges that prevent local governments from integrating community-based adaptation we now turn to examine how the process of flooding risk reduction unfolds at the local level in the municipalities of Navi Mumbai and Kalyan-Dombivali.

The geographic context: Flooding risk in the Mumbai region

The Mumbai Metropolitan Region (MMR) is one of the world’s largest urban agglomerations with a population of about 20 million according to the 2011 Census. It consists of 22 municipalities, each governed by its own local government, according to the provisions of decentralization legislation, i.e. the 74th Amendment to the Indian Constitution. The entire region receives heavy rainfall of more than 2200 mm annually, between June and September, which makes it vulnerable to seasonal flooding. Mumbai experienced its worst floods in recorded history on 26 July 2005, when the city received over a third of the total seasonal rainfall in a single day. In addition to heavy rainfall, factors such as location at mean sea level, tidal inflows, and increase in surface runoff due to rapid urbanization, coupled with the low capacity of the existing drainage systems, contribute to flooding. With climate change, studies predict that the amount and intensity of rainfall are likely to increase (Rana et al. 2014).

Climatic conditions in the region have undergone a change in the past century. Bhagat et al. (2006) note a 50% increase in the average rainfall per day experienced in the city. Despite the great difficulty and uncertainty in projecting the impacts of climate change on future precipitation (and the risk of flooding) in the Mumbai region, research indicates that by 2080, the intensity of extreme rainfall is likely to increase for all return periods, particularly for shorter return periods (more frequent) events (Ranger et al. 2011). Through a statistical downscaling of Global Climate Models, Rana et al. (2014) find an increase in the average amount of rainfall from 20% to 40% in various projections for the present century. Overall, these studies suggest a heightened risk of flooding in the MMR in future if planned adaptation measures are not taken in advance.

Navi Mumbai (NM) and Kalyan-Dombivali (KD) are ‘million-plus’ cities located in the MMR (see Figure 1). NM was conceived as a planned satellite town in the early 1970s to decongest Mumbai, and distribute growth inland in new areas. On the other hand, KD was formed by combining the twin towns of Kalyan (an ancient port, now an important railway junction), and Dombivali (an industrial suburb) in 1983 (Baud et al. 2013). NM has a population of 1.11 million, and KD a population of 1.67 million (Census of India 2011). Both cities are growing at a faster rate compared to the city of Mumbai, with annual population growth rates of 4.6% and 1.1% respectively. Despite being a ‘planned’ city, nearly 19% of NM’s population lives in slums or informal settlements, while for KD the corresponding figure is 45%.

In addition to the regional impacts of climate change discussed earlier, both cities are vulnerable to flooding on account of their specific geographic conditions. Many parts of NM were reclaimed from mud flats, and therefore are below the mean sea level. To prevent flooding of these low-lying areas during heavy rains, the city planners designed a series of holding (retention) ponds following the ‘Dutch method’ to store the storm water during high tide, and later release it during low tide (Kulkarni et al. 2014). Despite these hard infrastructure measures, our research indicates that some households continue to experience flooding due to a host of reasons that we elaborate in a subsequent section.

KD is also located in a low-lying region adjacent to the estuaries of three rivers –Ulhas, Kalu, and Waldhuni– that form 60% of the boundaries of
the municipality. Due to this, the city is vulnerable to riverine floods as well as flooding due to runoff from surrounding municipalities in upstream areas. There are also tidal inflows from the Thane creek estuary that prevent the drainage of these rivers during high tide (Baud et al. 2013). Rapid population growth in creek and river bank areas without corresponding expansion in drainage infrastructure is exposing a greater population to flooding risks in both these cities.

Methodology

To understand the process of flooding risk governance through decentralized disaster management planning, and the challenges that local governments face in implementing risk reduction measures that integrate household and community-level coping strategies, we adopted a case study approach (Yin 2009) to study NM and KD. Additionally, we used Thane (another municipality as well as district headquarters within the MMR) as a secondary case to develop a more detailed, in-depth understanding of flooding risks and municipal risk reduction approaches in the two primary cases.

Given the limited geographic scope of our study, we do not intend to generalize flooding risk management across the variety of mid-sized Indian cities or peri-urban municipalities. However, the analytic generalization of the case study method allows us to compare our findings with previous studies that have examined the challenges faced by local governments in implementing pro-poor risk reduction strategies. It also allows us to extend the emerging literature on climate-related risks and adaptation through decentralized disaster governance in smaller Indian municipalities on urban peripheries.

Primary data was collected from June to August 2015 during the monsoon season. We used mixed methods that included in-depth, semi-structured, open-ended interviews with key informants, on-site observations, and a survey of 130 households from seven low-income, informal settlements prone to flooding in the two municipalities (see Figure 1 for location of these settlements).

We held key informant interviews with twenty policy makers, municipal officials, elected representatives, planners, and state officials at different scales. These helped us understand the localities vulnerable to flooding, main causes and impacts of flooding, various measures being undertaken to mitigate floods, and provision of emergency relief through municipal disaster management planning. The interviews also touched on the various institutional and contextual challenges to implement risk reduction measures in general, and specifically those that were inclusive of the needs of vulnerable communities. In addition to the disaster management cells, interviewees at the municipal level were sampled from a range of departments related to flooding such as storm

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2 See Mukhija (2010) for an elaboration for the N of One plus Some approach to conducting a single case study, where he advocates using multiple secondary cases to augment a single case. In principle, we used the same method but our study differs since we used two case studies supported by a single secondary case.

3 We understand informal settlements as those where residents do not have tenure security. These could include but are not necessarily restricted to slums.
water drainage, water supply and sanitation, encroachment, solid waste management, fire and emergency services, and town planning. These informants were identified through a snowball sampling strategy by making visits to the city administration offices.

The informal settlements, where we conducted household surveys, were identified using a convenience sampling strategy following key informant interviews, on-site observations, and analysis of secondary data such as city development plans, and disaster management plans. Because we were interested in autonomous adaptation strategies adopted by the urban poor, the specific criteria that guided our sampling of settlements included high exposure to flooding risk, and higher concentration of low-income households in relatively poor housing and infrastructure conditions.

We selected the settlements of Ashok Nagar, Bhavani Nagar, Katemanavli, Atali, and Ahire gaon in KD, and parts of Ghansoli gaon and Digha in NM. Of these, Atali, Ahire gaon and Ghansoli gaon have grown rapidly in creek areas in the last ten years due to a high demand for affordable housing in the region, and a less stringent regulatory environment controlled by local politician-landlords, who are natives of these former villages. In all these settlements, most people live in pucca houses, and work in the informal service sector as housemaids, drivers, security guards, or construction workers. They also pay property taxes to occupy land and access municipal services, but do not have tenure security. Residents of these settlements lack proper access roads, reliable water connections or supply, sewers, storm water drainage, or solid waste collection infrastructure. In many cases, storm water drains double up as sewers and garbage dumping channels, which increases the risk of illnesses whenever they flood. Unlike many parts of Mumbai city, there are no developmental NGOs operating in these areas to compensate for poor service delivery by local governments.

Within these settlements, we surveyed households to understand socio-economic characteristics, access to basic services, perceptions and experiences of flooding, autonomous adaptation responses, and perceived solutions to mitigate flooding risk. Households located in flood-prone areas of these settlements were sampled with a combination of simple random sampling using door-to-door asks and purposive sampling to include the perspectives of households belonging to different social groups within the settlement. The structured survey instrument consisted of a combination of closed and open-ended questions. Each survey lasted about 30 minutes on an average, and was conducted in either Marathi or Hindi using an Android-based survey platform called Open Data Kit. Household perceptions of the drivers of flooding, and neighbourhood development histories were triangulated with the help of at least two key informant interviews in each settlement.

Findings

Household level impacts of flooding and autonomous adaptation

Flooding is perceived as a major risk in informal settlements in NM and KD. Nearly 95% of the households we interviewed felt that they were affected by heavy rains and flooding. Although the deluge of 2005—which several older residents recalled vividly—was one of the most damaging events, we found that many residents have also experienced flooding in subsequent years as well during monsoons with relatively low rainfall.5

Around a quarter of the households in our sample reported that they were last affected by flooding in June 2015, shortly before we conducted surveys.6 This indicates that, in addition to heavy rainfall, several drivers contribute to flooding risk. These include the geographic location including its relative affordability, and the quality of physical environment including provision of basic services such as storm water drainage and solid waste management. Alterations in storm water courses, and increasing runoff as a result of newly constructed buildings in their vicinity were also perceived by communities as drivers of flooding.

Flooding has wide-ranging impacts in informal settlements in NM and KD. On an average, people reported that their houses were flooded to a maximum depth of 0.45 m during the last flooding incident that affected them, and that their houses were flooded for 18 hours at a time.

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4 These are former villages within urban areas, governed by a different set of land use planning guidelines.
5 In our study, flooding refers to the inundation of people’s houses or immediate surroundings when water enters the structure from the ground up (Rumbach 2014). 90% of the households we interviewed said that the floor or the bathroom drain was the source of storm water entry in their house during heavy rainfall events.
on average\(^7\). The main impacts reported by the residents we interviewed include loss or damage to movable property such as furniture, mattresses, and household appliances (60%) as well as loss of stored food grains (37\%).\(^8\) Additionally, residents frequently mentioned hardships and opportunity costs such as time lost in cleaning their houses and surroundings after a flooding incident (44\%), loss of wages due to absence from work or absence from school (13\%), and increase in the incidence of illnesses such as common cold and fever (40\%).

Nearly 75\% of surveyed households reported deterioration in drinking water quality during the rainy season, and nearly 50\% felt that their toilet use was affected during flooding incidents. This has implications for neighbourhood and city scale planning of basic services and public health. When it rains heavily, there is flooding along access roads to public toilets in these informal settlements, or toilets get choked up due to backflow of sewage from the drains. Households that have a private toilet (65\%) also reported flooding of toilets due to poor capacity of the sewerage system, and choking of drains due to improper garbage disposal.

Almost 80\% of households reported that they take various autonomous adaptation measures in anticipation of flooding to avoid or minimize impacts based on past experiences. These measures can be classified as preparedness measures to mitigate the flooding risk through infrastructural improvements or maintenance at the settlement scale, or actions to minimize the intensity of heavy rainfall and flooding through structural modifications to one’s house in case it is not possible to mitigate the risk (See Figure 2 for the most common autonomous adaptation measures). These structural modifications include elevating the plinth above previously recorded flooding levels, creating small cement or brick bunds around doorways to prevent rainwater from entering the houses, or covering the house with tarpaulin sheets every monsoon (See Figures 3 and 4).

However, most households (48\%) take loss and damage minimizing measures such as storing valuables at a safe height or in a safe area, placing furniture on bricks or stones to prevent damage due to water, buying and stocking less food grains during the monsoon season, and / or saving money for recovery in case of a particularly damaging incident similar to the floods on 26 July 2005. Most of these measures are undertaken in an individualistic, piecemeal fashion at the household level. Households do not receive any support from local governments for physical upgradation. Previous studies of coping and autonomous adaptation to flooding risks in informal settlements in other urban areas of the global South have noted similar autonomous adaptation strategies at the household level.\(^9\)

In addition to autonomous adaptation taken before the monsoon, several people take steps to cope with flooding when it occurs. They do so by preparing to remove water from their houses, or taking shelter in nearby elevated areas or their relatives’ houses. However, we also found that a large number of people (nearly 50\%) simply do nothing, and wait for the floodwater to recede, due to a lack of awareness and / or coping capacity, or the non-availability of shelter close to their house. This is because most households we interviewed were low-income, and had low access to financial capital to make physical improvements to their house. Besides, a lack of tenure security prevented them from making any long-term investment in the upgradation of their houses and surroundings. Only about 55\% of the households we interviewed received information or early warnings on flooding, and related precautionary measures in advance.

Due to a lack of physical and financial capital at the household level, people are heavily dependent on local state actors and their social capital to increase their coping capacity during floods. Social capital refers to additional resources that a household can access at the time of disasters using their social networks, and relationships developed on trust, reliability, andPorio (2011) for strategies adopted by vulnerable households in Metro Manila. Douglas et al. (2008), too, note that adaptation strategies in urban Africa tend to be individualistic in nature.

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\(^{6}\) According to the Thane Regional Disaster Management Cell, which records daily rainfall in the district, the total annual rainfall in 2015 was 2225 mm, as compared to an average annual rainfall of over 2800 mm in the last decade.

\(^{7}\) Since 26 July 2005 is an outlier event which caused flooding up to a height of over 1.8 m for three days in some areas, we have excluded it from the calculation of these average figures.

\(^{8}\) Figures in parentheses indicate percentage of households that reported these impacts within our sample.

\(^{9}\) For example, see Jabeen et al. (2010) and Braun & Aßheuer (2011) for coping in informal settlements in Dhaka, and Porio (2011) for strategies adopted by vulnerable households in Metro Manila. Douglas et al. (2008), too, note that adaptation strategies in urban Africa tend to be individualistic in nature.
reciprocity, and shared norms (Braun & Aßheuer 2011). 61% of our respondents reported that they received some form of help during floods. Help was mainly in the form of relief measures such as food, drinking water, clothes, mattresses, and food supplies, or provision of shelter. Elected representatives at the local level (ward councillors) called nagarsevaks were counted as the biggest sources of help (by 69% of those who received help). Other sources of help that came up in our discussions were friends, neighbours, or relatives (14%), followed by community-based or local religious organizations (17%). Since social capital is weak in most newly developing urban areas, and as friends and neighbours tend to be affected too at the time of flooding, we find that there is a higher dependency on state actors (cf. Chatterjee, 2010 for the role of social capital in disaster recovery in older slums in Mumbai). As elected representatives and local politicians are also the main providers or brokers of housing and basic services in these informal settlements, they play an important role in shaping the coping capacities of vulnerable households.

Household and community perceptions of long-term solutions to mitigate flooding risk

Given the limited nature of early warning systems or public outreach measures, household and community perceptions of flooding risks are largely based on their past experiences of flooding events. We found that residents in older informal settlements such as Ashok Nagar, Bhavani Nagar, and Katemanavli in KD had a higher awareness of flooding risks in their neighbourhood as compared to those in more recently formed informal settlements in NM. Likewise, residents with past experiences were well aware of the multiple drivers of flooding in their neighbourhoods. In turn, they perceived a
wide range of long-term solutions at the neighbourhood or city scale to mitigate flooding risks or reduce its impacts. It is, therefore, important to engage them in flooding risk governance in these areas.

People’s conditional willingness to relocate suggests further, that they live in these risky and deficient conditions because of a lack of affordable housing options in safer areas. Nearly two thirds of the households we interviewed were willing to consider relocating, provided the new location was equally affordable, and offered similar conveniences such as easy access to schools, transportation nodes and places of work. Familial and community ties, and locked investments in homeownership were the reasons for unwillingness to relocate. Although relocation holds the promise of safety, it is currently not a viable solution for reducing flooding risks, unless local governments develop the capacity to regulate land use and make provisions for affordable housing development for the poor in a participatory manner.

When questioned about their perceived solutions to reduce flooding risks, many people were unwilling to voice their views because of a lack of faith in the local government’s commitment or ability to deliver these solutions in their informal settlements. However, a majority expressed that improvements to the existing storm water drainage system and solid waste collection services, periodic cleaning of gutters, and building embankments along rivers or major drains would greatly reduce the flooding risk (See Figure 5). Other flooding mitigation measures perceived by these communities at risk include the installation of improved early warning systems, financial support from the government to upgrade their houses or to elevate the entire neighbourhood, land use regulation to prevent development along rivers and storm water drains, and building better access roads to facilitate recovery at the time of flooding. The ability to provide and maintain most of these ‘hard’ infrastructural or ‘soft’ regulatory solutions clearly lies beyond the household or community level, and requires active intervention from the local government.

**Municipal approaches to flooding risk reduction through disaster management plans**

In the last decade, both NM and KD have implemented city-level disaster management plans in adherence to the decentralization requirements of the National Disaster Management Act of 2005, with provisions for responding to flooding –perceived as one of the biggest environmental risks in the region. Our analysis of these municipal disaster management plans (hereafter DMPs) reveals that the two cities have recognized several low-lying areas within each ward that are vulnerable to flooding-risk on account of their location and topography, higher concentration of population in slums or informal settlements, and (to a far less extent) poor access to infrastructure such as transportation, water, sanitation, healthcare, and storm water drainage.

Management plans in both plans pertain to the desilting of gutters, cleaning of storm water drains and nullahs (major drains that are either natural or built), and clearance of debris in partnership with other line agencies such as the railways and highways department. They also include stockpiling of equipment necessary for disaster response, relief and recovery; raising community awareness through early warning systems in partnership with NGOs and emergency services. Town planners, on the other hand, outlined various flooding risk reduction measures such as prevention of development in coastal regulation zones through land use planning, and reducing flooding by encouraging developers to plant trees, adopt permeable paving, and harvest rainwater to cut down surface water runoff.

Figure 5 - Most common solutions perceived at the household level to mitigate flooding risk. Source: Authors’ own survey 2015.

The NM DMP specifically outlines long-term flooding risk mitigation measures such as infrastructural improvements to the storm water drainage system, and improving transportation access to dense areas at risk for rescue and relief. Other measures include earmarking rehabilitation of settlements in sites prone to flooding and landslide risk in land use plans, and raising community awareness through early warning systems in partnership with NGOs and emergency services. Town planners, on the other hand, outlined various flooding risk reduction measures such as prevention of development in coastal regulation zones through land use planning, and reducing flooding by encouraging developers to plant trees, adopt permeable paving, and harvest rainwater to cut down surface water runoff.
the distribution of pamphlets and warning notices; training of municipal staff from various departments at all levels to respond during rescue efforts; and assigning vigilance duties during the monsoon months.

These measures were always emphasized by officials in interviews, and they often provided detailed updates on the status on ‘nallah saaf-safai’ (cleaning and maintenance of drains) in their jurisdictions to emphasize disaster preparedness. They also showed us their wireless communication and hotline devices in the disaster management control rooms that were installed to receive and process complaints during disasters. At the ward level, too, we were often directed to speak to officials in the solid waste management departments, because they were in-charge of sub-contracting drainage maintenance to ensure that the water courses were free of any garbage or ‘choke-ups’ that could cause water-logging or flooding during heavy rainfall. As Rumbach (2015) rightly notes, DMP documents are essentially disaster response plans that contain copious details on the relief supplies and equipment in store, contact details of emergency personnel in each ward, a list of location of shelters, and standard operating procedures in case of emergencies.

Despite outlining various holistic ‘hard’ and ‘soft’ long-term mitigation measures on paper (KD to a less degree), these DMPs fall short on implementation. They adopt a narrow, short-term emergency or crisis management approach that fails to reduce risks for the vulnerable, urban poor. In the next section, we examine why these implementation gaps arise as a result of differences between the local government’s perceptions and knowledge of the impacts of flooding risks and the needs of vulnerable communities, and a failure on part of the municipalities to engage with the public. Other barriers that prevent pro-poor risk governance include a lack of technical, human resource and financial capacities at the local level, and weak institutional and regulatory frameworks that provide no incentives for implementing pro-poor disaster governance.

Knowledge, capacity, and institutional barriers and opportunities in flooding risk governance

Our interviews with officials reveal that they do not perceive flooding, let alone climate change-induced variations in precipitation as a major risk. This is evident from their responses to questions on long-term mitigation measures: ‘Flooding is not a big risk, not as much as it is in Mumbai’ (Interview with official, July 2015).¹¹ In their view, unlike Mumbai which is located along the Arabian Sea, NM and KD abut a khadi (creek). So, these localities were not at risk of tsunamis or cyclones or sea-level rise—which they viewed as the main climate change-related risks. Another official felt that: ‘[Flooding] occurs only for a matter of few hours, at which time, we send our staff with pumps to clear the water-logging, provide food or tea to people whose houses get water logged. There are some disruptions but nothing serious... no loss of lives’.¹²

In NM, officials elaborated on the carrying capacity of the ‘planned’ storm water drainage system and holding ponds to highlight that heavy rainfall could not inconvenience the city for more than a few hours at a time. Further, officials in both municipalities strongly felt that flooding was only possible when heavy rainfall coincided with high tide as on 26 July 2005, which constricted the capacity of the existing storm water drainage system. As far as climate change was concerned, it was largely perceived as a distant threat that did not require any interventions in the short-term.

Planners and officials do not view flooding as a major threat because of lack of information and awareness on its localized but significant impacts in informal settlements (also see Wajih & Chopde 2014). This is partly due to a lack of technical data on local climate change projections or maintenance of databases on extreme weather-related complaints. It is also due to insufficient and incomplete data on key development indicators about the city such as slum population, and coverage of basic services like water, sanitation, and solid waste collection (all handled by different departments) that are linked to reducing vulnerabilities and increasing adaptive capacity. Their current measures are not grounded in evidence from vulnerable communities, as people report that they have never been consulted in the plan-making process. Even where hazard-risk- vulnerability assessments have been carried out—often through donor or state funding—there are no systems in place to update these assessments continuously, based on the occurrence of rainfall events, neighbourhood-level improvements and planning, rapid population growth and urban

¹¹ (Interview with official, July 2015)
¹² (Interview with official, June 2015)
measure their impact on risk reduction at the district and community level with funding from UNDP. However, it is too early to build capacity through simulation exercises at the Disaster Management Unit has taken some steps toward levels. The Government of Maharashtra development indicators at the neighbourhood or making tools that aggregate multiple risks and planning. This can include interventions such as awareness on the multiple drivers of flooding risk on rescue and relief operations to raise will have to move beyond their traditional focus on water logging and flooding was garbage disposal in nullahs by these ‘encroachers’. The criminalization of slum dwellers and flooding-affected persons as ‘encroachers’ as well as considering them the cause rather than the victims of flooding was common in many of our conversations on vulnerability of the poor. Ironically though, our research reveals that several of these ‘encroachers’ have citizenship claims to the city in the form of property tax receipts, and water and electricity bills. This reveals how crony capitalism acting in partnership with the local state (politician-landlords as well as lower level regulatory officials) has a role to play in increasing vulnerabilities by allowing the formation and maintenance of these informal settlements in the first place. As far as flooding risk reduction is concerned, DMPs do not propose any long-term mitigation measures in these ‘illegal’ settlements to avoid legitimizing them (Chatterjee 2010).

To close these knowledge gaps at the local government level, capacity-building measures will have to move beyond their traditional focus on rescue and relief operations to raise awareness on the multiple drivers of flooding risk and ways to address them through development planning. This can include interventions such as training staff in the use of GIS-based decision-making tools that aggregate multiple risks and development indicators at the neighbourhood or ward levels. The Government of Maharashtra Disaster Management Unit has taken some steps to build capacity through simulation exercises at the district and community level with funding support from UNDP. However, it is too early to measure their impact on risk reduction at the local level.

In addition to raising awareness within the city administration, it is important for municipalities to engage communities in flooding risk governance by gathering their perspectives, and raising awareness through education and outreach on early warning systems and proper waste disposal. This is especially important in marginalized communities in medium-sized cities such as NM and KD that lack a robust civil society and NGOs that can supplement the local government’s outreach measures, promote collective action for community-based adaptation, thereby increase the community’s adaptive capacity. Current strategies to raise awareness in informal communities at risk through pamphlets and booklets are ineffective, because they are not accessible to a majority of residents who have low levels of educational attainment. Local governments have to employ alternatives such as TV, radio, social media, SMS-alerts, and outreach in schools.

The lack of knowledge on local vulnerabilities at the municipal level is largely an outcome of poor human resource and technical capacity. Disaster management departments in these medium-sized cities often consist of 2-3 persons. They are largely driven by one or two ‘champion’ administrators, who tend to be the only people with technical knowledge on vulnerability assessment, mitigation, and the process of recovery. However, these administrators do not necessarily oversee departments such as solid waste management or drainage, which are linked to flooding risk reduction and mitigation. These departments operate on their own budgets, timelines, and developmental mandates, which partly causes disaster governance to translate into short-term preparedness and emergency management.

The positions of disaster management officers are currently contractual or part-time because of which it is hard to attract and retain technical capacities. Given the ‘specialist’ nature of the job, generalists in the city administration are unwilling (and sometimes unable) to commit their time and skills to it. There are presently no incentive structures in place to motivate city staff

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13 Within our sample, less than 40% of household heads had attained secondary education or higher, and nearly 18% were illiterate

14 See Mustafa (2005) and Ranganathan (2015) for a detailed account of how these lower middle class communities in informal settlements become victims of crony capitalism rather than the perpetrators of land grabbing (and flooding) in floodplains in Rawalpindi and wetlands in peri-urban Bangalore respectively.

15 We avoid mentioning the designation or affiliation of our interviewees to maintain confidentiality.
to participate in training exercises or mainstream risk reduction concerns in their respective planning activities. However, the relatively small-size of administration in these cities offers an opportunity to initiate inter-departmental dialogues and plans for an integrated flooding risk reduction.

The subnational state, which is the highest disaster management authority at the State level, can create incentives such as promotions, recognition, and allowances for staff across various departments. This way they can take an active interest in mainstreaming risk reduction concerns in their functions, and work across departmental silos. Although the state disaster management authority provides comprehensive guidelines for preparation of district DMPs, there are neither separate guidelines for preparing city-level DMPs nor any penalties for failure to implement proposed measures. This can be encouraged through funding streams or grants tied to the implementation of specific risk reduction measures that, in turn, are tied to vulnerability reduction in informal settlements. Similarly, because urban development is a State subject, the subnational state can facilitate long-term risk reduction through urban development policies. Thus, State-level policies should focus on directing cities to build and retain human resources, deploy financial resources for building localized knowledge on risks, undertake long-term mitigation through hard and soft measures, and mainstream risk reduction in regular development activities.

Our research within communities at risk also reveals that they often (almost always) mobilize through political channels — nagarsevaks and other elected representatives— to initiate developmental changes in their neighbourhoods, and to seek assistance in case of disaster events. Elected representatives also have access to special funds through which they undertake infrastructural improvements in their constituencies. Within the settlements we surveyed, these often included ‘visible’ improvements such as paving alleys, laying roads, installing streetlights, or improving the solid waste collection system, — not necessarily building or maintaining storm water or drainage infrastructure. Unfortunately, current disaster management plans only involve the city administration and line agencies, and outline roles for NGOs. They do not include capacity-building measures or active roles for elected representatives at ward levels to encourage them to consider flooding risks in their infrastructural improvements. This disconnect between the political and the administrative arms of the local government in flooding risk governance needs to be bridged by engaging elected representatives in early warning systems, infrastructure development, and public outreach.

**Conclusion**

Our study shows that there are multiple drivers of flooding risk in informal settlements in the peri-urban municipalities of NM and KD. One of the main drivers is the lack of affordable housing options at the city and regional level, which in turn forces the urban poor to live in poor quality housing in flood-prone areas along creeks and riverbanks, and/or in poorly serviced gaothans (former villages) that have less stringent development regulations. Other causes include increasing runoff due to new developments in the vicinity of these settlements, poor quality or non-existent drainage infrastructure, and improper waste disposal that chokes up the existing drainage systems. There is also some evidence to show that climate change will likely exacerbate flooding risk in the absence of adaptation planning.

Our findings show that poor households in these informal settlements are affected by moderate rainfall events too, due to their low coping capacity. In response to flooding events, households take a number of preparedness and impact-minimizing, autonomous adaptation measures. However, they are unable to take collective action to provide and maintain risk-reducing infrastructure or services at the community scale due to weak financial and social capital. Similar to other small and medium-sized cities, these peri-urban municipalities have few NGOs or civil society organizations operating in informal settlements, which can raise awareness on flooding risks or provide support for rescue and relief at the time of flooding (Rumbach 2015). Thus, the onus of risk reduction through long-term mitigation largely falls on local governments, elected representatives, and other state actors.

At present, municipal flooding risk reduction measures in NM and KD largely focus on short-term preparedness measures such as the maintenance of drains, and planning for response, relief and recovery in case flooding occurs rather than in preventing the disaster through long-term mitigation planning. However, these short-term preparedness measures rarely extend to poor communities in flood-prone, informal settlements. Public
awareness and outreach are limited in these settlements, while vulnerable communities are also not engaged in disaster governance for various reasons.

Local government actors lack knowledge on the magnitude and localized impacts of flooding in vulnerable communities. This is mainly because there is little research on the impacts of rapid urbanization on the ecologies of these peri-urban, small municipalities as well as on emerging risks due to climate change (Rumbach 2015). They also fail to acknowledge that rapid urbanization, and the shortage of affordable housing drives people to settle in informal settlements in flood-prone areas. They view the residents of these informal settlements as ‘illegal encroachers’ who are the cause rather than the victims of flooding. Because of this negative perception, they do not seek community input in disaster management planning nor do they extend risk reducing infrastructure to them.

A relatively small-sized city administration has to tackle many pressing development concerns. So, there is little technical and human resource capacity within these municipalities to undertake detailed vulnerability assessments through community participation or long-term risk mitigation planning. As shown by the experience of vulnerable communities, flooding risk can be greatly reduced through the provision of effective sewerage and storm water drainage, solid waste and debris disposal, and land use regulation to curb excessive surface water runoff. To promote inter-departmental collaboration and mainstreaming of risk reduction in day-to-day planning, awareness needs to be raised through training and capacity-building at the local government level.

In addition, elected representatives need to be actively involved in disaster governance as they provide or mediate access to housing and services in informal settlements, and help vulnerable communities during flooding incidents. This involvement is especially necessary in small city and peri-urban contexts that lack developmental NGOs or an active civil society that can facilitate community participation. Therefore, regulatory and institutional structures for decentralized disaster management need to be revised by the subnational state to encourage and incentivize inter-departmental collaboration; the mainstreaming of risk reduction concerns in regular development planning; and the participation of elected representatives in disaster governance.

In recent years, there have been increasing calls to mainstream climate change adaptation into existing disaster risk reduction policy structures, since both approaches focus on reducing risks for vulnerable groups, as also for the efficient use of human and financial resources (e.g. Schipper & Pelling 2006; Schipper 2009). Our study of flooding risk reduction through decentralized disaster management in peri-urban municipalities reveals that there are several knowledge and capacity gaps, and rigid regulatory structures that constrain local governments from taking a risk-reduction approach that focuses on vulnerable communities. These barriers are not unique to peri-urban municipalities, and have previously been observed in the literature on barriers to adaptation in other small and medium-sized cities in the Indian context. Overcoming these gaps in knowledge on the drivers of risks, vulnerabilities, and adaptation solutions through capacity-building and regulatory reform will pave the way for mainstreaming climate change adaptation concerns in future through existing disaster risk governance structures at the local level.

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References


Baud, I.; Pfeffer, K.; van Dijk, T.; Mishra, N.; Richter, C.; Bon, B.; Sridharan, N.; Pancholi, V.S. &


Lebel, L.; Manuta, J.B. & Garden, P. 2011. Institutional traps and vulnerability to changes in climate and flood regimes in Thailand. Regional


Abstract
This paper discusses the diverse and complex nexus of urbanization and climate change in changing water security in peri-urban areas of Kathmandu Valley, the capital of Nepal, and how managing water has been more challenging with the changes in the water sources after the 2015 Gorkha earthquake. A combination of qualitative and quantitative research methods was used to understand the ongoing water-related changes and the effects of the disastrous earthquake as perceived and experienced by the local people in Lubhu, the study area.

Traditionally depending on rivers, springs, dug wells, stone spouts, and ponds, the community-managed water supply services started in Lubhu in the 1980s. It was using a spring source in the neighbouring VDC with entire households depending on these public stand posts.

The population in Lubhu is increasing at an annual rate of about 4 per cent, subsequently increasing the demands for water. The water sources, however, have declined and degraded. Analysis of temperature data and the perception of people show an increasing temperature trend. Although analysis of rainfall data did not show a distinct rainfall trend, local people perceive a decreasing amount and increasing uncertainty in the rainfall period as a major stress in water and agriculture management.

While the recently started river-based community-managed water supply system has improved water access for domestic uses, the Chapakharka spring -the preferred drinking water source- declined after the devastating earthquake of 2015, adding new challenges for water management in this water deficit peri-urban area.

Key Words
Urbanization, climatic variability, peri-urban, water security, earthquake

Introduction
Nepal is among the least urbanized but also most rapidly urbanizing countries in South Asia, and Kathmandu Valley is the most urbanized area in Nepal (KVDA 2015; Muzzini & Gabriela 2013). The annual population growth rate of the valley increased from 1.27 in 1961 to 4.5 per cent in 2001 and about 5 per cent in 2011 (CBS 2012).

This urban expansion in the valley has been towards the periphery with a predominantly rural landscape. This has resulted in a significant change in land and water uses. The built-up area in the valley expanded from 3,330 ha in 1955 to about 16,470 ha in 2000, to 11,900 ha in 2012 (KVDA 2015; Pradhan & Perera 2005).

Subsequently, adjacent, former rural areas have transformed into peri-urban areas, characterized by mixed rural-urban land uses, economy, and livelihoods.

Peri-urban areas encompass aspects of rural and urban activities and institutions, and are influenced by rapid social, environmental, and technological changes (Marshall et al. 2009). They are transition zones distinguished by heterogeneity resulting from such rapidly changing land uses as much as social and economic differentiations. New pressures, demands, and flows of goods, services and resources, and a weak institutional presence make the peri-urban potential for conflict (Allen 2003; Douglas 2006; Narain 2014).

Although precise spatial demarcation of ‘peri-urban’ may not be possible (Narain 2010), it has common features such as increasing urban land uses and influences bringing a mix of urban and rural livelihoods, heterogeneous social groups leading to a complex social fabric, and flows of goods and services between villages and urban areas. These are also found in Lubhu, the area under this study.
The growth of settlements and the resulting land use and land cover changes in the peri-urban areas in Kathmandu Valley have been largely spontaneous, without any government intervention. The increasing urban agglomeration has been increasing water demands, degradation of traditional water infrastructures and institutions, encroachment, and pollution of water bodies. As a consequence, water sources have declined, and there is increasing pressure on available sources.

In addition to haphazard urbanization and consequent gaps between water demands and available water sources, climate change is factor in exacerbating the situation (Shrestha et al. 2014). District-wise analysis of climate change vulnerability has marked Kathmandu Valley as one of the most prominent regions vulnerable to the impacts of climate change in Nepal (MoE 2010).

Analysis of climatic trends in the valley marks an increasing temperature trend, while no distinct trend has been seen in rainfall. However, analysis of people’s perceptions shows both remarkable changes in climate trends and their impacts on water resources (Maharani 2013; Sada et al. 2014; Shrestha et al. 2014).

Further, the recent Gorkha earthquake of 2015 is likely to bring changes in water sources. Understanding these changes and their social implications will need extensive studies.

This paper is based on the empirical case study method combining qualitative and quantitative research in Lubhu, a peri-urban village situated in Southeast Kathmandu. The presentation discusses ongoing water-related changes in peri-urban Kathmandu Valley in the context of rapid urbanization and climate change, together with the effects of the disastrous earthquake of 2015, as perceived and experienced by local people in the study area.

Water security, urbanization, and climate change: a complex nexus

The Second World Water Forum introduced the concept of water security into the public discourse in 2000 (WWC 2000). According to the Global Water Partnership (GWP), water security can be defined as an access to enough safe water at an affordable cost without disturbing the natural environment and its services (GWP 2000).

A similar concept is used by Norman et al. (2010) defining water security as sustainable access to adequate quantities of water of acceptable quality, to ensure human and ecosystem health. According to Grey & Sadoff (2007), water security also comprises the protection of vulnerable water systems, protection against water-related hazards such as floods and droughts, sustainable development of water resources, and safeguarding the access to water functions and services.

Likewise, the GWP (2009) outlines the presence of the following three elements in a water-secured system:

i. Plans and policies on water are in place and incorporated into the national and international development agendas and processes,

ii. There is a thinking process and appreciation that investment in water is an opportunity and solution rather than a problem,

iii. There is a balance of social, environmental, and economic priorities as well as institutional and infrastructural solutions.

Hoogesteger et al. (2014) argue that water security is not just determined by absolute availabilities of water but involves a relational perspective as a function of the distribution of resources and services among different social actors, such that water security for one (group of) actor(s) may cause water insecurity for others.

As such, water security is determined by the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability (UN-Water 2013). Thus, it has social, humanitarian, economic, legal, and environmental dimensions. Also, it has increasingly been considered from a risk-science perspective in achieving tolerable limits of risks (Grey et al. 2013; Hall & Borgomeo et al. 2013; OECD 2013; UN-Water 2013).

In the multi-factorial water security index by Vorosmarty et al. (2010) with a threat scale ranging from 0 (no apparent threat) to 1 (extremely threatened), South Asia’s present threat index varies regionally between 0.6 and 1, while for Nepal the threat level is high to very high (0.6-0.8). Water shortages and the
increasing degradation of water quality and quantity in Nepal are attributed to rapid urbanization and industrialization, population growth, and inefficient water use (Cruz et al. 2007). While the urbanization process is often promoted as a pathway to improved basic services and economy, rapid urbanization as evident in Nepal has added challenges to the economy, ecology, and health, to resources utilization, and to basic service provisions including water (ICIMOD 2007).

The situations are aggravated by the changing climate and its adverse impacts on demand, supply, and water quality (Cruz et al. 2007). Gerten et al. (2011) in World Bank (2012) prognosticates that it is over ninety per cent likely for Nepal to become water-scarce driven by climate change alone. WECS (2011) considers water one of the hardest hit sectors by climate change in Nepal.

In Kathmandu Valley, population growth, urban expansion, and agricultural intensification are the main activities responsible for the increasing water demands (ICIMOD 2007). Water has been identified as a major driver to climate change impacts in Nepal (WECS 2011). Therefore, climate change is likely to increase pressure on water resources, which in the valley already are already under pressure. With the increasing pressure on water resources, water insecurity is felt hardest by socio-economically and politically marginal groups in Nepal society (Hoogesteger et al. 2014).

Research design and methodology

This study involved a combination of qualitative and quantitative research methods. A household survey was conducted with a gender-segregated questionnaire to understand perceptions and experiences of changing water uses, and availability and access mechanisms. It attempted to capture and compare the differences in these respects between men and women at household level.

Ten per cent of the households in different caste groups in each of the nine wards were taken as the sample, making a total sample size of 188. The information was discussed, triangulated, and substantiated through focused group discussions and key-informant interviews.

The focused group discussions were conducted separately with men and women to capture their perception on climate change and its implications for water resources and agriculture. Similarly, key informant interviews were conducted to understand the urbanization trends, the institutional role and strategies employed to reduce the water stress, and the changes in water sources and experiences of water security in the area after the earthquake. The key-informants included water users, local leaders, key functionaries of water users committees, personnel in local development organizations, and relevant government agencies.

Climate trend analysis in Kathmandu Valley includes rainfall data for seven stations and temperature data for four stations obtained from the Department of Hydrology and Meteorology (DHM). These data were analysed using statistical software called ‘R’ (Sada et al. 2014). Table 1 gives details on the meteorological stations selected for the study. All stations except Naikap had data for 30 years and more and thus qualified under the meteorological data analysis criteria defined by the World Meteorological Organization (WMO 1966).

The analysis of land cover change and urbanization for Lubhu was based on aerial photographs over 1979 and 1992 as well as on Google Earth images. These images were geo-referenced and digitally stored in five major classes: agriculture, built up area, forest, rivers, and road using ArcGIS. Open area and agricultural land were considered a single class, since the open area was considerably less in Lubhu in comparison to other classes. Information from key-informant interviews on land cover changes helped to minimize the error. The projection of the urbanization pattern was done using Cellular Automata and Markov Chain analysis.

Study area

The study was carried out in Lubhu, a rapidly urbanizing peri-urban area located in the South-Eastern part of Kathmandu Valley, located at 85° 24” East and 27° 39” North (Figure 1). It is a settlement with an area of approximately 476 hectares. The population in Lubhu is increasing at
Table 1: Available climate variables and covered period per stations

<table>
<thead>
<tr>
<th>Station</th>
<th>Period of Meteorological Records</th>
<th>Rainfall</th>
<th>Temperature</th>
</tr>
</thead>
</table>

Source: Compiled by the authors based on the data obtained from DHM for different stations

an annual rate of 3.6 per cent. According to the census of 2011, the population size was about 10,000 persons distributed across some 1,800 households (CBS 2012). The term Lubhu comes from two Newari words 'Luun' and 'Buun', meaning golden field representing the high paddy yield in the area. Lubhu was also a traditional market for surrounding VDCs and well-known for its traditional textile business. After a municipal declaration in 2014, Lubhu was included into the Mahalaxmi Municipality.

Result and discussions

Urbanization in Lubhu

As shown in Figure 2, the population increased by over thirty-six per cent between 2001 and 2010. The current average annual growth rate is 3.6%. This population growth rate at Lubhu is higher than the national annual average growth rate (1.3%). It is also higher than the growth rate of the
urban (3.4%) and rural (1%) population of the country, but lower than the average annual growth rate of 4.3% in Kathmandu Valley itself (KVDA 2015), and the urban (3.9%) and rural areas (almost 5%) in the valley (JICA 2012; Muzzini & Gabriela 2013). Access to water plays a major role in the expansion of settlements. The relatively lower urbanization rate in Lubhu could be the result of the lack of household water supply services in this peri-urban area.

The analysis of land use change revealed that the built-up areas increased from 6.4 hectares in 1979 to 14.6 hectares in 1992 and to 28.1 hectares in 2010. A land pooling project was implemented in Lubhu from 1993 to 1996. It contributed to an increase of selling of the arable land, resulting in an increasing number of households - from 1,439 in 2001 to 2,365 in 2011. With the current trend of urbanization, the built-up area would reach 69.3 hectares by 2030 with an increase of 146% compared to 2010 (Figure 3). This seems likely as the Long-Term Development Concept drafted by the Kathmandu Valley Development Authority envisions continuing the guided urban expansion towards the South, including towards Lubhu (KVDA 2015).

**Observed and perceived changes in climate**

The average annual temperature for the Khumaltar and Godawari, the meteorological stations closest to Lubhu, was 17.8°C and 16.7°C. The number of days with a temperature below 0°C was decreasing for all the four stations with temperature data. The most rapid decrease in Khumaltar and the number of hot days (temperature above 30°C) was found to be increasing at the highest rate at TIA station. Daily maximum and daily minimum temperatures showed an average increase of 0.05°C/year and 0.04°C/year respectively.

Baidya et al. (2008) showed comparable results for stations all over Nepal: an increase in warm nights and warm days and a decrease in cold nights and cold days. Similarly, Practical Action Nepal (2009), based on the observed meteorological data for the period 1976-2005, shows an increasing trend in the maximum temperature (0.050°C/year) and the minimum temperature (0.030°C/year).

Analysis of rainfall data showed no distinct change in the number and length of dry spells, the number of rainy days, total annual rainfall, and the daily intensity index. There was much spatial variation. An increase of events with >50 mm of rainfall was found for most stations. There were no significant increasing or decreasing trends in total annual rainfall. A study by Practical Action (2009) also found no significant trend of rainfall. In a time-series analysis of the effect of

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1 In Nepal urban refers to areas with a population exceeding 5000 persons, or a minimum population density of 10 persons per hectare (National Urban Policy 2007). Administratively, municipality, sub-metropolis, and metropolis refer to urban situations, whereas the Village Development Council (VDC) covers rural areas

2 Land pooling can be defined as a land management technique to carry out a unified design, servicing, and subdivision of a group of separate land parcels for their planned urban development. There is a sharing of the project costs and benefits between the land owners and recovery of the project costs by the sale of some of the developed plots. It has proven to be a successful land development scheme in Nepal (Oli 2003).
climate variables during 1978-2008, Joshi et al. (2011) also found the trend of rainfall was neither increasing nor decreasing significantly in that time period.

A seasonal breakdown indicated rainfall decreased mainly from October to March. This is the period for winter and spring rainfall, implying decrease in the seasonal rainfall. Increase in rainfall took place from April to September, except for June. June is the month for the onset of the monsoon. This average decrease in June may imply that the start of the rainy season had shifted to later in the season. There were also variations in the trends for the same months across the stations. These could be due to the differences in the rainfall amounts and microclimate in different areas within the valley.

In the FGDs on climate change perception, the respondents recalled that the decrease in the number of days with frost started becoming apparent in 1990. It became more evident in the period after 2000. Contrasting with the findings of the rainfall data analysis, most respondents also had a strong perception of decrease in rainfall. Delayed monsoon, decline in the persistence of monsoon rainfall and volume of winter rain, and increasing unpredictability of rainfall were other perceived changes in rainfall. Although no distinct trend was observed in the rainfall data, increasing rainfall uncertainty was perceived to be making rainfall unpredictable and unreliable for their agricultural water needs.

It is possible that the difference in the perceived and observed rainfall trends could be due to increasing water scarcity. Yet, it is also important to realize there is no optimum number of meteorological stations, and there are limitations in the data in existing stations as well as in the ability to conduct a micro-level analysis of climatic trends. This calls for a strengthening of the data-base and more research to understand micro-climatic trends.

Water (in) security in Lubhu

Natural water sources in Lubhu are limited with a few, temporary spring sources. However, until the 1980s, nine traditional ponds existed in the area. The ponds were used for irrigation, bathing, and groundwater recharge. By 2000 most of them had disappeared or had been drastically reduced in size for the construction of public infrastructure and religious land marks, or encroached on by private land owners.

Similarly, traditional stone spouts in the area have also deteriorated. Worse, five of these - Sankhadevi Dhara, Amrit Dhara, Bhagbati Lachi Dhara, Gaphal Dhara, and Jharu Dhara- have completely dried up and are now connected to drinking water supply lines to supplement local domestic water needs.

Considering Lubhu does not have any spring sources in the area and observing the location of these stone spouts, one may conclude that these spouts could have been fed from the Dovan Rajkulo, the irrigation canal flowing through Lubhu.

Evaluating the impacts on water is challenging, however. Damage and degradation of this multi-purpose canal and its channels could have been a major factor in the drying up of these traditional water sources.
A community-managed water supply system was introduced in Lubhu in 1981 by tapping the Chapakharka, a spring source from neighbouring Bishankhu Narayan VDC. This system supplies water to five rapidly urbanizing peri-urban villages: Lamatar, Sirutar, Bizankhu Narayan, Tikathali, and Lubhu.

According to key-informants, as Lubhu has no reliable water source of its own, the original agreement for water sharing at the source was to distribute half of the water to Lubhu VDC and the remaining half among the four other VDCs. However, the water from the source is distributed at present equally among the five VDCs. This has reduced the available water supply in Lubhu from this source.

The system has been supplying water through 67 public stand posts in Lubhu with each stand post designated for approximately thirty households around it. Water supply was provided twice on a daily basis: a few hours in the morning and a few in the evenings. This was in its initial phase, but now supply has declined and has become irregular over the years. Over the years the population in Lubhu and the other peri-urban villages sharing water from the Chapakharka spring sources continued to grow. This further increased the number of people to be served by this Chapakharka water supply system.

Moreover, according to local perception, the supply from the source has reduced due to the combined effects of climatic variables and urbanization. Although the annual rainfall trend did not show a major change, the monthly breakdown indicated seasonal changes, which could have affected the yield from the spring source.

The increase in water demands and decline of alternative water sources due to drying of the traditional water sources were prominent, therefore.

In these hydro-social changes, the public stand post from this Chapakharka supply system continues to be the only drinking water source for Lubhu. Other means of getting water for inhabitants include ferrying water from spring sources in neighbouring VDCs in containers loaded on bicycles, motorbikes or in vehicles collectively rented. These continue to be the means to deal with scarcity in the dry season and in the event of an unforeseen disruption of water supply as in the Chapakharka Water Supply Scheme. This system is often rendered inoperable during the monsoon due to landslides, destroying pipe lines laid down in the area.

There were also people depending on tanker supply as the only alternative of water supply. Those who could not buy water in bulk, bought water in small quantities from tanker operators. The usual rate was Rs. 5 (US$0.05) per gagri, a water fetching vessel with a volume of about 15 litres. The household survey showed 23% households purchased water in water unavailability from public standposts. Of this 17% buy water for drinking use followed by 3% for cooking, bathing, and washing, 2% for construction, and a very nominal percentage for other purposes such as festivals.

Despite efforts and access to means to reduce water scarcity, the increasing water insecurity remained the major problem in Lubhu. To reduce water insecurity, another community-managed water supply system, the Dovan Drinking Water Supply System, was initiated in 1998. This system was based on water diverted from the Dovan River flowing along the neighbouring Lamatar VDC. A total of 52 public stand posts were functional in supplying water from the Dovan River, and approximately 100 households depended on each of the taps.

Although this new water source was aimed at reducing the pressure on the Chapakharka water supply system, the poor quality of water in the Dovan River was a problem. The results of the water quality analysis for the Dovan River revealed that the physical and chemical parameters of water from the sources presently used by the people at Lubhu were within acceptable standards of National Drinking water Quality Standards (NDWQS). However, contamination of total coliform and E. coli, indicated possible contamination of water from faecal matters. This indicated that development of water treatment system would be a highly desirable initiative at Lubhu to ensure delivery of good quality water among the consumers. Pollution of this river had been brought about by increased dumping of solid waste and discharge of sewage in the upstream VDCs. It now compels Lubhu residents to continue depending upon the earlier supply for drinking water.

The household survey showed that more than 50% of people in Lubhu adopted some form of water purification. The filtration system of the Dovan River water supply started only in 2014. After it had started, over 500 private taps have been supplied from the Lower Dovan intake and
around 300 from the Upper Dovan. However, even the households with private taps still prefer using the Chapakharka supply as primary water source and Dovan only as an alternative. Considering the limited preference for Dovan, the local water resource committee has been rigorously exploring arrangements for financial and technical support to improve the filtration system.

Clearly, alternative water sources have not been able to reduce much pressure from the increasing water demands, particularly for Chapakharka. The household survey showed that in over 70 per cent households in Lubhu, only female members are responsible for daily water collection. Given the unpredictability of water supply, women in Lubhu usually collect as much water as they can when the supply is strong. The average water storage capacity per household in Lubhu is 584 litres. Considering the caste groups in the area, Brahmin and Cheetri are on top in storing water with 640 litres, followed by 569 litres by Newars and 459 litres by other caste groups. This hoarding of water is perceived as a way to secure some water security to meet extra water needs during festivals and when supply is scarce.

The disproportionate responsibility of water management forces the women to spend most of their morning time at the public stand posts. As this often conflicts with their other regular household responsibilities, women groups in Lubhu have evolved an informal but innovative system of fetching water in a queue. In this system, turns to get the water are according to a sequence decided by lottery among the women there. The revision of this water fetching sequence is done on a daily, weekly, monthly, or annual basis.

This arrangement created a form of social guarantee for the access of drinking water, thereby avoiding conflicts while fetching water. This suggests that water scarcity does not always lead to conflict (e.g. Homer-Dixon 1993), but can also be an incentive toward bringing in new forms of cooperation. Nonetheless, conflicts on account of water were still common experience for both male and female respondents (over 70%). Although the practice of water fetching in sequence is getting discontinued with emerging alternative water sources at some public taps, for many taps this sequence was found to have been on for over 30 years.

Community dug wells used to be a major water source in this traditional Newar settlement. But, with increasing water supply constraints at public stand posts, there has been a vast increase in the extraction of groundwater in the homestead. According to the survey, more than half of the households (53%) have groundwater extraction systems, while few households (7%) have rainwater harvesting as an alternative water source. However, similar to surface water sources, Lubhu is also poor in groundwater endowments. Not only is availability of groundwater poor, its quality is also substandard there. Local people perceived the discharge of sewer into the historical state sponsored underground canal -the Rajkulo- as a major cause of this depleting groundwater quality. Further, degradation of the traditional ponds and increasing the built-up area have reduced groundwater recharge in the VDC.

Although depletion of the groundwater table has not yet been a major concern in Lubhu, local people anticipate a decline in groundwater availability as a result of increasing groundwater extraction, reducing recharge sources, and increasing rainfall uncertainty.

**Urbanization, climate change, and water (in) security nexus aggravating food (in) security in Lubhu**

In Lubhu, the negative impacts of urbanization and subsequent changes in the water needs and priorities have been visible in the irrigation systems. Of the seven community-based irrigation canals there, the Dovan River rajkulo (the historical state-sponsored irrigation system) was the main irrigation source. Over the years, the maintenance of the irrigation system declined, and it degenerated after it was damaged by a flood in 1996. Ultimately, this historical canal was covered for the expansion of a road network passing through Lubhu.

Further, although the formal system requires septic tanks for sewerage management, local residents have been draining their household sewage into this underground canal. This has been adding to the chances of contamination of groundwater sources.

Likewise, the Godawari River that flows along the administrative border of Lubhu, faces pollution problems due to the discharge of sewage into the river. Effluents from an increasing number of textile factories in this area add more pollution into the river. This river is a major alternative water source for sanitary uses and for irrigation. Pollution of the water has not only reduced water availability in Lubhu, but simultaneously
increased health risks, for it is a source of irrigation for farmers in downstream Tikathali VDC. The situation is exacerbated by increasing irregularity in the rainfall pattern that compels local people to depend on this polluted river.

Lubhu was the traditional market for surrounding VDCs and well known for its traditional textile business, which had been expanding with urbanization. The survey showed that 30% of households were involved in business and about 20% in the service sector. Only 29% of households were involved in agriculture, with less than 10% male members involved in this work. The increasing feminization of agriculture was a result of the increasing engagements of family members in education and non-farm economy, thereby reducing their availability for and interest in farm-related activities. However, with the increasing scarcity of water caused by the unpredictable nature of rainfall and also loss of traditional canals and water sources, farmers try to complete transplanting paddy immediately after the good monsoon rainfall. Thus, the practice of engaging paid labour for the timely completion of paddy transplantation has been replacing the traditional parma practice - cooperative labour exchange among the farmers.

In the days of paddy transplanting there is shortage of farm-labour, which causes their wages to become higher. This brings about disputes among farmers as well as between farmers and farm-based workers. Those unable to manage or afford paid labour are compelled to request for help from neighbouring VDCs to transplant the paddy timely. However, for the workers this overlapping of the transplanting work within a few days means a lack of an extended source of income that could have been possible, if there had been irrigation or dependable rainfall.

The lack of maintenance for the irrigation systems in Lubhu may be attributed to the changing land uses and increasing shifts to non-farm occupations, which are contributing to social heterogeneity in the area. While Dovan Rajkulo is no more functional, other, smaller irrigation systems there have increasingly been dependent on rainfall due to a lessening water supply at the source.

With a reduced capacity of the irrigation system in Lubhu, agriculture is primarily rain-fed. In some areas, farmers have still been able to organize the formation of irrigation water user groups. But, with increasing urban influence turning the major irrigation system of Lubhu into a sewer line, such an institution has vanished in larger parts of the area.

According to the irrigation policy 2003 of Nepal, such an institution is a prerequisite to seeking governmental support for irrigation. As a consequence, the dissolution of such institutions has ended the possibility of seeking governmental support for irrigation as also reducing water insecurity.

The effects of climate change together with urbanization have not been limited to depriving people from physical access to water. They have extended towards weakening, eroding, and evolving the social capital and traditional forms of cooperation while bringing in new forms of conflicts and cooperation.

While groundwater irrigation is increasing as an alternative practice, groundwater availability in Lubhu is poor. It is limited to domestic water uses and supplementing home gardens. Thus the groups depending on agriculture as a means of livelihood are compelled to depend on some rainfed agriculture, making water and food security increasingly vulnerable to increasing rainfall variabilities.

Paddy was and continues to be the major crop in Lubhu. Paddy yield is reported to be optimal at 250 C, while the optimal temperature for wheat growth varies between 20.30 C and 22.00 C, depending on the development stage (Luo 2011). Considering the average temperature range in the stations closer to Lubhu, the increasing temperature could positively contribute to both paddy and wheat yield in the area.

In Nepal, the average annual production of paddy and wheat is 3312 kg/ha and 2412 kg/ha (MoAD 2012). The household survey showed that for Lubhu the average paddy production per hectare is 4900 kg and that of wheat is 1548 kg. However, the production of paddy and wheat has declined by over 26% and 40% respectively, over the last three decades. Farmers mentioned water scarcity, insect/pest diseases, low quality fertilizer, and a change in the rainfall pattern as the primary reasons for such changes in crop yield. Increasing hardship for water management and declining reliability of rainfall together with increasing opportunities of off-farm occupation and land value were perceived as major causes of increasing non-agricultural uses of land.

A very important reason for the shift in occupation were the declining economic returns
from agriculture. As shown by the household survey, around 30% of the households reported that their agricultural production meets the household food requirements for less than three months. The combined effects of urbanization and climate change have been reducing the cultivable area, increasing diversions away from agriculture and declining crop yield in those under cultivation.

These effects of urbanization and climate change increasing water insecurity are increasing people’s vulnerability to food insecurity.

With a declining irrigation service and changing rainfall pattern, more and more people switch over to less water-consumptive crops. Instead of Taichin-242 and Tainan-176, the high yielding varieties of paddy, farmers have started to cultivate drought tolerant varieties like Khumal-4, Khumal-8, and Pokherili. They also switched from wheat to barley, lentils, and soybean, while peas were the latest preference in the process of selecting less water requiring winter crops.

Since the middle of 2000, farmers started shifting towards cash crops such as mushroom, vegetables, and flowers. These could be irrigated using water extracted from dug wells, which are common across the households. Additionally, these crops were economically more productive and were increasing with expanding market opportunities in adjacent urban centres.

The increasing cultivation of high-value cash crops as a strategy to attract more investment in agriculture and to adapt to growing water insecurity is in line with the Agricultural Policy 2004. However, it cannot be ignored that it is also reducing the cultivation of staple food crops, the yields of which are already reducing over the years. These collectively imply increasing dependency on imported foods and adding to food insecurity.

Other major implications of urbanization, increasing climatic variabilities, and declining economic returns from agriculture have been leaving lands fallow or leasing them out for some other lucrative income source of income.

Brick factories became prominent leaseholders and scraped off the top soil for brick production. The consequences for crop productivity of such removal of top soil by the growing brick factories became evident in the form of degrading soil fertility and further declining crop production. Considering the significance of top soil to agricultural productivity (USDA 1993), more leasing out of land to brick factories adds threats to the peri-urban agricultural system and food security.

**Gorkha earthquake and the impacts on water security for Lubhu**

The 7.8 magnitude earthquake on 25 April 2015, termed as the Gorkha Earthquake, and the continuous aftershocks that hit the valley have indirect but potentially long-term effects on the water security in Lubhu.

The main source of drinking water, the Chapakharka spring, dropped by seven feet, causing the need for a major change in the intake structures. One of the key-informants shared this information: ‘The yield in the spring sources reduced drastically after the earthquake. The source itself dropped by around seven feet.

Had we been able to go to repair immediately, we might have been able to get it done. After the continued aftershocks it was not possible for us and now we need expert support, but have not received any yet.’

Although people in Lubhu are not clear whether the spring yield declined or had shifted to a new point, the major challenge was that the water at the intake point had dropped. The discharge was almost zero until the monsoon, but with the onset of the rainy season it improved but was still much lower than before the earthquake. Although water supply from the Dovan River had been developed, people are hesitant to use this as their drinking water source and continue to depend on the Chapakharka water supply.

Likewise, the other major water source for Lubhu, the spring sources in neighbouring Lamatar VDC, showed a decline in yield after the earthquake. According to key-informants from Lamatar, many spring sources showed an improved yield after the earthquake but dropped after the major aftershock on May 12. Field observations confirmed that many of these sources in Lamatar had declined and dispersed turning them unusable after the earthquake.

Since the spring sources used for community-managed water supply declined drastically, the water supply hours have been reduced from twice to once a day in the morning. Water users have been meeting their water needs by fetching water from other natural sources in the VDC. The reduced available source and reduced yield in the other functioning water sources have increased water-related stress as also water-fetching time.
After water availability in the preferred sources dropped, Lubhu people depending on these external sources adopted diverse coping strategies. These included buying water jars for drinking purposes, ferrying water from Lamatar during the night, or despite being hesitant about the water quality, using the water from the Dovan water supply system for drinking purposes.

As mentioned earlier, the Dovan River flowing via Lamatar is increasingly being polluted with increasing settlements in the upstream areas. Considering the private land pooling rampant in different areas of Lamatar, the selling of land and expansion of settlements are likely to increase, thereby increasing the number of water users and uses with this VDC.

Further, after the spring water source dropped in Lamatar, people in this area are also seeking support to divert water and filter the river water at a point upstream of the intake point for Lubhu. These changes in sources for accessing water and potential means for seeking water security are likely to add new challenges for the existing strategies for improving water security in Lubhu. Additionally, in case the source did not show a natural enhancement to an earlier level, there might be a need to relocate the intake or even explore an alternative water source to improve the water supply from Chapakharka. It is also important to note that following the declaration of municipalities and the need to cope with the damages caused by the earthquake, the selling of land and in-migration and thus, water demands in the peri-urban areas under the Chapakharka supply system are likely to increase.

As these areas are now parts of different municipalities, changing any arrangement with regard to this system can be beyond the capacity and authority of community-management systems individually. These complications can have implications on the existing and envisioned water security options, particularly for the people in water-deficit areas like Lubhu.

Conclusion

Based on research in Lubhu, the study described the complex and vicious nexus of urbanization and climate change, and how the compounded effects have been shaping water security and further adding challenges to food security, health, occupation, cropping choices, and social practices in the peri-urban areas. The study provides an insight that as urban expansion rapidly changes land and water uses and livelihood practices, the impacts of increasing temperature and declining rainfall dependability are exacerbating the situations in multiple ways rather than acting in isolation. People are making efforts to manage water and minimize the impacts at household level, for the hamlets as well as for the larger community.

A combination of diverse means is used in arranging their multiple water needs. These include not only physical means, but also social networks and institutional innovations that involve different forms of conflicts and cooperation. However, while urban expansion and water demands are increasing, both quantity and quality of the available water sources are degrading in this natural-water source poor village and are eroding traditional institutions and social capital.

The recently started river-based community-managed water supply system helped to reduce water scarcity for domestic uses. However, with its poor quality it could not reduce the struggle for drinking water management, so the struggle for water security continues.

Further, as the Chapakharka spring, the most preferred drinking water source, and other water sources used as alternatives declined after the earthquake, the uncertainty increased about their water access and water security. The growing concerns and initiatives made by the community in seeking for water security are positive.

Nevertheless, it is also important to acknowledge that not all changes and challenges can be dealt with by the limited capacity of the community. Exploring potential sources of support would be appropriate, particularly since the government has allocated a budget to explore new water sources and repair water sources damaged by the devastating earthquake.

While addressing these earthquake related damages, it is also important to pay due attention to diverse stress factors at work in peri-urban areas. These include urbanization and climate change, as evident from the study. It is important to understand how these shape peri-urban water security and can re-shape in the post-earthquake scenario.
Acknowledgements

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References


ICIMOD (International Centre for Integrated Mountain Development). 2007. Kathmandu Valley Environment Outlook. ICIMOD, Ministry of...
Environment, Science and Technology (MoEST) and United Nations Environment Programme (UNEP), Kathmandu, Nepal.


Sada, R.; Shrestha, A.; Shukla, A. & Melsen, L. 2014. People’s experience and facts of changing


Urban political ecology of water in Darjeeling, India

Prof. Gopa Samanta
Department of Geography, The University of Burdwan
email ID: gopasamanta@gmail.com

Kaberi Koner (Ph.D. Researcher)
Department of Geography, The University of Burdwan

Abstract

Water crisis is not a new phenomenon in Indian cities. However, the nature and dimensions of water problems vary widely depending on the physiographic, socio-economic, and cultural specificities of the urban space. Darjeeling’s water supply system is very old, since it was developed during the British period. Although the population of the city has increased significantly, the water supply capacity has remained almost the same over a long period of time, even after Independence. The municipal supply is insufficient and sometimes is not available for days. The situation is even more difficult on account of a high demand for water from hotels and tourists. The gap between high demand and meagre supply has paved the way for the entry of an informal and illegal private water market in the city. The households in the city, depending on their spending capacity, use multiple sources to optimize their access to water.

There are many institutional (financial, administrative, managerial, and political) problems in the water supply system, which make the crisis more complex. One reason for this complexity is that the level and patterns of negotiation with the crisis are not standardized throughout society. Power and status (economic, social, and gender-based) play an important role here. The paper, using an urban political ecology framework, tries to understand the socio-political complexity of water and its diversified impact on the different groups of people in the city.

Key words

Water, privatization, urban political ecology, governance

Introduction

Urban water has become a prime concern, as many countries both from the developed and developing world are suffering from an acute water crisis. In India, the urban population is increasing at a fast rate, exerting severe pressure on the existing, overstretched infrastructure (Kumar 2014; Shaban & Sharma 2007; Thompson et al. 2000). This matter needs to be addressed, because without proper arrangement for potable, adequate, and affordable water for all, expected development is not possible (Salman 2014; Upadhyay 2006; Venkatachalam & Vanathy 2012). The majority of Indian cities cannot meet the increasing demand for domestic water. The condition of small and medium cities is worse in comparison to big cities, as the urban local bodies (ULBs) of these smaller cities are not financially capable of meeting the increasing expenditure on water collection and distribution. The low incomes of these small cities are rooted in the weak revenue bases and minimal financial support from the government (Bajpai & Bhandari 2001; Shaban & Sharma 2007).

The increasing demand for water, meagre supply, and weak institutional setup of the cities make it important to discuss certain water-related issues. These include the existing water infrastructure, trend of growing demand, financial and structural support from the government or from private authorities, nature of the crisis, role of government, role of community, and so on. Each city has its own specific physical and socio-cultural circumstances. The economy and politics of that particular urban space, along with its physical and socio-cultural specificities, make the system distinctively complex. Whereas availability of potable water is strongly dependent on the physical set up, the issue of access to water is more closely linked to socio-cultural and political-economic forces. Therefore, in dealing with water issues, all these conditions need to be addressed at city-wide level by the city government. Physical availability or paucity and their techno-centric management cannot solve all the water-related problems faced by the citizens.
human beings. It depends on the geological, geomorphological, and climatic characteristics of that particular geographical location. Most surface water is typically seen as part of the public property regime, managed by different authorities such as ULBs, River Basin Authority, Water Supply Board, and so on (Ahmed & Zwartveen 2012). But water is no longer considered merely a natural resource, as it is linked with social, political, and economic issues in society (Strang 2004, quoted in Lahiri-Dutt 2006). Moreover, water is associated with environmental, biological, cultural, and psychological aspects of life. This hybridity makes it more complex, whether seen as a resource or as a basic service.

These days, water is more often considered an economic product (Zerah 2000) in many countries as well as in Indian cities. That is why solutions to the water problem are usually linked with user charges. This could be seen as an impact of the Dublin conference (1992), of which one of the principles says: ‘Water has an economic value in all its competing uses and should be recognized as an economic good’ (GWP 2000). However, many scholars (Mader 2011; Salman 2014; Smith 2009) have opined that it should be treated as a public good rather than an economic product. Another group of scholars such as Mehta (2003) and Krishnaraj (2011) opine that water should be treated as impure public good. Krishnaraj (2011) also believes that treating water as a public good is not the only solution to problems like unequal distribution and discrimination. According to Lahiri-Dutt (2006) this natural substance has been transformed into a cultural resource because of increasing effects of social, economic, cultural and political forces on water.

In the context of the above discussion, the paper examines the issue of equity of access to water by the city dwellers, through the urban political ecology framework as developed by Swyngedouw et al. (2002). Although political ecology approaches are highly diversified, the article is conceptually developed on the core idea (developed by Swyngedouw 1997 and 1999) that resulting environmental conditions are rooted in specific historical, social, cultural, political, or economic conditions, and the institutions engaged in them.

The present paper is based on empirical research carried out in Darjeeling city in India, where lived experiences of citizens are strongly linked to access to water. It explains how the socio-economic-political processes make water a complex resource, raising the question of urban sustainability as a political question, and highlighting how unequal access to water is affecting common citizens unequally, depending on their class, age group, and gender.

Further, it narrates how socio-economic status and political connections are crucial in determining access to water. It shows the diversity in effect of differential access to water on different groups of people in society, especially women, adolescent girls, and children from poor households. The article also tries to explain how politics and corruption have made the water situation more complex and unsustainable.

**Methodology**

In understanding these issues, we have depended on intensive field work carried out in two phases in 2015. Empirical research was carried out on the basis of quantitative and qualitative methods. Secondary as well as primary data were used to understand the broad and micro-scale situation respectively. Primary data were collected from various groups of people in the city through structured and semi-structured questionnaires.

The total number of samples covered in the survey was 190. Of these, 120 were households, 30 were children, 20 adolescent girls, and 20 elderly people. The last category helped us understand the changes in the pattern of availability and access to water. Around 20 hotels were surveyed with the help of a semi-structured questionnaire. We also used qualitative methods such as participant observation, focus group discussions, and personal informal interviews to gain a deeper understanding of the processes involved in the water supply system that make it so problematic. We applied qualitative methods mostly in case of interviewing elderly people, elected representatives, and officials of the municipality.

**The backdrop: Darjeeling city**

Daily uncertainty and anxiety over access to water is very common to the people of Darjeeling city. The physical and socio-cultural circumstances specific to the city must be studied to identify the patterns of the problem. Darjeeling is situated in the Lower Himalayas. Therefore its climatic, geomorphic, and hydrological characteristics are different from many other cities in India. Population pressure is significantly high because of a large tourist flow.
Already, the city has a permanent population of about 1.2 lakh, while seasonal labourers engaged in many informal activities and residential students add to the number.

In spite of a continuous increase in population over decades (Table 1), the city still depends on the water infrastructure developed by the British, which catered to a much smaller population of 10,000 to 40,000. As a consequence of the increasing burden, the already overstretched water supply system is in a stage of decay now. Moreover, climate change issues have been affecting the normal rainfall regime of the area, making water an even more uncertain resource.

As the headquarters of the Gorkhaland Territorial Administration (GTA),¹ the city has many institutional problems (financial and administrative) because of the political turmoil between the State Government of West Bengal and the GTA. As Darjeeling is under a dual administrative arrangement, it has become common practice for all political and administrative leaders in the area to pass on the blame for lack of development to the other.

The same is the case for water management. In fact, there are three agencies involved in water provisioning. The infrastructural development for water supply is mostly under the GTA and the Department of Physical Health and Engineering (PHED) of the State Government, while the water supply is in the charge of the Municipal Authority. The complexity of water issues in most cases is thus an outcome of having multiple organizations involved in the situation.

Darjeeling municipality is one of the oldest municipalities in India. It was established in 1850 by the then British government. Today it has 32 Wards, covering an area of 13.81 square kilometres. Two cantonments (Jalapahar cantonment in the South and Lebong cantonment in the North) lie within the municipal area. The surrounding regions of the city have a rich biodiversity of a unique and picturesque nature (Dash 1947). The average rainfall on the hill is 3092 mm. The geological and lithological characteristics of the hill as well as a high monsoon rainfall (maximum from June to September) have a direct bearing on landslides and other hazards.

¹ GTA – Gorkhaland Territorial Administration is a semi-autonomous administrative body. It was formed in 2012 after long agitation on the demand of Gorkhaland as a separate state in India. Darjeeling Sadar subdivision, Kalimpong Subdivision, Kursong Subdivision and parts of Siliguri Subdivision are under their administration.
surrounding hill areas as well as from the North Bengal plains. Table 1 shows the steady growth of the city over time.

The population size counted by the census does not give us any idea of the actual population pressure, thus increasing the demand for each service in the city, including water. As mentioned earlier, a large number of seasonal labourers, especially from other parts of West Bengal, Bihar and Nepal, are engaged in many informal activities (as porters, construction labourers, collectors and sellers of used plastics and papers). They stay in the city for eight to nine months, except for the period of the chilly winters.

Darjeeling has many reputed residential schools, the students of which are not counted in the population size. However, they also stay here for nine months on an average. Moreover, as one of the top-most international tourist destinations in India, it receives a large number of tourists every year (Table 2). Taken together, all these people double the actual population and put immense pressure on the existing infrastructure and available services.

### Changing economy and society of the city

The population of the city is composed of different castes, religions, and economic groups. Most people are of Nepali origin having migrated from Nepal. There are also Bhutias (people of Bhutan) and Tibetans (Dash 1947; Lama 2009; O’Malley 1907). Four religious groups are represented: Hindu, Buddhist, Christian, and Muslim. The water culture of the city dwellers varies considerably along religious lines.

At present, the city is overcrowded, with its permanent and floating population. Demand of land for residential as well as for commercial purposes is increasing. Many multi-storeyed buildings have already come up, and several

### Table 1: Population growth and decadal growth of Darjeeling City

<table>
<thead>
<tr>
<th>Year</th>
<th>Population</th>
<th>Decadal growth #</th>
</tr>
</thead>
<tbody>
<tr>
<td>1872</td>
<td>3157</td>
<td>-</td>
</tr>
<tr>
<td>1901</td>
<td>16,924</td>
<td>1.64</td>
</tr>
<tr>
<td>1941</td>
<td>27,222</td>
<td>2.22</td>
</tr>
<tr>
<td>1951</td>
<td>33,605</td>
<td>1.9</td>
</tr>
<tr>
<td>1981</td>
<td>57,603</td>
<td>2.56</td>
</tr>
<tr>
<td>1991</td>
<td>73,062</td>
<td>2.12</td>
</tr>
<tr>
<td>2001</td>
<td>1,07,197</td>
<td>3.18</td>
</tr>
<tr>
<td>2011</td>
<td>1,18,805</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Source: Dash 1947 (up to 1941) and Census of India (1951-2011).
#- authors’ calculation

### Table 2: Tourists’ inflow in the city during 2009-2014

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of tourists visited</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Domestic</td>
</tr>
<tr>
<td>2009-2010</td>
<td>352378</td>
</tr>
<tr>
<td>2010-2011</td>
<td>222371</td>
</tr>
<tr>
<td>2011-2012</td>
<td>367745</td>
</tr>
<tr>
<td>2012-2013</td>
<td>461173</td>
</tr>
<tr>
<td>2013-2014</td>
<td>3284486</td>
</tr>
</tbody>
</table>

Source: Tourism department, GTA
others are being constructed. These infrastructural activities are destroying natural springs in the vicinity, which are the city’s lifelines. Therefore such development has a negative influence on the sources of water.

In addition, real estate and infrastructure development (construction of multi-storied residential houses, high-rise commercial buildings, big hotels, and roads), deforestation, and unmanaged solid waste disposal are limiting the seepage of rain water into the sources of the springs. For example, a few years ago, a multi-storied commercial building was built above the source area of a spring locally named Laldiki that was providing water to thousands of people. During interviews, locals mentioned that the flow of water from the spring had reduced after construction of this building. The municipality had given building permission to its private owners, without considering the environmental outcome. This is not an exceptional case; rather, such instances are quite common in the city.

Physical development of the city is no more restricted to the municipal boundary. It is increasingly encroaching upon peri-urban areas, at the cost of small and marginal farmlands. This peri-urban development is pushing marginal people further away from the main city on one hand, and is forcing them to depend on an informal service economy on the other.

The loss of land for cultivation has become a common scenario due to the development of resorts, which occupy prime locations in terms of scenic beauty and distance from the city crowd. The development of hotels and resorts in the peri-urban areas raises the demand for water, since these are not covered by the municipal supply.

Most of the water points from which water vendors collect water are also located in peri-urban areas. Poor people, who directly collect water from such springs, often have to wait for a long time, because these vendors collect from the same sources. Moreover, since the peri-urban areas are not under municipal regulation, they are used by different interest groups in terms of land acquisition and water collection. These processes put tremendous burdens on the livelihood of the marginal groups living there. In the process of socio-environmental changes in the peri-urban areas, one can see that commercial organizations gain, and marginal sections pay for it. This clearly validates a ‘political ecology approach’.

Differences on the basis of social and economic power between various groups are also noticeable within the city. Shaban & Sharma (2007) have pointed out that in Indian cities access to basic services like water depends on the economic and social standard of households. In Darjeeling, people experience this differential access likewise. In addition, political identity sometimes becomes an important factor in accessing the facilities. Many poor people from Bihar and other parts of Bengal come to the city to work in the construction sector. They live at or near Dr. Zakir Hussain Basti and Harizan Barik areas. Experiences of such seasonal labourers are very painful with respect to access to water, because they are outsiders in the city. Some said: ‘Local people do not permit us to take water from the local springs or from community taps as we are outsiders. We purchase water from the local shop at our mahallah (neighbourhood).’ Buying water is a common practice in the city for all. Even beggars buy water daily or according to their needs.

Almost 10 per cent of households have an in-house, municipal water connection. These households have a comparatively better status, either financially or socially. Others are dependent on community taps, springs, and private water supply. Because a municipal water connection is very expensive\(^2\), and supply is very irregular and intermittent, springs and private supply have now become the principal sources of water. Poor households cannot afford a private supply usually. So they often collect water from distant springs, even though it means spending long hours going to and fro. In such cases, the water carriers are mostly women and children. This has been observed by many other studies (AquaFed 2007; UNICEF 2006; UN WATER 2006; WHO and UNICEF 2006; Women and Water 2005).

**Water scenario of the city**

Generally, mountainous regions face acute problems of safe and potable water due to lack of

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\(^2\) Now to get municipal connection people have to pay Rs. 55-60,000 or more, depending on the distance. Generally poor people live in distant areas and therefore, the initial cost is relatively higher. So, it is not affordable for them.
available ground water. They are essentially dependent on surface water such as rivers, streams, springs (jhoras), etc., which are prone to pollution and deterioration from anthropogenic activities. Receiving high rainfall (3100mm per annum), Darjeeling was quite a water-efficient city for a long time in the past—with a limited population. The crisis started to crop up in the 1980s. At present, it suffers from an acute water crisis, mainly in terms of paucity of drinking water in the summer season (Planning Commission of India 2008).

Although there are a few major and minor rivers located far away from the town, it is nearly impossible to serve the area with water from these rivers, on account of several physical, economic, and technological constraints. The Balasan River Project was initiated in 2008 to pump water from the Balasan River to Senchal Lakes (North and South) to meet the increasing water demand of the city. However, it is still not successfully operational, due to many administrative and technological problems.

The Darjeeling municipality supplies water from two reservoirs at the Senchal range. Water is collected through the masonry conduit from the 26 springs[^1] in the area, and stored in the Senchal North and South Lakes. These were built during the British period, in 1910 and 1932. The water storage capacities of these reservoirs were 20 MG and 12.5 MG respectively, meant to serve only the then population of about 10,000 people (Darjeeling Municipality 2011). Now, the city has a population of over 1,20,000, seeking to survive on the same source of water. Supply lines do not cover the whole area either. The peripheral areas usually have limited supply lines.

To meet the increasing demand, a third lake called Sindhap was constructed in 1984 by the PHED. It is not functional for it suffers from a leakage problem. Therefore, all responsibilities of water supply and management effectively lie with the Waterworks Department of the municipality, since the twin lakes (Senchal North and South) are under this department.

**Water culture and its change**

As we have seen, there was no water scarcity previously. There was no population pressure and the city was not as commercialized as now. Many perennial springs (locally called dhara or jhora) used to flow through it. And after completion of the twin lakes municipal water supply was potable, regular, and adequate.

According to elderly people (some more than 70 years old), the city was very comfortable, peaceful, disciplined, and clean during their childhood. They used to collect water from springs as well as from a public hydrant (community tap). Municipal water supply would be on twice a day, from 6 to 8 o’clock in the morning and from 4 to 6 o’clock in the evening. People used to collect water according to their daily needs. Water was so abundant they never had to use the water in the evening that had been stored in the morning.

The crisis has changed the water culture of people in the city significantly. Now, they do not take proper care of hygiene for lack of water. The crisis had reached such a level that even the news that a person had committed suicide in the source lake, had not stopped people from using that water. Cultural practices of water use have also changed by this scarcity. The acute crisis has made people more conscious about wise use (re-use, less use) of the water.

**Digging into data on water supply**

Official data show that people get water once in 4 days. We tried to calculate the existing gap between water demand and supply in the city (Table 3) to understand the nature of the crisis in overall availability, and observed that the condition is really worrying. Moreover, this calculation shows the general situation of water scarcity. If we look at the community-wise demand-supply gap, it will give a very grim picture of poor households particularly.

According to municipality data, out of 21,782 households, only 2,145 households have municipal water connections. That is about 10 per cent of all households. Besides, 500 community taps or public stand-posts are located in different areas of the city. Thus the total number of water connections in the city is 2,645.

From the field survey, it is observed that on an average 20 families are dependent on one community tap. Thus, the estimated total number of households dependent on municipal supply is 12,145. If we consider the average size of a household as 5, then the estimated population dependent on municipal supply is 60,725 persons, which is nearly half of the population of Darjeeling.

[^1]: Previously the number of springs was higher but now, due to high deforestation in the catchment areas of the springs, many springs along the Senchal range have dried up.
### Table 3: Total water demand and supply of Darjeeling

<table>
<thead>
<tr>
<th>Total population</th>
<th>1200000 (rounded)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Consumption as per WHO recommendation</strong></td>
<td>70 litres or 15.5 gallons per person per day</td>
</tr>
<tr>
<td><strong>Total demand (household)</strong></td>
<td>$1200000 \times 15.5 = 1,860,000$ gallons/day</td>
</tr>
<tr>
<td>i) Hospital</td>
<td>40,000 gallons/day</td>
</tr>
<tr>
<td>ii) Army</td>
<td>50,000 gallons/day</td>
</tr>
<tr>
<td>iii) St. Paul’s school</td>
<td>20,000 gallons/day</td>
</tr>
<tr>
<td><strong>Total demand</strong></td>
<td>$1,970,000$ gallons/day</td>
</tr>
</tbody>
</table>

**A. Water production per day**

<table>
<thead>
<tr>
<th>Time</th>
<th>Production</th>
<th>Gallons/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.00 am to 4.00 pm</td>
<td>$13 \times 40,000$</td>
<td>520,000</td>
</tr>
<tr>
<td>4.00 pm to 3.00 am</td>
<td>$11 \times 30,000$</td>
<td>330,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>850,000</td>
</tr>
<tr>
<td><strong>Wastage</strong></td>
<td>25%</td>
<td>212,500</td>
</tr>
<tr>
<td><strong>B. Net water available</strong></td>
<td></td>
<td>$637,500$ gallons/day</td>
</tr>
</tbody>
</table>

**C. Fixed supply**

<table>
<thead>
<tr>
<th></th>
<th>Gallons/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital</td>
<td>40,000</td>
</tr>
<tr>
<td>Army</td>
<td>50,000</td>
</tr>
<tr>
<td>St. Paul’s school</td>
<td>20,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$110,000$</td>
</tr>
</tbody>
</table>

**D. Water supplied to public**

<table>
<thead>
<tr>
<th></th>
<th>Gallons/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net water available</td>
<td>$637,500$</td>
</tr>
<tr>
<td>Deduct fixed supply</td>
<td>$110,000$</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$527,500$</td>
</tr>
</tbody>
</table>

**E. Water deficit per day**

<table>
<thead>
<tr>
<th></th>
<th>Gallons/day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Demand</td>
<td>$1,860,000$</td>
</tr>
<tr>
<td>Water available</td>
<td>$527,500$</td>
</tr>
<tr>
<td><strong>Water deficit per day</strong></td>
<td>$1,332,500$</td>
</tr>
</tbody>
</table>

**F. Duration of water supply**

|          | |
|----------| 4 days |

*Source: Waterworks Department, Darjeeling Municipality 2011*
the city. However, in reality all the households are not served by this municipal supply.

Therefore, the crisis indicated by the municipality does not represent the reality, since the municipality takes into account all the people in the city while calculating the demand, whereas half of them do not have a municipal connection at all. The water shortage as shown in the municipal data is thus an exaggerated figure. If we take into account the municipal figures of water availability, and compare these with the demand raised by only those households that have a water connection, logically there should be very little scarcity. However, in reality there is a huge gap between the demand and supply of water even to these limited households. This raises the question: “Where does the water go?” This is also pointed out by the local people. They also have an answer: they think there is a system of illegal water transfer, operated against high bribes.

It is observed that the gap between demand and supply is increasing with time. Utilizing this gap, private water suppliers have entered into the market. Private vendors have been present in the city since the 1980s, but today most households buy water from them. This makes them a very important component of Darjeeling’s water supply and management.

**Private water supply and ‘Water mafia’**

Private water supply in Darjeeling has become the only viable alternate solution to the current water crisis. This business is likely to flourish in future as well, with the increasing gap between supply and demand. Dependency on water vendors is increasing at a faster rate in both domestic and commercial sectors. We noted a few factors in the city that are paving the way for private water supply, such as the inadequate and irregular water supply from the municipality, very high installation costs for municipal connections, growing number of tourists and their increasing demand, and the change in the culture of toilet use (from non-flush to flush toilet).

Tourists always demand more water as they are not used to the water crisis in the city and often come from high-water-consuming societies. They are not ready to cut down their use of water at any cost, and if hotels cannot supply enough water to their guests, they will lose business in the competitive market. Thus hoteliers have become good customers of the private vendors, as they purchase in bulk, in comparison to the households that purchase much smaller amounts from them.

Moreover, all construction activities are dependent on private water supply, since they require huge amounts of water. Additionally, new apartment buildings are entirely dependent on private supply, for they do not want to depend on the irregular supply from a municipal connection. Private water vendors conduct business without any permit from the municipality and therefore do not pay taxes to it. They collect water from the springs outside the municipal area and sell it in the city. Although the process seems to be very simple, there is a big nexus within the system which is not so straightforward.

According to some people, local political leaders are involved in the water business. It is one of their earning sources. Because they are influential people, the municipality does not intervene in the private vendor’s business or force them to pay taxes. According to one councillor of the municipality: ‘A few political leaders are engaged in the water business. They have their own water tanker and it is not a new practice in the city. During the regime of Gorkha National Liberation Front (GNLF) in 1980s and 1990s, many people of that party were in the water business and now many from the current ruling party, Gorkha Janmukti Morcha (GJM), are also involved in the same business.’ Although the turnover of individual business is small, local people call these leaders-cum-businessmen ‘water mafia’.

**Politics, corruption, and crisis**

Nature and society are both socially constructed to significant degrees (Greenberg & Park 1994). Political ecology as an intellectual tradition seeks to dismantle dominant accounts of environmental issues, considering that these portrayals are often conducive to unjust socio-environmental change (Radonic & Kelly-Richards 2015). Using that perspective, this study analyses the interlinked relations among the political system, economic or productive activities, and the distribution of power in controlling the overall water system. Following Bell (2015), it can be argued that the water distribution and supply system is neither natural nor casual. Rather, it is more associated with the complex socio-political processes engaged in the organization of productive activities and space.

The water crisis in Darjeeling represents a unique complex of many forces acting together to make the city water unsustainable. Increasing natural
paucity of water (drying of springs) linked to either climate change or to anthropogenic activities has become a common phenomenon. Narrow political and financial interests of some politically powerful people have made the situation more difficult. Spatial inequality also exists, in both the frequency and duration of supply. This happens because of the differential power position of the councillors in the municipality. More politically powerful people grab more water for their neighbourhood areas. During the household level survey, local people complained about illegal connections, illegal supply, and illegal tapping of water in the city. Such illegal connections and supply are the result of an asymmetrical distribution and use of power; illegal tapping raises the question of failure in governance. It also depicts the material inequality of a formal hydraulic system from which the people are excluded (Radonic & Kelly-Richards 2015).

Many locals think they do not get enough water because of illegal supply practices within the municipal system. They also opined that people from a higher economic class or from politically connected families do not have such a water crisis, and get adequate water regularly. The municipal ‘valve-men’, who control the flow of water in the municipal pipelines in different parts of the city, are also important agents in manipulating the water supply and are believed to be involved in illegally supplying water to rich people and hoteliers to earn some extra money. The majority of the people surveyed are of the opinion that valve-men are also responsible for the crisis in municipal supply.

A few hotels have special liaisons with people in the Waterworks Department of the municipality. During our survey of hotels, we observed that different hotels mentioned different amounts as municipal tax, which is not possible in reality because the municipality has a fixed rate for all commercial connections. The annual municipal water tax for domestic and commercial connections is Rs. 500 and Rs. 2000 respectively. Hoteliers mentioned amounts between Rs. 10,000 and Rs. 12,000.

On further enquiry, we came to know that the amount includes illegal supply of water by valve-men. Some of the hoteliers also mentioned that ‘valve-men are our saviours. Whenever we are in a tight situation, we call them to open the valve and we get water at the cost of bribe given to them.’ We tried to cross-check this fact with the councillor in charge of the Waterworks Department and she lamented: ‘Yes, I know they do. They do it mostly in the evening hours. I try to visit around evening to stop them but regular monitoring is not possible for me also.’

Water has become one of the most important items on the political agenda in Darjeeling, but it is only limited to the pre-election campaign. Before elections, all political parties promise to supply sufficient water. According to citizens surveyed, the elected representatives forget about the water situation after election and make way for the private operators in the city. In Darjeeling, the water sector has not been formally privatized by the state. But, with the continuous failure and negligence of the municipality, people increasingly depend on private supply. This kind of informal entry of private operators has become common in many cities in India, thanks to a market-friendly economy (Banerjee-Guha 1994) characterized by state withdrawal from and increased privatization of ‘urban basic services’.

Impact on Citizens

Without adequate, affordable, and safe water, no life can be sustained smoothly. It is a basic amenity, and its potable and equitable access is a matter of human rights (UN assembly 2010). Iyer (2003) argued it should be treated as a basic right. Scholars such as Sangameswaram (2012) have also tried to strengthen the concept of ‘right to water’.

The right to water includes numerous issues like access, affordability, supply, delivery, participation of the common people in decision-making processes, etc. Basically, the right to water means having access to water for basic needs without any discrimination. Such a basic water necessity, in turn, varies from 20 to 50 litres per capita per day (lpcd), according to different donor agencies like WHO, USAID, and the World Bank (Sangameswaram 2012).

The field survey shows that most people in Darjeeling get an average of 20-22 lpcd of water for their daily use, which is much less than Indian standard norms.4 It has been stated, that if people consume less than 25 litres of water, it is not possible to maintain minimum cleanliness (Zerah 2000). Therefore, shortage of water also

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4 According to the Ninth Five-Year plan (1997-2002), the standard domestic water requirement is 125 lpcd in areas with a planned sewerage system, 70 lpcd for areas without a planned sewerage system, and 40 lpcd for people who collect water from stand-posts.
deteriorates the quality of sanitary practices. According to Thompson et al. (2000), the quantity of water use and daily hygiene have a strong connection. When the quantity of water for daily use is limited, water for washing hands after defecating and before eating, for bathing and cleaning clothes, for washing utensils, and other purposes will be minimised. Therefore, the level of hygiene will go down.

Municipal water is supplied once in 4 to 5 days in the monsoon season (June to September) and once in 10 to 15 days in the dry season (December to May). The frequency and intermittence are not the only problems people have to face: the pressure of water is also very low, which increases the time of waiting for water collection manifold. Zerah (2000) has shown that the intermittence problem and low water pressure are common in a few parts of Delhi. These problems are more intense in Darjeeling city. As municipal supply is very irregular and scanty, people use spring water and water from private suppliers. People even collect water from leakage points in pipelines.

In the dry season (from December to May), scarcity reaches its peak. People then have to wait for four to five hours to get a few buckets of water from the springs. Day by day, the situation is becoming more difficult to sustain for dwellers of this city. A large percentage of households depend on multiple water sources, including private sources (Table 4). This dependency on multiple water sources proves the unreliability of public supply (Zerah 2000).

Rich people can manage the crisis by purchasing water, but the poor cannot always afford it. Affordability is again a very complex matter (Sangameswaram 2012). According to the WHO’s recommendation, only 3-5 per cent of an individual’s income should be used for water. But in the case of Darjeeling, we have observed that the cost of water is much higher than expected. Sometimes, it is as high as 15-20 per cent or more for people from low-income groups. Therefore, the poor have to depend more on spring water. Since women and children are the main water collectors of the family, they suffer more.

This scarcity has wide-ranging effects on society. The crisis does not affect all people in the same way and with the same intensity (Table 5). Poor people, women, and children spend more to get the same amount of water as upper classes, in terms of labour, time, health, and money. Daily anxiety about water also gives birth to a feeling of uncertainty and insecurity with the people, which can be defined as ‘water paranoia’.

### Table 4: Percentage of households dependent on multiple water sources

<table>
<thead>
<tr>
<th>Types of sources</th>
<th>In-house municipal connection</th>
<th>Community tap</th>
<th>Springs</th>
<th>Private water supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of dependent households</td>
<td>44</td>
<td>52</td>
<td>96</td>
<td>88</td>
</tr>
<tr>
<td>Percentage of households</td>
<td>36.67%</td>
<td>43.33%</td>
<td>80%</td>
<td>73.33%</td>
</tr>
</tbody>
</table>

Source: Field Work, November 2015

### Impact on women

The dialogue on water has long been gender-neutral before the arrival of literature in the last two decades, claiming that women are more affected by the limited access to water than men. Although it varies in intensity from country to country, girls and women have to spend more time and money collecting water. The situation can be critical during the monsoon season (June to September) and the dry season (December to May). As a result, women and girls have to miss school and work.

### Table 5: Percentage of people engaged in water collection

<table>
<thead>
<tr>
<th>Water collector</th>
<th>Only women</th>
<th>Women &amp; children</th>
<th>All the members</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of households</td>
<td>24</td>
<td>96</td>
<td>30</td>
</tr>
<tr>
<td>Percentage (total households)</td>
<td>20%</td>
<td>80%</td>
<td>23.33%</td>
</tr>
</tbody>
</table>

Source: Field Work, November 2015
country, a gender-based division of labour is still common to all societies around the world. This division of labour places the responsibilities in the domestic sphere on women, which includes household water management. The nature of management of domestic water varies depending on the level of access to water, which is again determined by class and power equations. There is a vast amount of empirical research with respect to gender and water highlighting that women bear the burden of water-related duties (Lahiri-Dutt & Harriden 2008; Lahiri-Dutt 2009; Lahiri-Dutt 2015; Sijbesma 1987; Van Houweling 2015). They are also the main victims of water scarcity (Jaiyebo 2003; Joshi 2011; Kulkarni 2011; NCW 2005).

Thus, women are unquestionably the most vulnerable section, when it comes to the water crisis. They have to negotiate with the scarcity each and every moment during their household work (AquaFed 2007; GDG 2002). They arrange for the use of water for other members of the family as well. From the survey on the pattern of water use it has been noted that women do not suffer to the same degree in all families; it depends on the family’s financial and social position. According to Ahmed & Zwartveeen (2012: 10) 'different modes of access also imply different social conditions that ensure water security (adequate quantity, quality and reliability) for some households, individuals and enterprises, and water deprivation for others.'

Uncertainty about the collection, carrying, storage, and management of water at household level creates many psychological problems for the women. About 90 per cent of women interviewed said they get maximum stress from these problems. Among them, 55 per cent said they felt impatient at the long wait for water. About 95 per cent mentioned that this crisis creates deep anxiety in their minds, because they have to negotiate with a daily uncertainty about water. Some of them even lamented they go to sleep wondering whether they would get adequate water the next morning or not. All the time, they feel some sort of tension because of this lack of water. Quarrelling with neighbours about water has become a regular phenomenon. About 85 per cent said they face such altercations daily.

Physically, women suffer from pains in their hands and waist, and they experience breathing problems while carrying water up a steep slope. Sometimes they feel insecure or embarrassed on the way back home from the water collection point, which is located far from their houses.

Local boys often trouble them and cause nuisance. In this context, Sijbesma (1987) pointed out that it is very common in many developing countries for women to face health problems and embarrassing situations while collecting water.

In the dry season, people (both men and women) sometimes collect water from a laldiki and giridhara (water source). They, then, have to wait for four to five hours for a few buckets of water in the middle of a cold night. Thus, they cannot sleep peacefully at night. About 55 per cent of respondents, especially those who come to the spring from distant areas, confirmed this. Sometimes they go at 11 or 12 in the night to stand in queue, so they get water at around 3 to 5 am.

Among spring-water collecting households, about 54 per cent stated they have to walk for more than 20 minutes (for one trip) to collect water on roads with a steep slope. At one time, they can carry 30 to 40 litres of water and they generally make the trip 3 to 5 times a day. Consequently, the total time spent on water collection is very high. Therefore, the actual cost of water increases, time-wise and labour-wise. All women were aware of the loss of time due to water collection. About 60 per cent of women respondents were of the view that they were wasting time for household water management, 15 per cent complained they could not take rest at all because of this, and 20 per cent thought they could utilize this time for some income-generating activity.

**Impact on adolescent girls**

The impact of water scarcity on adolescent girls has been widely studied in the context of developing countries, especially in Asia and Africa. The immense loss of time due to water carrying often takes a high toll on girls' education. Girl children in Africa often miss going to school because they have to collect water for their families (Women's Earth Alliance 2011). According to a UN Women publication (2014), African women and children spend 40 billion hours to collect water per year.

We interviewed adolescent girls (students of class 8 to 12) and some girl students from colleges to understand the difficulties they face as a result of inadequate water supply. They shared their painful experiences caused by lack of adequate water at home as well as in schools. All respondents (100%) mentioned they suffered from water scarcity both in the house and in school. When they go to collect water, they find it...
hard to carry it up steep slopes during menstruation. They also do not get enough water to stay clean during that period.

About 55 per cent of the respondents have no toilets and latrines inside their houses. They use either community toilets or pay toilets according to the affordability and proximity to their houses. Conditions of pay toilets are slightly better than those of public toilets. People do not have to carry water at pay toilets. Public toilet users have to carry water from their homes and the condition there is the worst. They said that due to inadequate water, toilets and latrines become dirty and sometimes the outlets of latrines get choked due to insufficient water. As a result, these facilities are often not in a position to be used, but people are compelled to use them as they have no alternative.

Many girls are troubled by urinary infections. During the field survey, we interviewed a Muslim family at Dr. Zakir Hussain Basti (Ward no 18), where all three girls and their mother had been suffering from such infections for many years. The doctor had advised them not to use dirty, unhygienic public toilets, but they had no choice. Similar experiences were shared by girls from Jawahar Basti located below the mall, Bhatia Basti (Ward no 31), and Ganesh Gram (Ward no 13).

Among the respondents, only 35 per cent were students of private schools while the remaining 65 per cent were students of government schools. According to their responses, conditions of private schools were better than those of government institutions. However, even the conditions of private institutions are not always satisfactory, because they also face unavailability of water at times. Occasionally, the students of such institutions have to use dirty toilets in an emergency, whereas such incidents are a regular practice for the students of government schools.

Students of government schools lamented the bad situation in their schools, because there was no proper arrangement of water in the toilets and latrines. Because of this, they do not use it regularly, but are forced to do so in emergencies. Moreover, because there is no system of sanitary napkin disposal, they just throw them here and there beside the toilets. They do not even get water to wash their hands after using the toilet during menstruation. UNICEF (2014) has stated that ‘Menstrual hygiene management includes safe hygienic materials, knowledge and confidence on how to use them, adequate facilities for washing and means for disposal with privacy and dignity,’ but there is no such provision in government schools in Darjeeling city.

We also interviewed three students from the Tibetan Central School, who had come from Arunachal Pradesh and stay at the hostel of the school. They, too, have to collect water from the spring, because in the dry season they do not get adequate water for their use from the hostel. According to the World Bank (GDG 2002), if water and sanitation services could be ensured and improved, the life of the women and girls would become better. In Darjeeling, the quality of life for adolescent girls is deteriorating due to inadequate access to water and sanitation services.

**Impact on children**

Children of the families that have to collect water from outside, either from community taps or from springs, or from both, are more vulnerable. They often have the responsibility of collecting water, because their parents, especially mothers, ask them to do so. About 75 per cent children stated that their mothers asked them to fetch water. It is quite understandable that women try to reduce their excessive work pressure by putting the responsibility of water collection on their children. However, this affects the children badly in many ways. Among the surveyed children, very few belonged to economically well-off families, while the maximum were from poor families. Our target group was also children from lower income groups, to understand the impact of the crisis on them. However, we tried to talk to children from a higher income group as well, to compare the differences in daily routine of children of the same age group from different economic backgrounds.

All the children from the economically poor families collect water from the springs and from community taps according to their family’s need. They study in government schools. Water is not available in most schools and where it is, it is inadequate for use in toilets and latrines. They generally use toilet paper due to the water crisis. But the situation is unhygienic: they reported that toilets and latrines of the schools are not clean, and smell extremely badly. Provision of drinking water is there in schools, but all of them carry water from home, because of the bad quality of the school water.

The children have to wait for hours in line while collecting water for their homes. Waiting time varies with the season; in the dry season, the time...
and government grants is relatively low. Their strong, since their income from both revenues and managerial (and political) and institutional problems (financial, administrative, and political) are noticeable in the water sector of Darjeeling. In this context of pro-poor policies in Chennai, where over 25 per cent of the total urban population lives in slums, we can also argue that a pro-poor policy in the water sector is a must for a city like Darjeeling. The issue of water cannot be dissociated from the overall development of the city.

The study shows that women bear the sole responsibility of managing water at household level in the form of collection, storage, and minimising use. Yet, the voice and participation of women in the formal management of water and in decision-making are insignificant as well as unnoticed. This is not just a case for one Indian city, but has become a global phenomenon. Galvin (2011) has rightly pointed out that without community participation, particularly of the women who experience water hardships most directly, no significant progress is possible in addressing water needs in a sustainable manner.

**Institutional problems and the question of good governance**

It is the institutional responsibility of a local government with respect to water supply, to reduce the negative externalities of the system (Venkatachalam & Vanathy 2012). Several institutional problems (financial, administrative, and managerial) and political issues are noticeable in the water sector of Darjeeling. In addition, the water supply system suffers from high leakage. Approximate wastage of water due to leakage is 25 per cent of the total production. Renovation of pipelines is an urgent necessity and will incur a huge cost. The city government is not in a position to spend such a large amount. The financial base of the municipality is not strong, since their income from both revenues and government grants is relatively low. Their only income comes from the annual tax for in-house water connections, which is set at Rs. 500 and Rs. 2,000 per year for domestic and commercial connections respectively. Moreover, billing and collection of money are not done systematically. According to Zerah (2000), the ill-managed billing system affects the capital base of water agencies negatively.

According to the employees of the Waterworks Department, the main problem is the lack of funds from the State Government to develop new water infrastructure. State Government officials opined that the GTA is receiving funds for infrastructure development, from which they could invest in water infrastructure. To meet existing demands, either one big reservoir or many small subsidiary tanks need to be built. However, there is not sufficient land within the city to construct several subsidiary tanks. Suitable land is either under the forest department or the army. Lack of coordination among the multiple authorities involved in controlling the city's administration (Municipality, GTA, Forest Department, and the Army) aggravates the problem.

According to the common people of the city: 'Leaders are busy in politics and they have no time to listen to the common people's problems.' In the city, no pro-poor policies on water have been implemented, despite the presence of 37 notified slums, constituting 23 per cent of the total urban population. Following the argument of Venkatachalam & Vanathy (2012) in the context of pro-poor policies in Chennai, where over 25 per cent of the population lives in slums, we can also argue that a pro-poor policy in the water sector is a must for a city like Darjeeling. The issue of water cannot be dissociated from the overall development of the city.

Many people were of the opinion that the problem of water in Darjeeling is not natural. It is a created and manmade problem. One respondent said, 'The local government knows all about the severity of water scarcity, but they are less interested to solve that.' Local people are of the opinion that all problems are being caused due to high corruption and nepotism. They are very disappointed with the municipality's services. At this juncture, the question of good governance stands out as most important in the city's water management. People want an accountable, transparent, and corruption-free local government.

**Conclusion**

Urban political ecology is increasingly being used as a popular framework for understanding the
inequality of power, rooted in complex human-environment relations in cities (Radonic & Kelly-Richards 2015). This framework helps us to understand how politics is rooted in all socio-environmental changes in cities and how it is impacting people in unequal ways (Swyngedouw et al. 2002). Some people gain from such changes whereas others suffer; and in most cases, the equation is skewed in favour of those in power.

The article explains the depth of the water crisis in Darjeeling city using the same framework. The study found that the water crisis in the city is not necessarily linked to natural availability only, but more to a number of socio-economic-political forces operating in the city. The limited presence of the government in the city water services encourages private operators to take a stake in water supply and control. Our empirical findings also show that the impact of water scarcity is not affecting everyone’s life equally. The poor suffer because of less political-economic power, and women, adolescent girls, and children suffer because of their position at the lower end of the social ladder, controlled by strong patriarchal gender norms. Health and education, which are significant components of human development, are at stake for children and adolescent girls. Women cannot be employed in gainful activity because of losing so much time for the mere collection and management of water.

Water is still considered a matter of 'public good' in India and is a state subject (Iyer 2003). The municipality, as a local level government, has a constitutional responsibility to supply regular, adequate, and potable water to every household without any discrimination based on economy, ethno-racial structure, caste, religion, and sex. According to Narain et al. (2014), in a governance system, the state, markets, and civil society act as major factors in determining its activities. In the case of Darjeeling city, the state has failed to provide the necessary service due to multiple actors involved in the same service from different public organizations. Each organization blames the other for the lack of fund allocation and water infrastructure development.

Table 6: Perception of the people on the municipal water supply

<table>
<thead>
<tr>
<th>Performance</th>
<th>Very inefficient</th>
<th>Not good</th>
<th>Average</th>
<th>Good</th>
<th>Very good</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of households</td>
<td>64</td>
<td>16</td>
<td>40</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Percentage of the households</td>
<td>54%</td>
<td>13%</td>
<td>33%</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Field Work, November 2015

There is also the problem of boundary maintenance between the city government and the rural panchayats controlling peri-urban areas, which complicates the situation further. The failure of the administration facilitates the entry of market forces as another significant controlling factor of water sustainability in the city. The situation is now beyond the control of the local government because of the limited financial resources at their disposal. All this indicates a bleak future for the city in terms of a sustained water supply.

References


Galvin, M. 2011. Participating in urban myths


WHO and UNICEF. 2006. Meeting the MDG drinking water and sanitation target: The urban and rural challenge of the decade. Geneva, Switzerland: WHO.


Abstract

Providing adequate water to meet the booming urban need is a great challenge for the local administration in developing countries. Generally, there is a huge supply-demand gap in the public water distribution in urban areas. This might be mitigated through transferring water from peri-urban or village aquifers through the water market. However, the continuous transfer of groundwater has led to the depletion and degradation of groundwater, and its implications on the regional environment and the livelihood of the village poor are of major concern.

This paper examines the significance of groundwater in meeting the demand in various sectors (including urban needs), particularly during water resources vulnerability, the water market as a demand management option, and various impacts of rural to urban groundwater transfer, based on a study in Chennai. The paper also argues the need for formalizing the groundwater market in the context of its pressing need in supplementing the urban water supply, and the challenges of environmental and socio-economic sustainability in the villages. In this regard, a rigorous scientific analysis of the dynamics of groundwater in the water marketed areas, the strict enforcement of groundwater laws, applications of economic instruments, and an active collaboration among different stakeholders including the government departments, are suggested.

Introduction

Recently, most of the developing countries have been experiencing rapid urbanization. The trade liberalization policies adopted by these nations, during the globalization phase, have given a boost to many urban-based economic activities in the industrial and service sectors. According to Lundqvist et al. (2003), ‘Virtually the entire population growth in the world during the coming decades will occur in or be concentrated in urban agglomerations and most of it in less developed countries.’

The increasing population and concentration of various economic activities, in urban areas, has led to an increase in demand for water from the non-agricultural sectors. At the same time, to meet the ever growing basic needs of people, the production of more food grains and other agriculture products is also required. This has led to an increasing demand for water in the irrigation sector.

The problem is further compounded by environmental pollution due to the indiscriminate waste discharge from the various sectors.

Under these circumstances, it is more important than ever before to use water efficiently with appropriate allocation strategies. Generally, the solution to water scarcity problems is centred on two strategies:

(a) The supply side management like watershed development and water resources development, and

(b) The demand side management by the efficient use of the available water, both in the short and the long run.

Though there are a number of demand management options available, one of the management strategies adopted either formally or informally across regions by the groundwater market, is reallocation of water, particularly in regions where water scarcity is acute (Palanisamy 2008).

Normally, urban water supply schemes target surface water such as rivers, tanks, or reservoirs as sources, and provide adequate treatment before distribution. But in many developing cities, the Water Board is not able to provide an adequate quantity of protected water, particularly in the summer months, when the flow or storage of the surface sources reduces.
Besides the urban sprawls and newly emerging commercial institutions industries are also struggling to obtain water through public supply. Hence, there is a huge supply and demand gap. In these circumstances, the aquifers of the peri-urban villages act as a supplementary source or an effective demand management option, and huge quantities of groundwater are transferred to the city. In some instances, the government itself makes arrangements to transfer groundwater through pipelines or tankers. More often perhaps, a substantial volume of groundwater is transferred by private parties, and an informal private ‘water market’ of different magnitudes functions in most of the third-world cities.

The continuous extraction and transfer of groundwater from peri-urban areas to the city adversely affects the water table and village activities in many locations, where the rate of extraction exceeds the rate of recharge. The impacts are more on the poor or marginal farmers and agriculture labourers, who are not in any way involved in the water business. Moreover, whenever the water table goes down they are not in a position to invest in deepening a well or digging a new one. Due to this, the poor are denied accessibility to groundwater, leading to major water rights and equity issues. Hence, groundwater extraction from rural and peri-urban areas to meet urban demand needs to be examined in a broader perspective.

The paper emphasizes the need for management of groundwater in peri-urban areas, considering its significance as an urban demand management option as well as its sustainability, through a comprehensive study in Chennai, one of the metropolises in India. The research was carried out by the author in connection with the Crossing Boundaries project, organized by the Centre for Water Resources, Anna University Chennai. Information was gathered through secondary sources and primary studies. Detailed field investigations were carried out, and information gathered through interviews (with researchers, government officials, water sellers, and affected parties in villages, packaged-water company owners, and tanker operators) and focused group discussions with different stakeholders.

**Groundwater resources: competing use and emerging challenges**

Throughout history groundwater has been integral to human life and livelihoods, and for stable agricultural production in the face of water resources variability. But groundwater stock (aquifer) is only a small fraction of the overall water availability, and is not evenly distributed around the world. Of the total annual precipitation of 577,000 cubic kilometres (km$^3$) per year, 79% falls into the ocean, 2% into lakes, and 19% on land. Most of it evaporates or runs off into streams and rivers. Only 2,200 km$^3$ (2%) is infiltrated into aquifers as groundwater (UNESCO 2009).

Socio-economic drivers of groundwater development or extraction showed substantial geographic differences, unrelated to the resource availability. Agricultural demand for groundwater has often been spurred by both explicit and hidden subsidies for rural electrification, irrigation equipment, and well construction. In South-Asia, for instance, subsidized rural electrification to meet irrigation demands, has been a key driver of groundwater use, especially in dry land areas with no surface water services (UNESCO 2009). Besides, the progressive adoption of precision agriculture (requiring on-demand, just-in-time irrigation) has considerably intensified groundwater use and boosted its productivity. Broadly, the drilling, pumping, and well maintenance services have progressively reduced the cost of groundwater exploitation.

Apart from irrigation, groundwater is also a major source for domestic (both rural and urban) and industrial water supply around the world. In the urban category, not only mega-cities but also thousands of medium-sized towns depend on groundwater. Cities like Beijing, Dhaka, Lima, Lusaka, and Mexico are located on or near major aquifers, and urban water supply depends heavily on groundwater.

In certain cities (for example, Bangkok, Buenos Aires, and Jakarta), the level of groundwater has fallen considerably as a result of aquifer depletion, saline intrusion, or groundwater pollution. These trends have tended to obscure the mushrooming growth over the past 10-15 years of private self-supply from groundwater by residential, commercial, and industrial users in Latin America, and South and South-East Asia (UNESCO 2009).

Groundwater accounts for more than 30 per cent of the urban water supply (and a higher proportion by a number of consumers) even in many cities and towns far from major rivers. Competition over groundwater resources between urban and rural users, and the
emergence of a water market are now becoming more apparent. Expanding municipalities and industrial and commercial activities in peri-urban and linked rural areas are competing with agriculture for groundwater. The heavy private use of groundwater in urban and peri-urban areas for mitigating their ever increasing demand complicates the operation of water utility services (both water supply and sanitation). African cities are increasingly using boreholes to improve water security, with the aim of easing pressure on the water facilities in densely populated suburbs (UNESCO 2009).

Local aquifer studies concluded that, where groundwater services are in heavy demand, much of good quality groundwater has already been used. Contemporary recharge to shallow aquifers has become seriously (perhaps irrevocably) polluted, and relaxing water abstraction and pollution pressure on aquifers will take considerable time (UNESCO 2009). According to Foster & Chilton (2003), the development of the power-driven pump in the mid 20th Century led to the emergence of many groundwater-dependent economies, and recently to warnings of the potentially adverse impacts of excessive abstraction and aquifer pollution.

Aquifers that are shallow and ‘open’ to regular and dependable recharge are more vulnerable to pollution from agrochemicals and urbanization (sewage and industrial effluents). Generally, precision agriculture and large-scale commercial farming are likely to be located near urban areas, and they primarily depend on groundwater and use large quantities of chemical fertilizers, pesticides, and fungicides, which also contaminate the shallow groundwater.

Aquifer depletion and degradation have far-reaching implications including public health and resource sustainability. They also adversely affect economic growth in many parts of the world. A recent study by the World Bank (2007) in the Middle East and the North African region estimates that groundwater resource depletion has substantially reduced the GDP in some countries - Jordan by 2.1%, Yemen 1.5%, Egypt 1.3%, and Tunisia 2%. In brief, the reductions in groundwater stocks appear to have been translated into reduced economic productivity of water.

In India, groundwater resources play a significant role in meeting the ever-increasing demands of the agricultural, industrial, and domestic sectors, and their extraction has witnessed a phenomenal growth over the last five decades. At present, more than 85% of the domestic water supply in rural areas, about 50% of the water requirements in urban areas (domestic and industries), and more than 55% of the irrigation water requirements are being met from groundwater (Romani 2007).

Despite this, proper plans for scientific development of the resource are lacking. Allocation and management of groundwater, and extraction are mainly done by private enterprises. The unscientific and inefficient use of this vital resource contributes to its increasing scarcity, reflected in a steep decline of water levels and, in certain situations, a sharp deterioration in the quality of water. The scenario is critical now and there is little scope for the future development of groundwater. In Tamil Nadu, out of 358 assessed blocks only 145 (38%) are safe, 57 (15%) are semi-critical, 33 (9%) are critical, and 142 (37%) are over-exploited (Romani 2007).

**Groundwater market: as a demand management option**

Any resource when it is scarce, like water, gains economic value. Once the basic human and environmental water needs have been met, the remainder should ideally go to where water has the highest value to society. But this may not be the case in a water market.

The emergence of markets for water is determined by several socio-economic and cultural factors, and functions in a slightly different manner from markets for other commodities and inputs (Palanisamy 2008). Water markets are typically spontaneous (initiated by private individuals to achieve mutual gains), informal (transaction of water takes place without any legal bindings and for the mutual benefit of buyers and sellers), unregulated (no strict regulation is followed), localized (mostly functioning at the village or regional level), fragmented (geographical separation of sellers), and seasonal (demand varies across seasons) (Shah 1986).

Water markets in India are highly irregular, and prices are determined by the marginal costs of pumping and the elasticity of the water demand. Normally sellers enjoy the monopoly, as there is no immediate alternative option available for buyers to obtain water.

The literature on groundwater markets ranges from highly positive ones confirming that
groundwater markets are the ‘vehicles of poverty alleviation’, to those that accuse them of ‘creating water-lords’ and appropriating the surplus from the poor (Palanisamy 2008).

In a broader sense, positively speaking, water markets ensure efficiency and equity, and thereby generate adequate social benefits to society. They play an important role in the reallocation of resources from surplus to deficient areas, and increase water productivity. The major argument in favour of the water market in the agricultural sector (rural to rural) is that it helps to access the resource by landowners without wells, and increase crop productivity, employment, and livelihood options for the poor and the landless.

It also helps in the improvement of the water quality by transferring water from surplus areas with high drainage problems to scarcity areas, thereby reducing many quality-related problems like salinity. Hence, the rural to rural (within the agricultural sector) water market is less controversial than the rural to urban (inter-sectoral) one.

The rural to urban groundwater market commonly exists adjacent to large urban areas and medium-sized towns. The transfers here typically involve the sale of water by well owners (generally farmers) either directly to industries or to tanker companies, which then supply it to end-users in urban areas, such as industries, commercial establishments, and households. In other words, it is an inter-sectoral transfer of water.

This kind of water market will lead to social inequality in a situation, where water sellers have a monopoly of the market, and have a hold of a major share of the buyers’ profit too because of the sale of water. As more people resort to water selling, the water market can cause excess pumping of water, making the groundwater aquifer more prone to depletion. This will pose a challenge to achieve sustainable water management and to ensure intergenerational equity to resource access, particularly in water scarce regions (Palanisamy 2008).

Recently, particularly in developing countries, the increasing demand for water for non-agricultural purposes has compelled a diversion of adequate water from the agricultural sector to non-agricultural users on a priority basis, which has led to the growth of an informal water market among these sectors. Despite significant restrictions on the tradability of groundwater, the informal water market has developed in response to increasing water scarcity, and to the differential value of water across sectors.

That is why active trading takes place between the agricultural and urban sectors across the world. The market serves the useful function of supplying water to users who otherwise would not be served by the highly subsidized municipal water systems. However, the market would be far more efficient if legal restrictions and the excessive electricity and municipal water subsidies were removed (Palanisamy 2008).

A study carried out by Prakash (2012) at the peri-urban area of Hyderabad revealed that tanker water comes from water-rich peri-urban areas, and this market has been growing over the last two decades. During summer, when water demand increases, there are reports of conflict between water sellers because this mechanism operates in such a fashion that the water-selling intermediaries are rewarded more than the actual water seller, who is usually a farmer in a peri-urban location.

**Water supply challenges in Chennai**

Chennai, the fourth-largest metropolitan city in India, is one of the rapidly urbanizing centres in South-Asia. The Chennai Metropolitan Area (CMA) comprises a total area of 1189 km2. It consists of Chennai City (176 km2), 16 Municipalities (240 km2), 20 Town Panchayats (156 km2), and 216 Village Panchayats (617 km2) (CMDA 2007).

Chennai witnessed rapid urbanization during the post-independence period, particularly during the post-liberalization period. The CMA’s population has increased from 1.5 million (1951) to 3.5 million (1971) to 5.8 million (1991) and further to 9.8 million during 2011. Besides the permanent residents, the number of migrants and floating population is also high in Chennai.

The provision of water for the ever-growing urban population is a challenge to the city administration. Rapid urbanization, with the expansion of residential, industrial, and business establishments, has put significant pressure on the water sector of the city and its periphery. Chennai gets an average annual rainfall of 1290 mm. In the urban areas, only about 5% of the rainfall seeps into the ground.

Chennai’s water supply has a long history, dating back to when its first water supply scheme was provided in 1772 to the St. George Settlement.
through the ‘Seven Wells Government Works’. 10 wells measuring around 5 meters were sunk in an area of about 5 kms north-west of the Fort, from where water was raised by manually operated devises, collected in a cistern, and distributed through cast iron pipes.

In 1866, a scheme called ‘the Madras Municipal City Water Works’ was approved to divert water from the Kosasthalaiyar River. A weir called the Tamarapakkam anicut was constructed across the river for diversion of its surface flows. Further, in 1944 a regulator was constructed across the river, 20 km upstream of the Tamarapakkam anicut to provide an assured supply.

In the 1960s, the irrigation rights of the command areas under Cholavaram and Red Hills reservoirs were purchased to fulfil the increased demand. At the end of the 1960s, detailed hydrological studies were carried out with UNDP support, and 6 well fields were identified for groundwater extraction to augment the city’s demand.

The formation of the ‘Chennai Metropolitan Water supply and Sewerage Board’ (CMWSSB) as a statutory body in August 1978 is a landmark in the modern history of Chennai’s water supply. It was established to exclusively attend to the growing demand, and for the planned development and appropriate regulation of water supply and sewerage services in the Chennai Metropolitan Area, with particular reference to the protection of public health and all related matters. Several improvement works in the existing sources were taken up by the Board to provide an assured supply.

At present, surface water sources such as the reservoirs at Poondi, Cholavaram, Redhills, Chembarambakkam, Veeranam Lake, Rettai Eri, Porur Lake, and Kandaluru Reservoir in Andhra Pradesh under the Krishna Water supply Scheme, are the main sources of water supply for Chennai. Groundwater from the well fields developed in the Araniyar-Kosasthalaiyar River Basin, and the southern coastal aquifer and seawater-based reverse osmosis (desalination) plants are the other sources of water supply.

Even though a number of water supply schemes have been developed for the city, the Water Board is not able to supply an adequate quantity of water, particularly during periods of less rainfall. An analysis of the average annual rainfall in the surface water supply sources (Pondy, Cholavaram, and Redhills), and the water supplied to Chennai City over three decades, observed that the supply varies with respect to the rainfall. That is, when the rainfall was more, supply was high and vice-versa (Veeralakshmi 2009).

The volume of public water supply in Chennai progressed over time, but not very appreciably with respect to the population and economic growth. The decadal analysis of water supply revealed that even if the average water supplied has increased over the years, there is a considerable variation in the quantity supplied even in recent periods (Table 1). This is a clear indication of the insecurity in the Chennai water supply.

<table>
<thead>
<tr>
<th>Years</th>
<th>Variation</th>
<th>Cumulative average</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum</td>
<td>Minimum</td>
</tr>
<tr>
<td>1941 - 1950</td>
<td>110.99</td>
<td>79.48</td>
</tr>
<tr>
<td>1951 - 1960</td>
<td>143.84</td>
<td>66.90</td>
</tr>
<tr>
<td>1961 - 1970</td>
<td>178.53</td>
<td>120.61</td>
</tr>
<tr>
<td>1971 - 1980</td>
<td>243.11</td>
<td>114.94</td>
</tr>
<tr>
<td>1981 - 1990</td>
<td>256.74</td>
<td>140.50</td>
</tr>
<tr>
<td>1991 - 2000</td>
<td>410.50</td>
<td>112.22</td>
</tr>
<tr>
<td>2001 - 2010</td>
<td>586.55</td>
<td>140.40</td>
</tr>
</tbody>
</table>

source: Computed, based on CMWSSB 2011 statistics
There are huge supply-demand gaps in the Chennai water supply, and the deficit during 2005-2008 ranges from 38 per cent to 58 per cent (Table 2). The deficit is primarily met through either extraction from the local aquifer or through transported groundwater from peri-urban areas. However, since the local aquifer is highly depleted and degraded, most of the deficit share might be mitigated through the groundwater market.

Changing the groundwater regime or emergence of the water market

Generally, most of the discussion on urban water supply focuses on the public water distribution system, in terms of per capita supply and its various related technical, managerial, and financial problems of its operation (Vaidyanathan 2007). However, the public system is not the only source of urban water supply, particularly in a water-scarce city like Chennai where different urban uses are affected by various private options. Historically, the groundwater extracted from privately owned wells was the main private source. That groundwater in the city has been depleting and degrading progressively, due to indiscriminate extractions and urban waste disposal. Hence, a considerable volume of groundwater has been transferred from peri-urban areas to the city.

The source-wise daily household water consumption in Chennai City (Table 3) indicates that public water (Metro water) supply contributes only less than one-third (31.6%) of the total consumption. Sources other than Metro water (which includes households’ own wells and bore wells, community wells, bottled water, etc.) contribute significantly to the total consumption.
and private tankers) accounted for over two-thirds of the total domestic water consumption. Around 24 million litres of water for domestic households’ consumption is supplied by private tankers and packaged water companies, whose sources are the peri-urban aquifers. During surface water scarce periods, public supply also considerably depends on these peri-urban aquifers.

In other words, more than two-thirds of the total domestic consumption comes from groundwater, either within the city or from the peri-urban areas. Apart from households, private and public institutions, commercial establishments, and industries also demand a huge quantity of water. It seems likely that these would depend on private tankers to a greater extent than households. >why?

Recently, considerable change has occurred in the groundwater regime. This is very clear from the nature of extraction within the city, and the increasing dependency on the peri-urban aquifer. In Chennai, from 1980 to 2004, the number of open wells had doubled, but the number of bore wells had increased nearly thirty-fold. A large number of shallow open wells have gone out of use with an increasing number of deep bore wells over the period. This is an indication of the lowering of the water table - a sure sign that the rate of extraction exceeds the rate of recharge, and that the static reserve (groundwater stock) is being depleted. The rate of extraction in a normal year (estimated at 180 mld) in fact exceeds the normal natural recharge estimated by CGWB (152 mld) (Vaidyanathan 2007).

Nowadays, tapping external sources of groundwater and water marketing (for public and private supply) is one of the major strategies to meet the growing city demand. During the 1960s and 80s three aquifers (Tamaraipakkam, Panjetty, and Minjur) in the north and north-west of the city, and those along the coastal belt from Thirvanmiyur to Kovalam were identified for city water supply. The north-east part of the city was taken up for extensive hydro-geological studies as part of a UNDP project, and established the potential for groundwater sources and development (Table 4). The table also clearly brings out the failure of wells due to the depletion of groundwater sources in the last 30 years, due to over-extraction of groundwater.

In addition to the above wells, the Water Board has hired private agricultural wells from early 2000 to augment the water supply. This practice was more during the scarcity periods. The average yield mobilized through these sources was 37 mld during 2001, but it increased to 77 mld by 2005 (CMDA 2008).

Availability of water and road accessibility are the main criteria in the selection of wells. More than 180 private agricultural wells have been identified, and from each well at least 10 to 18 loads of water were pumped (0.1 to 0.2 mld).

The price of water paid to the well owners varies with the season and quality of the groundwater. During peak seasons, the Metro Water Board transports at least 6000 tankers of water each day to the city. The total estimated cost of hiring these agricultural wells is Rs. 85 million per year (Janakarajan et al. 2007). In addition, numerous

Table 4. Well fields details

<table>
<thead>
<tr>
<th>Name</th>
<th>Year commissioned</th>
<th>Initial period</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Number of wells</td>
<td>Yield (mld)</td>
</tr>
<tr>
<td>Tamaipakkam</td>
<td>1969</td>
<td>30</td>
<td>50</td>
</tr>
<tr>
<td>Panjetty</td>
<td>1969</td>
<td>13</td>
<td>41</td>
</tr>
<tr>
<td>Minjur</td>
<td>1969</td>
<td>9</td>
<td>34</td>
</tr>
<tr>
<td>Poondi</td>
<td>1987</td>
<td>12</td>
<td>27</td>
</tr>
<tr>
<td>Flood plains</td>
<td>1987</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td>Kannigaipur</td>
<td>1987</td>
<td>5</td>
<td>14</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>74</strong></td>
<td><strong>180</strong></td>
</tr>
</tbody>
</table>

Source: CMDA 2008
private tanker operators also transport water from various peri-urban villages, to supplement deficiencies in the public supply and/or to provide to users who do not have access to Metro water. In brief, acute water scarcity coupled with the ineffectiveness of government action has made the tanker water business a lucrative industry over a short span of time.

In the water market, three major parties are involved: water sellers, intermediaries (lorry tanker operators), and consumers. In the villages, some well owning farmers have been willing to involve themselves in the water market, because they can earn more by selling groundwater for urban use than from farming. The estimated net profit through the water market from a peri-urban well (selling an average of 10 loads per day at the rate of Rs. 100 per load) is Rs. 20,637 per month, which is far higher than the agricultural returns (Rs. 5000 per month) through irrigation from the same well. The selling price of water to urban consumers is around Rs. 700 / tanker with a 12,000 litre capacity. The lorry tankers’ net profit is Rs. 25,491 per month (Veeralakshmi 2009).

The inducement of water selling is especially strong during years of drought and lean seasons, when public supply will considerably reduce and private users are willing to pay relatively high prices. This tendency is growing because scarcity in the city is becoming endemic and increasing.

Apart from the tankers, the packaged water companies are also extracting a huge volume of groundwater from rural areas and transferring it to urban areas, where the majority of consumers are concentrated. According to such a company proprietor in Chennai, around 350 packaged water (water bottling) companies are in the Chennai area alone, while a majority of them are located in the peri-urban villages. The estimated groundwater transferred by 48 packaged water industries from peri-urban villages near South Chennai is 19.2 mld (Packyalakshmi et al. 2010).

**Socio-economic implications of groundwater markets**

Groundwater transport from Chennai’s peri-urban villages to the city is an inevitable practice that has been followed for nearly four decades. Unfortunately, most water marketing villages in peri-urban Chennai have been transferring groundwater without considering the overall human and environmental water needs in the villages.

Ideally, a market will transfer commodities/resources from surplus to deficit areas. In water markets, water selling farmers compare the values of water for crops or the agriculture sector to those of the urban demand. The prices set in the markets signal the marginal values of water for these different uses, and allocation takes place based on economic efficiency. However, the open access nature of the aquifer and the need for equitable accessibility of the groundwater for all local communities for their livelihoods are major social concerns. Besides, the ecological sustainability of the region is also significant.

In India, the rights to groundwater belong to the landowner as groundwater is attached with land. Since landownership is a prerequisite to ownership of groundwater, it is difficult to assign ‘open access’ to a groundwater resource. Though landowners own groundwater de jure, this right is limited by huge investment, necessary to tap the groundwater, which makes for only restricted access to those who have adequate resources to invest. Under these circumstances groundwater rights are obscure (Nagaraj 2009).

However, a deep bore well owned by a particular landowner can absorb the underground water that exists in its neighbourhood also, because an aquifer is interlinked, or not demarcated like surface land. According to the Planning Commission (2007), since groundwater is an open access resource, a ‘tragedy of commons’ often occurs when everyone tries to extracts as much water as he or she can and degrades the source in the bargain.

During the initial periods of water extraction, not one of the impacts (in the form of either groundwater depletion or degradation) was revealed in the peri-urban villages. Perhaps the extraction rate was below the recharge rate at that time, or within the limits of a sustainable yield. But over time, the extraction rate increased considerably, in proportion with the water requirements of the city. As a result, the groundwater table and the village economy have been affected in various degrees. For example, the estimated sustainable yield from the A. K. basin was 100 million cubic meters (Mm3) per year, but the total extraction was 300 Mm3, three times the sustainable yield (Janakarajan et al. 2007).

The emerging inferences and social implications of the water market in peri-urban Chennai are:

- In villages, rich farmers are mostly involved
in the water selling business, hence the ones making profits. They feel that water selling is more profitable than agriculture.

- The water market is a fluctuating and highly uncertain process. Hence, its magnitude and impacts vary from time to time, and place to place.

- Villagers insist that the extraction of groundwater for agriculture and local purposes is not the cause of depletion of the water table. According to them, through irrigation, a major share of the water recharges into the aquifer and stabilizes the hydro-geological system. They argue that selling or transferring has a much more significant impact on the aquifer.

- For the villagers, groundwater extraction and/or transfer for industrial purposes are more problematic than for domestic purposes, since it is viewed sympathetically.

- The depletion of the aquifer and water quality degradation have adversely affected the regional environment. Many water bodies have disappeared from the villages. The aquatic eco-system and biodiversity have also been affected because of it. In addition, in coastal belts, there has been extensive seawater intrusion.

- Most village activities (agriculture and livestock) have become less due to the trading of groundwater. The main victims are marginal farmers and agricultural labourers (the landless), who face severe unemployment problems. Many of them have migrated to the city to find employment, which puts extra pressure on the already stressed urban infrastructure.

- Drinking water scarcity and related problems are also acute in certain villages. Women face more problems on account of this water scarcity, because they have to fetch water from greater distances now.

There is no uniformity in the water market; its function and implications vary significantly. This is illustrated through four case studies. In the following a description is presented of each, outlining a different pattern of functioning and corresponding implications for water rights, access, reallocation, equity, and conflicts.

**Case 1: Benefits to Somangalam village**

Somangalam is a peri-urban village, located around 30 kms west from Chennai City. The Somangalam tank and its sophisticated irrigation network used to provide adequate water for agricultural activities. Moreover, the groundwater potential in the village was good. However, recently, agriculture in the village has reduced considerably, and most of the fields have not been cultivated. Farmers felt that agriculture was no more a profitable business.

In 2002, a water-scarce period in Chennai, almost the entire village was involved in the water selling business. Nearly all farmers sold an average of 20 tankers (12,000-13,000 litres) per day. Brokers facilitated the process by getting orders for water and making the necessary arrangements for water extraction from different locations in the village.

The entire village supplied water from irrigation wells with the help of irrigation pumping facilities, which was facilitated by the fact that electricity was free. According to villagers, ‘the Government itself ordered us to provide water to the city with the help of irrigation pumping systems.’ (Discussion with farmers 2008).

The selling price of water was Rs. 50 per tanker, meaning each farmer who was involved in the water supply business, earned Rs. 1000 per day or Rs. 30,000 per month. According to a farmer, ‘it was a golden opportunity for us since we never earned Rs. 30,000 per month through agriculture. We are still eagerly waiting for such opportunities.’ (Discussion with farmers 2008).

Villagers said that the water sold during 2002 did not affect either the groundwater table or the village eco-system. This might be because of the huge potential of water resources in the village as well as less utilization for agriculture in the recent past. Moreover, water transfer was not continued from Somangalam, except through two packaged water units, which extracted only a limited quantity of groundwater. There was a good groundwater potential in the village and extraction remained confined within certain limits.

**Case 2: Conflicts in Valliyur village**

But the situation is different in villages where water extraction is persistent. In these villages significant impacts were revealed and conflicts were also reported. Valliyur village is located 30 kms from the city, in the A.K basin of North
Chennai. Historically, groundwater was the primary source of irrigation and the main crops cultivated were paddy and groundnut. During the 1980s around 280 agriculture wells existed in the village at depths of around 50-80 feet. Due to water sales, the water table in the village has declined gradually and farmers have deepened their wells up to 130-160 feet. 60 dug wells have been abandoned due to a falling water table in 1990. 11 Metro Water Board bore wells supplying water to the city to the tune of 16 mld have mostly failed (9 out of 11). After this, the Water Board started to purchase water from the farmers in the village. In the initial period around 40 mld water was purchased from 75 farmers, while it reduced to 16.84 mld in 2004 due to the depletion of the groundwater.

Moreover, the Tamil Nadu Water Supply and Drainage Board also started to pump water for supplying Thiruvallur town from Valliyur village. Up to 1995, the people of Valliyur had been quite passive. That is, they did not resist water being transferred from the common lands of the village, though it had been happening for more than 30 years. But when the water table in the village started to decrease progressively, farmers had to spend a considerable amount of money to deepen their wells. Moreover, agriculture too had declined drastically, and this affected the livelihoods of the marginal farmers and agricultural labourers. Drinking water scarcity also became prominent in the village.

Resistance started to build up against the water extraction and marketing. Local Self Help Groups (SHG) started opposing the transport of water out of the village during 1995, and insisted to the village Panchayats to pass a resolution, banning water selling. But the Panchayat did not do it on the ground that ‘groundwater is pumped only from the Government land.’

When the purchase of water from farmers started in 2000, the village people again revolted. This time, too, the Panchayat refused to pass a resolution on the ground that ‘farmers are selling water from their own lands.’ Subsequently, some villagers filed court cases to ban water sale from the villages. However, the Metro Water Board succeeded in getting stay orders on these.

A violent conflict broke out on 15th August, 2004, when over 400 people gathered near the Metro Water pumping station. Metro Water and higher Revenue Department officials arrived on the spot. To stem the crisis a Peace Committee was formed. The committee consisted of members of water sellers, non-sellers, SHGs, and officials. The sale of water by farmers to the Metro Board was to be stopped according to the committee’s decision on 15th September 2004. But this decision did not materialize and water selling continued in the village. Metro Water argued that water purchase should not be stopped. Water sellers in the village also were keen on continuing to sell water.

On 16th September 2004, villagers gathered near the Metro Water Board’s giant water tank, from where water was pumped to the city. They blocked the road and broke the pipeline. After this incident, police arrested 44 people under the Public Property Damaging Act and remanded them to judicial custody for 15 days (Janakarajan et al. 2007). Even after all these problems and negotiations, water sales were resumed from Valliyur village!

Case 3: Environmental and socio-economic impacts in South Chennai villages

Eight peri-urban water marketing villages come under the Mambakkam mini-watershed in South Chennai. They were studied by Packialakshmi et al. (2010) to obtain a comprehensive view of the rural to urban water market. The quantity of groundwater transfer from these villages was 36.3 mld, of which about 17 mld was through private water tankers and about 19 mld as packaged water. A groundwater analysis based on PWD data indicated a steep decline in the water table during 1971-2007. The pre-monsoon water table fluctuated more (2-7m below ground level, bgl) than the post-monsoon water table (0-3 m bgl). Earlier, this groundwater was available the whole year, but nowadays only for 3 months after the monsoon.

The water quality analysis revealed that the concentrations of TDS, chloride, and sulphate were high in certain villages, when compared to the BIS drinking water limit. The pre-monsoon and post-monsoon analyses revealed that precipitation and dilution were significant factors in the hydro-chemical constitution of groundwater. Hence, the pre-monsoon values of TDS, chloride, total hardness, and sulphate were slightly higher than those of the post-monsoon and BIS standards.

In other words, there was an inverse relationship between the water level and the concentration of the ions, i.e. an increase in the chemical
composition of the water with a decrease in the water level (Pakyalakshmi & Ambujam 2011). It indicated that continuous functioning of a groundwater market in the villages may lead to further deterioration of the groundwater quality in the near future.

All water-marketed villages were experiencing a declining trend of agriculture. The reduction in area under cultivation varied from 28% to 93% in 1991-2007. Farming gradually has become a minor occupation, as urbanization has changed the land use pattern substantially.

This declining trend of agriculture has a direct relationship with proximity to the city, i.e. villages close to the city experienced a rigorous decline. The declining trend of agriculture forced people to move out from the villages in search of employment.

Villages are also experiencing severe domestic water scarcity problems. Since shallow wells dried up, many households had deepened their wells or dug new bore wells, but they were not satisfied with the yield. The water supplied through the public system was not adequate. Higher income groups in the village depended largely on packaged water.

The indiscriminate extraction and transfer of groundwater without considering its renewability adversely affects the village ecosystem, and sometimes an irreversible damage is caused to the aquifer. Earlier, the surface water potential in these villages was good, but now most of the water bodies are useless, due to their reduced base flow. Declining agriculture affects natural systems through a reduction in the return flow from the irrigation and run-off, and through water table depletion due to reduced recharge. Besides, it has also led to deterioration of groundwater quality.

When the public protested against the sale of water, government officials seized 11 tankers. Reacting to this, water tanker operators staged a protest, and more than 200 tankers were parked on the road at Medavakam, blocking the traffic (The Hindu 2010). However, the water market operating from the villages in the Mambakkam watershed is still active.

**Case 4: Sustainable and democratic approach in Kannapalayam village**

The water market experience from Kannapalayam is slightly different from the above cases, and unique because of its sustainable and democratic approach. Kannapalayam is a north-western peri-urban village of Chennai, located at the bank of the Cooum River in Poondamalli union, Tiruvalur district. In 2008, a water market started functioning from the village. Other than in the other water marketing villages, the Kannapalayam villagers decided that water from the agricultural wells or farm lands should not be sold, since it affected the water table and agriculture. Hence, they specified a location, adjacent to the Cooum. It is also the immediate downstream of a check dam constructed across the river during 2005, located far from farmlands and residential areas, exclusively available for water sale. Water sellers purchased small plots and constructed bore wells for the sale of water, and at present 8 wells are functioning.

Generally, in a water market set-up, the water supplying company (tankers) is located outside the village or cities. But in Kannapalayam, the villagers themselves are involved in the process, and they supply water to selected urban consumers on a regular basis. Outsiders are not allowed to enter the village for water. Presently around 50 villagers are actively involved in water transfer through their own tankers.

Mainly mini tankers (5500 litres capacity) are preferred in consideration of the poor road conditions in the village, and the distance of the supplying spot from the main road (4 kms away). Around 2.7 million litres of water (500 tankers) are supplied daily to the city from Kannapalayam. The average price of water taken by suppliers from wells is Rs. 60 per tanker, and the selling price is Rs. 850 (Focus Group Discussion 2011).

According to well owners and water suppliers, they had identified an excellent spot for water extraction thanks to its good yield and quality (sweet with less TDS), something that is naturally preferred by urban consumers.

Water is supplied to households and restaurants (not to industries), and the villagers felt that providing water for drinking is a great service. They also claimed they were actively involved in various social welfare activities in the village like supplementing the village’s drinking water supply, repairing motors free of cost, and giving donations for religious functions (Focus Group Discussion 2011).

However, village officials observed the water market from a different perspective, considering its long-term consequences. According to an official, ‘Even if the water market has many
advantages, it is a violation of the ‘Groundwater Act’ and hence illegal.

Initially, only limited quantities of water were transferred from the village, which they accepted on humanitarian grounds, since both villagers and consumers were benefiting. But now sales have increased considerably, and have become a real business with a profit motive. Some water selling wells had dried up recently; hence, new wells were constructed.

With financial and political influence, water sellers are overcoming various barriers in the water market. For example, to obtain an electricity connection from the Electricity Board (EB), the concerned applicant (bore well owners) was to get prior permission from the village authority by indicating the purpose. However, well owners have been obtaining such EB connections without this! On many occasions, the revenue authorities take action against the offenders by imposing fines, sealing the tankers, etc.’ (Personal interview with an official 2011).

Some villagers, who were not involved in the water market, also expressed their concern about draining the groundwater from the village by considering its depletion and degradation in future. However, they admitted that at present, since water extraction was restricted to an ideal geographical location, the overall groundwater table in the village was not affected (Discussions with farmers 2011).

Need for sustainable groundwater water market

Generally, population and economic growth, and the associated increase in water demand will place unprecedented pressure on aquifer systems. Further depletion and degradation of aquifers would be anticipated, unless there is much more investment in effective governance and management practices. In addition, climatic change will place some key aquifers under additional pressure. In heavily populated areas, communities will need to self-regulate resource use. Demand-side approaches that focus on obtaining a consensus on aquifer use may have more success in the long run than technical supply-side or hardware-led approaches (UNESCO 2009).

In many public debates, declining groundwater levels or quality are cited as the main reason for the need for management action, but resource depletion and degradation are only part of the problem. In the rural to urban water market, a proper evaluation of the groundwater potential, and monitoring and regulation of extraction from villages are essential. Precise data on the status of groundwater resources is still not available in sufficient detail to make a comprehensive assessment. In the Chennai case, we have noted that the rate of groundwater extraction within the city exceeds the natural rate of recharge.

According to the Groundwater Estimation Committee norms, the utilisable groundwater recharge in the Chennai river basins is around 1100 Mm3, and the current net groundwater draft 770 Mm3. On this basis there is a substantial unutilized balance available for exploitation. However, this is not consistent with the field observation of a progressive fall in the groundwater table in the eastern part of the basin, and the fact that out of the 26 blocks outside the city agglomeration (where groundwater is already over-extracted) only 3 are rated ‘safe’, 13 as ‘semi-critical’, and 10 are ‘critical or over-exploited’.

Hence, a reassessment of the groundwater potential, the current rates of extraction, the use for various purposes including water market, and the trends in the water table is necessary. A more up-to-date estimate of the agricultural use, and the likely reduction in it as the urban sprawl spreads up the basin, is also desirable to determine whether, in fact, the unexploited potential is as large as 350 Mm3 (Vaidyanathan 2007).

The rural to urban water markets are increasingly common adjacent to large urban areas as well as medium-sized towns, and their impacts are also more significant. In spite of this, the water market is an important institutional mechanism to manage water scarcity in urban areas.

The experience from many parts of the country reveals that there are no formal water markets functioning in India (Diwakara & Nagaraj 2003; Moench & Janakarajan 2002; Nelliyyat 2010; Nisha 2008; Veeralakshmi 2009). Generally, marketed water is sourced from groundwater. Hence, the issues related to water markets should be handled from a groundwater management perspective.

This study highlighted various issues involved in groundwater transfer from rural areas to cities. The state has attempted to address this issue legally. The Chennai Metropolitan Area Ground Water (Regulation) Act, 1987 ‘envisages the control, regulation, abstraction and
transportation of groundwater in the notified area through (1) the regulation of existing wells, (2) regulation of the sinking of new wells, (3) issue of licenses to extract water for non-domestic use, and (4) issue of licenses for transportation through goods vehicles.

In Chennai, the majority of the villages involved in water selling may be located outside the metropolitan area, and come under the Tamil Nadu Ground Water (Development and Management) Act. This act aims ‘to protect groundwater resources to provide safeguards against the hazards of its over-exploitation and to ensure its planned development and proper management in the state of Tamil Nadu and matters connected therewith or incidental thereto.’

Notwithstanding these acts, the over-exploitation of resources has taken place. Water trading may violate the conditions prescribed in the above mentioned acts. The concerned Government authorities are also not strictly enforcing the acts or taking any serious action whenever someone violates the norms.

A more convergent and sustainable groundwater resource management will be achieved only through: (a) substantial investment in management operations on the ground, (b) working primarily through community consultation, and (c) a cross-sectoral policy dialogue.

Groundwater recharge processes are extremely complex, and there is still considerable uncertainty about their relationship with natural vegetation, land management, and groundwater use. While many specific local-scale recharge studies are available, the knowledge of the range of recharge modes across large river basins and their linked aquifers rarely comes together to form a systemic overview. For many heavily exploited aquifers, groundwater abstraction and use are still poorly quantified, and dedicated groundwater monitoring networks have not been established.

Instead, periodic observations are made of pumped wells, which give only an approximate measure and are completely inadequate for detecting the response to recharge events. Many cities are working ‘blind’ when they distribute water supplied from groundwater sources. In some hydro-geologic settings it is difficult to improve on the efficiency of the natural recharge processes, while in others, the economically feasible proportion of recharge enhancement over natural recharge is very limited, although techniques can help solve local problems and improve groundwater quality.

The highest management priority, though, will always be to protect the main recharge zones. Historically, the tanks that exist in urban and peri-urban Chennai act as recharge structures. Unfortunately, at present most of the tanks have disappeared or shrunk due to unscientific urbanization and encroachments.

In brief, market forces, which treat water as a commodity, offer an effective way of reallocating limited water supplies among competing users. Both the rights of the use of water and the actual volume of water can be exchanged in the market or transactions within regions. No doubt, this will facilitate better allocation of scarce water resources across different sectors, so that the overall development objectives could be achieved at a much faster rate. However, since the rural to urban water market is informal, groundwater resources have experienced over-exploitation, which has led to substantial environmental and socio-economic impacts in rural areas. Hence, appropriate steps have to be taken urgently towards sustainable rural to urban water transfer.

Management strategies

According to Narain et al. (2014), while conventional approaches to urban planning and rural development create a dichotomy between rural and urban areas, the concept of peri-urban raises questions both about the sustainability and equity dimension of urban expansion. The groundwater depletion issues in peri-urban villages due to the emergence of water markets (supplying to cities) is a typical case.

Unfortunately, due to the hidden nature of groundwater controlled by hydro-geological features, not much scientific attention has been given to understand the dynamics of its flow in space and time. In most cases the rural to urban water transfer takes place informally, and the demand-driven exploitation without considering its regenerative capacity may lead to a crisis.

Easter et al. (1999) examined the effectiveness of the market in allocating scarce water resources, and found that informal markets may be good for local level allocation (traditional irrigation system), but formal markets will be required for transaction between different regions and sectors.
The aquifer depletion related problems are also an intra-generational issue. Even if various groundwater management Acts are enacted, they are unlikely to be effective. Since water is used for productive or ‘lifestyle’ purposes in urban areas, it is appropriate to apply economic criteria to its allocation. But water pricing alone will not produce the necessary reallocation, since prices in many sectors do not reflect the underlying economic values, and there are many cases of market or service failure (UNESCO 2009).

Reallocation from a lower to a higher value use can be achieved by enabling the traditional markets as well as by applying administrative measures, creating formal water markets or trading water rights. In any case, society and the concerned authorities should set appropriate limits on transfers to protect third parties, the environment, and wider social interests.

Groundwater management deals with a complex interaction between society, the hydro-geological (physical) environment, and policy designs. Aquifers are exploited by human decisions, and over-exploitation cannot be always defined in technical terms. Groundwater is a ‘common pool’ resource, and has been typically utilized in an ‘open access’ framework. Here, the users have no incentive to conserve the resources for the future, and their self-interest always leads to over-exploitation.

In the case of groundwater, the establishment of some sort of water rights and a responsible system, specifying the withdrawal or entitlement of water, is crucial for the development and promotion of the water market in a much more formalized manner. Moreover, there are no institutional arrangements in place to: (a) govern water rights, (b) control the functioning of the informal water market, (c) effectuate pricing in the informal water market and (d) resolve conflicts. The introduction of a system of trading in water rights will provide opportunities for individuals who own water, to trade that property right to other potential users (Palanisamy 2008).

According to Shah, problems of groundwater over-exploitation in India are bound to become more acute and widespread in the years to come, unless corrective mechanisms are put in place before the problem becomes insolvable.

Lack of information and an absence of systematic monitoring of availability and withdrawal of groundwater are major barriers that prevent the transition from groundwater development to a management mode. Further, unlike in the case of surface water, public agencies have only an indirect role to play in the national groundwater sector, due to its development mostly in the private, ‘informal’ sector, and the quality and amount of application of science and management to this sector has been much less when compared to the surface water sector.

The present study clearly reveals the significance of groundwater for human needs and economic activities (urban requirement) as well as the consequences (rural activities), if the resource is over extracted. The challenge, therefore, is to supplement urban needs without affecting the village eco-system and economic activities. The groundwater extraction/transfer from villages should be within the limit of its regeneration. In this regard, the following suggestions are made:

- Proper mapping of the groundwater potential (both quantity and quality) in the water trading villages and estimates to be made of the aquifer regeneration level. This task may be carried out by the Groundwater Division of the State Public Works Department with the collaboration of the Central Ground Water Board. Since the agricultural water requirements are gradually going down in the peri-urban villages, a certain amount of water can be transferred to the city, keeping in mind the safe yield limits of the aquifer, and the ecological sustainability of the village.
- In the groundwater marketing villages, rainwater harvesting should be promoted. In this regard the concerned department should identify the appropriate spots for artificial recharge and build shafts. Moreover, natural recharge options such as tanks should also be activated through community participation.
- Since the Groundwater Acts are enacted in the State and the Chennai Metropolitan Areas, the norms specified in the acts should be strictly enforced in a way to regulate its over-extraction.
- Since the villagers are the cause and the victim of groundwater over-exploitation, proper co-ordination between them (water sellers and non-sellers) is required. In this, the local body (Panchayat) should take the lead in addressing the competing needs and ensuring village welfare.
- The Government should also think more about the economics of groundwater...
management. Apart from fines, penalties, water cesses, or charges, the Government can also think of ‘compensation and incentive strategies’ for preserving groundwater.

- Since the water supplied through tankers does not undergo any treatment before consumption, the quality of the marketed water should be assessed to safeguard the health of the urban community, the ultimate consumers of the marketed water. The wells located close to polluting sources should not be used as sources for water selling.

Conclusion

The study highlights the critical importance of groundwater, and the need for its sustainable management with respect to the rural to urban water market. Precious and renewable natural resources like groundwater play a significant role, particularly during the years of less rainfall or surface water scarcity. In areas where surface water irrigation does not exist or insufficient, groundwater acts as a source of irrigation and its dependency is multiplied even after rural electrification. With ever-increasing demands from new domestic and industrial areas, groundwater has become an important source. However, this precious resource is under threat due to over-exploitation and pollution. Hence, the need for a judicious use and management of groundwater is essential for sustaining human livelihood and the ecosystem.

In Chennai, the absence of a perennial source as much as an inadequate and uncertain public water supply has induced people to depend on groundwater. But at present, most parts of the city face groundwater depletion and degradation. Moreover, the overall urban demand has increased manifold. Hence, a considerable amount of groundwater has been transferred from peri-urban areas. In Chennai’s case, since the water market also acts as a supplementary option for public supply failure or deficiency, it is a highly uncertain and fluctuating process. Therefore, its impact in villages is not consistent but varies considerably, based on many factors, as observed from the case studies. All case studies clearly reveal that the water market, which transfers groundwater from the peri-urban areas to Chennai City, acts as an effective demand management option. Since groundwater is a renewable resource, the magnitude of water transfer and the duration of the market play a major role in determining the stock of the resources. If the volume of extraction or transfer is within the regeneration capacity of the aquifer and the extraction durations are short (few days), its ecological impacts are insignificant, as Somangalam village experiences.

However, the continuous extraction of groundwater in huge quantities for water market adversely affects the aquifer in peri-urban areas. Its socio-economic consequences show up in peri-urban areas through a reduction in agriculture and drinking water scarcity. Besides, the water market adversely affects the quality of the groundwater. Since those people who are involved in the water market, are benefitting (at the cost of others), the water market has certain externalities associated with its functioning and conflicts have emerged. The results from the Valliyur village and the villages under the Mambakkam mini-watershed in South Chennai substantiate these arguments.

Even if regulatory measures are in place, on most occasions they are ineffective due to political pressure and lenient action from the government or enforcement agencies. The fact is that the groundwater in peri-urban areas is a critical source in meeting urban requirements. Further, undefined property rights of groundwater hamper the authorities in taking appropriate and strict actions.

The Kannapalayam experience indicated that a planned water market is helpful for a win-win situation for the peri-urban villagers (providers of groundwater) and the urban consumers (users of groundwater). The spot of locations identified as sources for the functioning of water markets and the selection of wells matter a great deal. The study proved that constructing the wells in the vicinity of perennial surface water sources (rivers, check-dams, tanks, etc.) with avoidance of wells located in agriculture and residential areas for a water market is an ideal strategy.

The study of the four villages in this paper suggests that rural-urban water transfers through water markets can create conditions for conflicts also. This usually depends on the nature of the aquifers, the level of exploitation, and the persistence of water extraction. Since groundwater is an invisible resource with a lack of clearly defined and enforceable property rights, conflicts can be common, though they may take long to surface.

Though well functioning rural-urban groundwater markets can play an important role in meeting the urban supply-demand gap, they have serious local equity implications as they
deprive local communities of access to this resource. Thus these markets represent a process in which some individuals or groups lose access to groundwater to support the needs of others. Hence, these markets need to be studied from a justice and equity perspective as well, other than being seen as a mechanism to reallocate resources from low to high value uses. There are emerging local voices of dissent, though they take time to surface. In the end, though, the persistence of these sales suggests that local politics and power relations may have a greater role to play in this process.

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References


Packialakshmi, S., Ambujam, N.K. & Prakash, N. 2010. Groundwater market and its implications...
on water resources in the southern peri-urban interface, Chennai, India. Journal of Environment
development and sustainability, doi 10.1007/s10668-010-9269-1, Springer.

Packialakshmi, S. Ambujam, N.K. 2011. A hydrological and geological investigation on the
Mambakkam mini watershed, Kanchipuram district, Tamil Nadu. Environmental Monitoring

Palanisami, K. 2008. Water markets as a demand management option: Potentials, problems and
prospects. IWMI-TATA water policy program. International Water Management Institute
(IWMI) Hyderabad, India.

Planning Commission - Government of India. 2007. Ground Water Management and

Southern India. Peri Urban Water Security Discussion Paper Series, Paper No. 4,
SaciWATERs.


Shah, T. 1986. Groundwater markets in water scarce regions: Field notes from Karimnagar
district (Telengana), Mimeo. Andhra Pradesh, India: Institute of Rural Management, Anand.

Shah, T. India’s Ground Water Irrigation Economy: The Challenge of Balancing Livelihoods


Vaidyanathan, A. 2007. India’s water resources: Contemporary issues on irrigation. Oxford
University Press. 209-247.

Veeralakshmi, V. 2009. Water market in Chennai:

A study of water transfer from peri-urban villages - Kovilambakkam and Nanmangalam. M. E.
(IWRM) thesis. Centre for Water Resources, Anna University, Chennai.

World Bank. 2007. Making the most of scarcity: Accountability for better water management
results in the Middle East and North Africa. MENA development report. Washington DC.
Abstract

Literature in New Institutional Economics notes that organizing people for collective action is an uncertain and complex job. In the case of natural resources, uncertainties of knowledge exist. These can be reduced by blending scientific and local knowledge as indicated by Ostrom. The case study in this paper examines how the local knowledge system was replaced by a scientific knowledge system initiated by the British, in which knowledge was being governed by power relations. The paper discusses a case of decline of rainwater harvesting systems in urban Bikaner in the post-independent period, which had started in the colonial period in terms of change in knowledge of water management from the pre-British to the British period. It also emphasises how urbanization and a change in power relations have led to a decline of rainwater harvesting systems that used to be maintained by the community. These processes have also changed the governance structure for the maintenance of water harvesting systems.

Keywords

Common property resources, rainwater harvesting systems, knowledge, Bikaner, governance

Introduction

India lies in tropical/sub-tropical zones of the world that receive seasonal rainfall. Rainfall in India is concentrated in four months of the year and does not occur daily; it is also not evenly spread over a period of 24 hours. These are the reasons for the existence of diverse rainwater harvesting practices in the country. Rainwater harvesting (RWH) has been practised here since ancient times as a mode of adaptation to environmental conditions. This revealed an in-depth understanding by people of nature. However, in India, RWH is a ‘Dying Wisdom’, which refers to the fact that knowledge of the management of RWH has not been preserved (Agarwal & Narain 1997).

Literature in New Institutional Economics recognizes the importance of local community knowledge in maintaining resources (Ostrom 1990, 1992). Interestingly, this literature has developed based on cases of community-level governance systems, where communities have been able to preserve knowledge of such governance for many years.

Extensive work by Elinor Ostrom shows that the ‘tragedy’, the most commonly cited reason for destruction of common properties, is not as prevalent as believed by Hardin (1968), and various complex common properties exist in different parts of the world. Ostrom (1990) argues that the key mechanism to sustain Common Property Resources (CPRs) is communication between individuals. This ensures collective efforts to overcome free riding, and helps avoidance of destruction of those CPRs. The framework developed by Ostrom (1990) points out that a blending of various kinds of knowledge is important to reduce the uncertainties for governance of a CPR. However, the problems in blending such diverse knowledge systems are left unexplained. The current paper makes an attempt to analyse these complexities taking the case of water harvesting systems in Bikaner City, in Rajasthan, India.

It is well known that for many years, the dominant discourse on knowledge considered scientific knowledge to be rational, sequential and, therefore, superior to local knowledge, which was considered to be experiential and simultaneous (Dusek 2006). In such a situation power structure influences which kind of knowledge would be applied for problem solving (Bhaduri & Singh 2015). It has been argued that technology cannot be understood in isolation; rather, it must be seen in relation to the community and its practices (Layton 1974). Institutions play an important role in shaping the knowledge of the system (Lam 2000). Its production involves the application of physical and social technologies, which, in turn, requires the mediation of institutions (Eggertson 2009). This way, knowledge, technology, and institutions are interlinked.

Two major reasons may be attributed for the
erosion of collective action that has changed the intrinsic relationship of knowledge, technology, and institutions. First is the non-use of historical local knowledge in the post-independence period initiated in the British period. The latter period was characterized by several institutional changes in governance mechanisms, informed by a different set of knowledge parameters than what formed the bases of many water harvesting systems in India (Vani 2009). Second is the process of urbanization that started in the 1980s. It is argued that the erosion of RWH in Bikaner necessitates an analysis, to understand the complexity involved in sharing different kinds of knowledge. It is, therefore, important to understand the way various technological and institutional interventions have been taking place regarding water governance, and how prevailing power structures have shaped these processes.

There are five kinds of water harvesting structures that used to be practised in urban Bikaner, talaab, kund, kuan, kuin, and baori till the 1980s. Talaab, kuan, and kuin were practised as CPRs, while kund and baori were mostly managed as private resources. Since medieval times, Bikaner City was khalsa (State) land, the jurisdiction of which was under the state. People could buy land from the state, but the governance of rainwater harvesting system was with trustees of a particular caste, who appointed a priest of the talaab, which also used to have a temple on its premise. Joshi (2006) attributes two major reasons for the decline of RWHs in Bikaner: the pipeline supply of water to the city and encroachment of catchment areas of the talaab. Migration of people from rural areas to urban areas in search of livelihood as also failed government handling of such activities has led to such increased encroachment.

The Census of 2011 reports an increase of urbanization from 2001 to 27.81% to 2011 (31.16%). The urban population in India has increased from 28.6% in 2001 to 37.7% in 2011 census (Chandramouli 2011). The number of towns in India has increased from 5161 in 2001 to 7935 in 2011 adding 2774 new towns. In India the degree of urbanization increased from 17.3% in 1951 to 27.8% in 2001, and up to almost 38% in 2011 (See Table 1).

Table 1. Number of urban agglomerations/towns and population by residence in India: 1901-2001

<table>
<thead>
<tr>
<th>Census year</th>
<th>Number of towns/urban agglomerations</th>
<th>Urban population</th>
<th>Urban population as % of total population</th>
</tr>
</thead>
<tbody>
<tr>
<td>1901</td>
<td>1830</td>
<td>25,851,873</td>
<td>10.8</td>
</tr>
<tr>
<td>1911</td>
<td>1815</td>
<td>25,941,633</td>
<td>10.3</td>
</tr>
<tr>
<td>1921</td>
<td>1944</td>
<td>28,086,167</td>
<td>11.2</td>
</tr>
<tr>
<td>1931</td>
<td>2066</td>
<td>33,455,989</td>
<td>12.0</td>
</tr>
<tr>
<td>1941</td>
<td>2253</td>
<td>44,153,297</td>
<td>13.9</td>
</tr>
<tr>
<td>1951</td>
<td>2822</td>
<td>62,443,934</td>
<td>17.3</td>
</tr>
<tr>
<td>1961</td>
<td>2334</td>
<td>78,936,603</td>
<td>18.0</td>
</tr>
<tr>
<td>1971</td>
<td>2567</td>
<td>109,113,977</td>
<td>19.9</td>
</tr>
<tr>
<td>1981</td>
<td>3347</td>
<td>159,462,547</td>
<td>23.3</td>
</tr>
<tr>
<td>1991</td>
<td>3769</td>
<td>217,551,812</td>
<td>25.7</td>
</tr>
<tr>
<td>2001</td>
<td>4378</td>
<td>285,354,954</td>
<td>27.8</td>
</tr>
</tbody>
</table>

Source: Census, 2001
Bikaner is among the top hundred populations of urban agglomerations in India (Urban India 2011: Evidence). The urban population in Bikaner is 23,63,937 (Census 2011) with urban population of about 34%. The decadal growth in 1991-2001 was 38.18% (Rajasthan Development Report 2004), while the decadal growth in 2001-2011 was about 25% (Census 2011) in Bikaner.

Bikaner district is located in the north-western part of Rajasthan. The climate is arid with a high temperature and high evaporation losses. The mean annual rainfall (1971-2005) there is 297.7 mm, and (1991-2010) is 277.55 mm whereas normal rainfall (1901-1971) is lower than the average rainfall and placed at 257.8 mm. Almost 90% of the total annual rainfall is received during the south-west monsoon, which enters the district in the first week of July and ends in September. The temperature varies from 48 degrees in summer to 1 degree in winter (Sehgal, 1972).

Governance of CPRs: A conceptual framework

According to Ostrom (1990), at the most general level, the problem of CPR appropriators is institutionalizing ‘organization’. In other words, to change the situation from one in which appropriators act independently to one in which they adopt coordinated action interdependently, to obtain higher joint benefits and reduce joint harm. To achieve coordinated action, three basic problems need to be addressed: supply of new institutions, credible commitment, and mutual monitoring.

The new institutions supply rules, which apply at the level of operational, collective choice and of constitutional choice. Operational rules solve problems of credible commitment and mutual monitoring, which shape the provision of and appropriation behaviour to CPR. Both credible commitment and mutual monitoring depend on a host of factors. These are expected benefits

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1 Talaab is a deep, rainfed, well-designed and constructed reservoir, surrounded on all four sides by high masonry walls, holding enough water for the year round. Many of these constructions are made five to ten metres deep and have banks for different purposes like bathing, washing, cattle, and aesthetic purpose. The catchment area of a talaab is usually a large area and used to have medicinal varieties of trees planted in it.

2 Kund is a tank or reservoir in which rainwater is collected for drinking. Water from the catchment area is collected into the tank through a sieved inlet.

3 Kuan is a well with diameter of 4 to 100 hands. 4-100 is a huge range and would include kuins as well?

4 Kuin is a well with a diameter of 4 to 8 hands.

5 Baoris are ponds in which water is reached by descending a set of steps. In Bikaner, the catchment area usually has a kund, whose outlet is connected to the baori.

6 An informal discussion with a retired research officer of Bikaner Archives, Rajasthan.

7 http://www.cgwb.gov.in/District_Profile/Rajasthan/Bikaner.pdf
and costs, internal norms, and discount rates\(^8\) of a society. When appropriators are physically and economically secure at present, the discount rate is likely to be high. If the present generation maintains the resource system by quantity and quality, their discount rate falls to low level, because they are assured that their progeny will be deriving gains from this well-maintained system. Further, when a person has strongly internalized a norm, she or he feels ashamed when a personal promise made, that is, a commitment is not kept. If a norm is shared with others, that person is subject to social censure if she or he has done something wrong. The norms of a group are also a factor in measuring the commitment of people. So, in the context of CPRs, shared norms of behaviour compel people to work for a CPR. Since CPR settings extend over time and people adopt internal norms all the time, it is possible for individuals to utilize contingent strategies\(^9\) in relation to one another. The benefit people get from working for a CPR, apart from economic gains, is a good practical knowledge of the system, which is helpful for its long-term maintenance. Also, the commitment of people to maintain a CPR will be high without the presence of external enforcers. The commitment issue is linked with mutual monitoring aspects: people are likely to be committed to work for a CPR, when mutual monitoring takes place. On the other hand, this may not be always true; people may also be committed to work, when shared norms of the group are rigid (Ostrom 1990).

Ostrom (2000) discusses five ‘bundle rights’ to define rights on properties, that is, when a group of people hold these rights. The rights refer to access, withdrawal, management, exclusion, and alienation. Accordingly, there may be five types of stakeholders. They are authorized entrants, users, claimants, proprietors, and owners. If in addition to collective-choice rights of management and exclusion, individuals also hold the right of alienation -when they can sell or lease their collective-choice rights-, they are defined as owners (Ostrom 2000). With respect to CPRs an individual or community often has rights of access, withdrawal, management, and exclusion for the management of such resources. They can exclude other individuals/communities from using the resource, but they do not have alienation rights on it. In the literature on bundle rights, it is generally assumed that owners have the authority to sell or lease a CPR. This would reflect ownership of the land as such. Also, being ‘owners’ automatically meant being in possession of all four ‘common’ kinds of rights (access, withdrawal, management, exclusion) as well as the right of alienation.

**Characteristics of knowledge**

Knowledge-based resources are seen as drivers for their successful management. Governance of natural resources does require management of local knowledge, which is uncodified or tacit in nature. Dusek (2006, 157-159) discusses that, Western colonial powers often dismissed indigenous technology and logical knowledge, only to replace it with techniques less efficient and effective in the tropical, arctic, or other environments.

Dusek (2006) further argues that Western science is also a kind of local knowledge. Both Western science and local knowledge are local knowledge systems to be evaluated on their own merits, especially with respect to applicability to local conditions. It is worth mentioning that the process of synthesis of conflicting knowledge depends on power relations and there is no knowledge that does not presupposes power (Bhaduri & Singh 2015). When knowledge is produced by an external actor and imposed on a group, it can become biased and negatively influence the indigenous knowledge of people (Akena 2012).

In Bikaner, one may already observe an intervention of this Western scientific knowledge system in the Gang Canal Project in 1927 by the British. It substantiates the point that the colonial administrators saw themselves as bringing in genuine knowledge and replacing local knowledge considered primitive. The governance of RWHS in the pre-British period depended on the authenticity of community knowledge. This

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\(^8\) Discount rates are affected by the range of opportunities an individual has or may have outside any situation. Individuals by nature attribute less value to benefits they expect to receive in the distant future and more to those expected immediately. It means that individuals tend to discount future benefits and are attracted more to present gains. Moreover, discount rates applied to future yields derived from a particular CPR differ across various types of appropriators. This is because discount rates are affected by the levels of physical and economic security faced by the appropriators.

\(^9\) ‘Contingent strategies’ refers to a whole class of planned actions that are dependent on given conditions.
overlapped in the British period with their scientific knowledge system, while post-independence British policies were followed with respect to the management of resources (Vani 2009). This, perhaps, has led to a decline of RWHs. An analysis of the case is presented after the next section.

Methodology

Qualitative research followed by the case study method (Gerring 2004) including grounded theory (Strauss & Corbin 1998) was used in the study. A qualitative semi-structured interview schedule was used to collect information regarding water harvesting systems in 5 field visits. Fieldwork was done exclusively in urban areas of Bikaner. Respondents were selected from diverse backgrounds, who were well experienced with the system. Key informants were academicians who had worked in the area, historians and research scholars still working in the area, activists who had worked for water harvesting systems, and archivists. The researcher was awarded precise information by most of the respondents about things pertaining to the problem of RWH and water issues as such. Apart from this, a visit to the Bikaner State Archives helped in collecting some records on water harvesting, called Kamthana bahis¹⁰. The bahis were mostly consulted that pertained to the period from the 17th to the late half of the 19th century. In addition, the Kagad bahis provided basic information about the land revenue system, methods of assessment, relations between tenant and landlord, and the mode and machinery of revenue realization, especially of khalsa land in the 18th and 19th centuries.

Governance of Rainwater Harvesting System in Bikaner: an analysis

The discussion mainly refers to the pre-British period, but continues into the British period. Literature on the governance of commons points out that the understanding bundle rights is important for the maintenance of CPRs held by individuals or groups. In Bikaner, the rights to access, withdraw, manage, and exclude were held by the particular community or caste to which a RWHS belonged¹¹. The people of that community or caste could decide whether to access the RWHS for an aesthetic purpose or to withdraw from it. They contributed to provisioning activities, which were a part of management rights. They could not exclude anyone from the RWHS from the above-mentioned four rights, because water was considered sacred. So, the right of alienation did not lie with them. In Bikaner, a number of talaabs and kuans existed, and people living in the vicinity of these structures were involved in their maintenance. These were not necessarily people of a particular community. Usually, though, people from far-off places would not come and do it; they would rather help in the maintenance of structures close to their own homes. Although, as a community, people could exclude other communities from accessing their talaab or kuan, they seemed not to have been doing so, because of a social norm that considered it appropriate to let everybody access water.

There were several factors which led to a credible commitment by people for the provisioning of RWHS. The first was the lack of rainfall and extreme dryness of the region. People themselves were committed to work, since there was an extreme water scarcity, and the only sources of water were these water-harvesting systems. Also because water was considered sacred¹². The maintenance of talaabs, etc. in Bikaner was age-old. There were no formal rules people were supposed to follow in maintaining them. They had a sense of duty as also a need to maintain the structures, which was their major motivation. The concept of voluntary contribution of labour, which existed in their community for CPR maintenance, was called shramdan. Sometimes maintenance activities like cleaning and digging of mud for wells, etc., or provisioning activities for these structures, 

¹⁰ These bahis provide information about various types of artisans and skilled labourers, who were deployed on various construction and repair works. They also contain information about the wage structure of the artisans' class and details on artisans who came from other places like Jaipur, Marwar, and the Deccan. The bahis throw light on the source of various building materials e.g. murad (meaning?), chuna (lime), bajari (gravel), bricks, stones as well as water colours, and their prevalent market rates. Further, they contain information about the mode of transportation of building material from the points of origin or supply up to the construction site.

¹¹ It is also in order to point out that access and withdrawal rights may mean the same thing in water harvesting. In other words, access would automatically imply withdrawal (consumption) of the same resource.

¹² An informal discussion with old people of Bikaner.
required labourers and people of different professions. Funding was then provided by the ruler of Bikaner (Kağad bahi no. 50). Since people always benefited from getting involved in such kinds of activities, provisioning frequently prompted dependent action from them by reducing their discount rate. Consequently, more people would come and work for provisioning activities of RWHS. For instance, Kamthana bahi no. 8 discusses the maintenance of the Amarsar well. A tank beside it was constructed for which around Rs. 33 was invested. 94 labourers were employed for this work which included a number of castes. The information in the bahi notes that the payment was not based on caste. Every labourer was given equal payment. Untouchables were not allowed to enter the talaab and work for provisioning activities.¹⁴, though.

Most of the times in Bikaner city, graduated sanctions were not imposed on people who were not involved in provisioning activities, because the work was funded by the ruler. The appropriators in Bikaner were committed to contribute to provisioning activities, because they realised it was in their self-interest to work for RWH.¹⁵ Ostrom says that an appropriate monitoring mechanism is necessary to achieve credible commitment. Some individuals who created institutions, mutually committed themselves to follow rules and monitored their own conformance to their agreements as well as their conformance to the rules in a CPR situation (Ostrom 1990). In the present case, no mutual monitoring mechanism for provisioning activities was required, because people were given incentives for provisioning activities for RWHS, at the places where the work was funded by the ruler.¹⁵ People, who participated in the construction of an RWHS, were also involved in maintaining it. The benefit they gained, was the knowledge attained during construction of the RWHS. This helped them in the long term to manage the systems and reduce their discount rate. In Bikaner, water scarcity in the region raised a fear in the community about the possibility of water shortage, making them more involved in provisioning. Also, the notion that water is sacred made it easier for people to come together and work for it.

This paper mainly refers to the post-independence period. It may be argued that knowledge of RWHS was preserved till the early 1980s, since pipelined supply of water was not there and people were bound to work for RWH. The decay of knowledge became evident with urbanization of Bikaner in the 1980s, when encroachment of the catchment area of the RWHS began. During the British period, the British did not have any interest in demolishing or taking control of the RWHS, because the area did not have good crop yield and, therefore, did not generate revenue for them. Since Bikaner was not a revenue generating area because of being in a dry region of the country, the British government proposed to bring the area under irrigation by introducing the Gang Canal Project in 1927. However, they never interfered with people in the governance of the local RWHS. The Gang Canal Project, provided easy access of water to people for irrigation. Subsequently, the Rajasthan Canal Project, initiated in the 1970s, provided drinking water to people. These events broke the credible commitment of people to the provisioning of an RWHS. They gradually stopped working for an RWHS in areas where they could get access to water for irrigation from the Gang Canal. This cancelled out the management rights of communities. Gradually, the knowledge that existed in the community about maintenance of these systems got lost and people never tried to revive these practices because of easy access to water. Since they were getting benefits from the Gang Canal Project, they gradually stopped with provisioning activities. The introduction of a new scientific knowledge system in the form of the Gang Canal discounted future gains of the people. And so, this new knowledge system may be understood as a reason for the removal of access, withdrawal, and management rights of communities with respect to the RWHS. All this broke the commitment to work for provisioning. Further, migration of people from rural areas to Bikaner City as much as encroachment of the catchment area of the talaab from the 1980s by these migrants was mentioned by respondents as major reasons for the decline of these systems. The encroachment of catchment areas was especially serious, when people began cutting different varieties of trees and herbs which had medicinal value, but which disrupted the water

¹³ The primary reason being the shared norm of their society that considered water sacred and that it should be shared with everyone. One cannot rule out self-interest driven action here as well. People in their private lands share water only when there is adequate rainfall.

¹⁴ One can argue that the actions of the villagers are in line with what Olson had suggested. For him, smaller groups can organize collective actions, which jointly optimizes their self interest more easily than large groups.

¹⁵ An informal discussion with a researcher in the archive of Bikaner.
flow into the water harvesting systems. All these areas have been now captured by people and houses have been built. The government also did not take any initiative to save the catchment areas from encroachment; worse, it regularized these lands to people who had captured it for more than 5 years (Sehgal 1972).

Conclusion

This paper has discussed two major reasons for erosion of collective action which changed the relationship existing between knowledge, technology, and institutions. The first is replacement of the local knowledge system of water conservation by a scientific knowledge system for water supply initiated in the British period and continued post-independence (the Gang Canal Project followed by the Rajasthan Canal Project). The second is the urbanization of Bikaner, which accentuated around the 1980s. The colonial perception of knowledge perhaps relied on the belief that scientific knowledge was universal, objective, and deductive, and therefore can be applied in all situations and contexts. This unequal power relation also acted as a barrier to the synthesis of the two types of knowledge. When the British idea of universal scientific knowledge started spreading (Gang Canal Project in Bikaner in 1927), the shared knowledge of people gradually disrupted and people were not motivated anymore to work for RWHS in Bikaner. They rather focussed on individual benefits. In Bikaner, we observed that the Rajasthan Canal Project provided a pipeline system of water supply, which made people selfish, and they never got involved in the maintenance of RWHS. Since there was no government interference, no one took care, when decline of these systems started in Bikaner. So, we note that a technological intervention can lead to a change in institutional structure where collective action became unnecessary. Moreover, urbanization of Bikaner, especially in the catchment areas of the RWHS, and negligence of encroachment activities by the government from the 1980s was noted as the major reasons for the decline of these systems. Apparently, knowledge of construction and management of RWHS has not been preserved in Bikaner. Still, some of these systems exist in villages, but they are not properly maintained, because people responsible for their maintenance have been involved in other jobs. The demise of RWHS in urban Bikaner is a cause for concern, as these urban commons are critical to cultural vibrancy and community bonding, which had made people learn how to defend their collective resources for a long time (Gidwani & Baviskar 2011). Western scholars consider urban commons as non-excludable and non-depletable public goods (O’Brien 2012), while in the case of India, wells, ponds, and other water bodies -which have been an integral part of the community in rural as well as urban areas-have been considered depletable resources similar to Hardin (1968). ‘Urban ecological commons play an important role in making cities sustainable, providing spaces for community mobilisation and social capital and encouraging social integration’ (Mundoli, Manjunath & Nagendra 2014). The literature on urban commons in India discusses that urbanization, land acquisition, and real estate development have played a significant role in the depletion of CPRs. These studies on erosion of lakes in Hyderabad (Prakash), Bangalore (Nagendra & Ostrom 2014) and role of caste domination in reducing access of peri-urban communities to the CPRs in Gurgaon (Vij & Narain 2015) suggest that the reasons for the decline of the CPRs in Bikaner (Joshi 2006) are similar to the reasons of decline in Hyderabad and Bangalore. Urbanization is linked with the governance of commons. Cities in India had a large number of water bodies to cater the daily needs of different user groups. Most of these are now in a state of decline at many places. The literature on the management of urban commons needs to be further developed in the context of India, where community managed CPRs have been an integral part of society for a long time in urban areas of the country. At places where revival attempts have been made, the local knowledge of people has not been adopted by the government or Non-Government Organizations.

In this paper we have discussed that the analysis of commons shows a relationship between knowledge, institutions, and technology. Revival of these systems will require revival of the knowledge systems associated with them, given

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¹⁶ An informal discussion with Mr. D. L. Chagani, an activist who tried to save the catchment area of Sansolava talaab in Bikaner.
¹⁷ The dependence on piped water supplies resulted in decline of johads in Morni-Shiwalik Hills of North-west India (Narain 2014).
¹⁸ A discussion with a villager of Gangapura village
¹⁹ Interview with Mr. Harishankar Goyal, lawyer and an activist in Alwar, Rajasthan.
that institutions and technology are studied in close relation with the knowledge of the system. There needs to be intervention by the government as also by the local people to remove encroachments from the catchment areas, and proper urban planning should be done by the government to revive the RWH in Bikaner.

Acknowledgments

This paper is a part of my doctoral research. I sincerely acknowledge the many insightful discussions I had with Saradindu Bhaduri on the structure and content of the paper. I would like to express my gratitude to him for guiding me in writing it.

References


Bahi No. 9. 1829 V.S. 1772 A.D. Kamthana Bahi (Bikaner). pp.18 (1,2).


Kamthana Bahi no. 8 V.S. 1829 p. 113(2).

Kagad Bahi no. 50 V.S. 1900 p. 113.


Abstract

Sri Lanka faces a number of waste-water issues and water related health hazards due to inappropriate disposal of sewerage to water bodies. Hence, proper treatment and disposal of sewerage is of utmost importance to control waste-water issues and water-born diseases.

As a solution, small-scale sewage treatment plants (STPs) have been constructed in a number of places in Sri Lanka. However, there are several concerns about the appropriateness and effectiveness of such small-scale STPs, since water-born health hazards continue to increase. Therefore, as an alternative, large-scale centralized sewerage treatment systems have been proposed, since they are considered technically effective. However, large-scale centralized systems have major concerns regarding feasibility of sewerage treatment with respect to their operation and maintenance, and financial and socio-economic aspects.

This study was carried out (i) to evaluate the performances of 8 small-scale STPs managed by different agencies such as the government, private sector, and community-based organizations, and investigate the reasons behind satisfactory/unsatisfactory performance, and (ii) to study the feasibility of a centralized STP system that had been proposed for Kandy City.

The performance of the 8 small-scale STPs was evaluated using a check list that consisted of 109 performance indicators under five categories - general, technical, physical, personnel, and operation & maintenance (O&M). In addition, focused group discussions, and formal and informal discussions with beneficiaries and other stakeholders were carried out.

A comprehensive economic analysis was conducted to investigate the feasibility of a centralized, large-scale STP proposed for the city of Kandy. Sensitivity analyses were also carried out with different discount rates, tariff rates, and payment scenarios.

The results showed that only 2 out of 8 STPs, which were operated by private agencies, performed well. Though 4 out of 8 STPs had higher scores for physical and technical aspects, they scored poorly in personnel and O&M. This indicates that the construction of technically sound STPs does not necessarily guarantee its success, while the institutional aspect appears to be more important.

Recruiting trained personnel and providing them with responsibilities is required for a better performance of STPs. The most promising approach would be to handover such a system to a competent organization.

According to the economic analysis, the proposed large-scale, centralized STP is not financially feasible at the rate of the sewerage tariff proposed by the National Water Supply and Drainage Board, and the breakeven tariff rates are much higher than the proposed rates.
The project becomes economically feasible only if enormous expected benefits are to be accrued from tourism and increased land values.

It appears that for sewerage treatment in Sri Lanka small-scale decentralized STPs with an improved institutional arrangement including well-established procedures of O&M and qualified personnel are more suitable than large-scale centralized STPs.

**Key words**

Sewage treatment plant, waste-water, sanitation, performance, institutions

**Introduction**

Even though water supply, sanitation, and hygiene conditions are highly satisfactory in industrialized countries, the situation is alarming among most of the developing countries. Over one billion people in the developing world do not have access to a minimal amount of clean water and deprivation in sanitation is even more widespread. Half of the developing world’s population (i.e. 2.6 billion people) does not have access to basic sanitation (HDR 2006). As a consequence, worldwide about 1.7 million deaths per year occur-90% of which are children-, mainly through infectious diarrhoea due to unsafe water, poor sanitation and hygiene. In other words, access to sanitation, the practice of good hygiene, and a safe water supply could save 1.5 million children a year (World Bank 2008). Many health hazards in developing countries and transition-economic countries are related to poor water quality and limited water quantity (Vandeweerd et al. 1997).

Septic tank treatment systems have been accepted as an efficient practice for sewage (black water) treatment over the years, despite rapid urbanization and concentration of population in main cities and suburbs, which limit the space for individual systems. Currently, there is a growing concern of the impact of sewage contamination of inland water bodies such as streams, rivers, and lakes, hence waste-water treatment is receiving greater attention.

According to Vandeweerd et al. (1997), more than 90% of sewage in the developing world is discharged directly into rivers, lakes, and coastal waters without any treatment. The typical domestic waste-water treatment system is a centralized municipal-sized facility that treats waste-water to specified discharge limits, to protect human health and the environment (Bradley et al. 2001). As a result, centralized sewage and waste-water treatment and disposal systems, commonly known as sewage treatment plants (STPs) have come up (Gijzen 2001).

Sri Lanka also faces a number of water and waste-water issues and water-related health hazards (WHO 2000). Nawas et al. (2005) reported that access to clean water and adequate sanitation facilities is a great challenge in highly populated areas. This can be primarily attributed to sewage and silage disposal (Bandara 2003; Sally et al. 2006).

The larger cities such as Colombo, Galle, Jaffna, and Kandy have serious problems in managing large quantities of sewage, industrial effluents, and industrial and domestic solid waste, because no proper treatment and/or proper disposal facilities are available (Bandara 2003). A report by UNEP (2001) estimated that each day in the Colombo Metropolitan Region 428 metric tonnes of sewage are released into the ground through septic tanks and pit latrines, and 138 metric tonnes of sewage are released into natural waterways.

Kandy area suffers from a serious problem of waste-water disposal leading to indiscriminate pollution of the Mahaweli River, the main source for drinking water supply. There is no proper system of waste-water disposal, and about 80% of used water is released as waste-water without any treatment (Thrikawala et al. 2008). In addition, highly polluted water is being carried by tributaries like Meda-ela, Pussella Oya, and Pingaoya to the Mahaweli River (Dayawansa 2006). The Pussallawa Oya sub-catchment of the Mahaweli watershed was the main source area for the ‘Hepatitis A’ outbreak recorded in Gampola in May 2007 (Abeyesinghe 2007).

A recent study conducted by Rajapaksha et al. (2008) showed that comparatively higher pollution levels were found at outflow points in Pussallawa town due to the unavailability of onsite sewage treatment facilities and the mismanagement of waste-water. Rajapaksha (ibid.) also reported that onsite sewage treatments are not possible in Pussallawa town especially in view of limited land availability.

There are a number of STPs that have already been established in Sri Lanka. However, the efficiency of treatment and the success of these systems have been consistently questioned and debated. The general impression is that most of these STPs are not functioning well.
An evaluation study conducted by Sudasinghe et al. (2011) has shown that their success, efficiency, and sustainability depend on several factors such as technology used, physical conditions, operation and maintenance, and work force.

In the meantime, a large-scale STP has been proposed for Kandy City to ensure health and sanitation of the local community and preserve the environment. The proposed system for the Kandy Municipal Council (KMC) is a large project with an establishment cost of 14 billion rupees and monthly O&M costs of 11 million rupees. It is, therefore, important to assess its feasibility and propose strategies that need to be considered during its implementation.

In this context, this study was carried out

(i) to evaluate the performances of eight small-scale STPs, which are representing different locations and conducting operations and maintenance by different agencies such as the government, the private sector, and community-based organizations, and investigate the reasons behind any satisfactory/unsatisfactory performance, and

(ii) to study the feasibility of the centralized STP system that had been proposed for Kandy City.

**Methodology**

A total of eight STPs representing different locations and management organizations such as the government, private sector, and community-based organizations were selected for evaluation. Initially, a situation analysis was carried out using Participatory Rural Appraisal (PRA) tools such as transect walks, social mapping, field observations, and Focus Group Discussions (FGD) with women groups, youth groups, office bearers, and technical groups in O&M.

Key informant interviews with several stakeholders were held to gather information on STPs. They included government officers from the Mahaweli Authority of Sri Lanka, managers of sewerage treatment division of NWSD in Rathmalana and Kandy, field engineers of STPs, the officer in charge of O&M of STPs, STP operators, and office bearers of a CBO in Raladinugama.

During these discussions, data were collected on available STPs in Sri Lanka, funding agencies, problems faced during operations, responsibilities of operating staff, and major constrains of STPs in the society. In addition, a survey based on a questionnaire was conducted. Past studies and guidelines from reports of the Central Pollution Control Board, Ministry of Environment & Forestry Board in India and China (Boller 1997; Mins 1996) were used to develop 109 performance evaluation criteria under five categories. They were termed ‘general’, ‘technical’, ‘physical’, ‘personnel’, and ‘operation and maintenance’ (Sudasinghe 2010; Sudasinghe et al. 2011). A checklist survey with these 109 variables was completed for each STP. Observations were made during field visits and discussions were held with officials who operated the STPs. Responses of the communities served by a particular STP were recorded, and O & M data and documents such as project proposals, designs, and O & M manuals were consulted.

An index was finally calculated, based on the percentages of good practices out of the total criteria identified. The index provided information on the performance of an STP for each of the five performance criteria described above. The observed status of five criteria was compared with an ideal status and a combined score was used to decide whether the performance was ‘good’, ‘satisfactory’, or ‘poor’. If an STP met more than 70% of the criteria (or the index had > 70), the performance was considered ‘good’. Index values of less than 50%, and between 50% and 70% were considered ‘poor’ and ‘satisfactory’, respectively. The overall performance was determined by dividing the number of better performing criteria observed by the total number of criteria that included as.
performance indicators in the checklist (Sudasinghe 2010).

The study also evaluated the financial and economic feasibility of the proposed centralized STP for Kandy using an extended cost-benefit analysis. The analysis used secondary data on monthly water consumption of the Kandy municipal area from the NWSDDB and the estimates of costs and benefits of a feasibility study of the proposed STP conducted by a so-called Special Assistance for Project Formation (SAPROF) team under Japan Bank for International Cooperation (JBIC).

The analysis assumed eight years for the construction period and 30 years for the project period. It used an Excel spreadsheet, and sensitivity analyses were done for different discount rates and values of environmental benefits.

### Results and discussion

#### Overall Performance of Sewage Treatments Plants

Summary of results obtained during the evaluation of selected STPs are given in Table 1'. According to results, the overall performance of each five criteria tested for the eight STPs scored more than 50% indicating that the STPs were conceived and designed appropriately. The physical status in general was found to be satisfactory. The problem appeared to be in the area of recruiting competent, trained personnel with responsibilities to look after daily O&M. It was found that most officers responsible for managing the treatment plant did not possess the required knowledge on chemical treatment. They were not aware of its importance to eliminate health hazards and prevent environmental problems.

One may conclude that substantial investments in construction of STP do not necessarily help to treat sewage and dispose of in an environmentally friendly manner. There should be a strategic approach to develop the required man power in Sri Lanka in the area of sewage treatment.

Results reveal that two STPs managed by private organizations showed good performance indicating that institutional aspects are more important than technical designs and physical status. For example, the STP at the Faculty of Dental Sciences was built under a Japanese grant (from Japan International Cooperation Agency (JICA)) with the supervision of foreign experts, and the current physical status of the STP is ‘good’ with an index value of more than 90%. However, the non-availability of trained, responsible personnel for its management has led to an overall ‘poor’ performance.

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¹ The detail results are given in Sudasinghe et al. (2011).

### Table 1. Performance (%) of selected STPs based on five major criteria studied

<table>
<thead>
<tr>
<th>STP [O&amp;M by]</th>
<th>General</th>
<th>Technical</th>
<th>Physical</th>
<th>Personnel</th>
<th>O&amp;M</th>
<th>Overall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raladinugama scheme [C]</td>
<td>34</td>
<td>24</td>
<td>66</td>
<td>47</td>
<td>17</td>
<td>33</td>
</tr>
<tr>
<td>Zoysapura scheme [G]</td>
<td>49</td>
<td>33</td>
<td>55</td>
<td>12</td>
<td>46</td>
<td>45</td>
</tr>
<tr>
<td>Suwasewana hospital [P]</td>
<td>34</td>
<td>81</td>
<td>96</td>
<td>37</td>
<td>60</td>
<td>70</td>
</tr>
<tr>
<td>Hantana scheme [G]</td>
<td>66</td>
<td>80</td>
<td>36</td>
<td>37</td>
<td>23</td>
<td>48</td>
</tr>
<tr>
<td>Digana village [G]</td>
<td>50</td>
<td>33</td>
<td>72</td>
<td>1</td>
<td>23</td>
<td>26</td>
</tr>
<tr>
<td>Raddolugama scheme [G]</td>
<td>83</td>
<td>48</td>
<td>57</td>
<td>25</td>
<td>40</td>
<td>39</td>
</tr>
<tr>
<td>Earl’s Regency [P]</td>
<td>50</td>
<td>76</td>
<td>86</td>
<td>75</td>
<td>78</td>
<td>72</td>
</tr>
<tr>
<td>Dental Faculty [U]</td>
<td>34</td>
<td>67</td>
<td>92</td>
<td>25</td>
<td>80</td>
<td>47</td>
</tr>
</tbody>
</table>

Source: Performance evaluation of 8 STPs based on the checklist
The above example, however, should not imply that only the private sector may have capable personnel and the competence to manage an STP. There are a number of constraints, though, that government institutions experience in managing STPs. Inadequate allocation of funds for O&M, lack of required trained personnel, difficulty of getting the required work done due to many institutional and political reasons, and lack of accountability to the client are some of the major constraints. They also lack a proper plan for O&M, rehabilitation, and replacement.

Most STPs managed by government organizations are now over 20 years old and are reaching the end of their useful lives such as the Zoysapura STP and the Digana stabilization pond system. In general, the life time of a STP is set at 30 years (Tchobanoglous et al. 2003).

Another major problem government managed STPs are facing is the pressure of providing additional connections exceeding the capacity of the STP. Some of these are given illegally to new households, which are outside a particular housing scheme. These extra connections cause overcrowding of the designed capacity of the STP leading to malfunctioning of the treatment process. As a result, the STP releases partially treated or raw sewage into the environment. As observed during the study, partially treated STP effluent has polluted water resources due to a high concentration of organic matter. More so, overflowing of STPs due to malfunctioning of the treatment process has, in some instances, created conflicts within the community.

Handing over responsibilities to community-based organizations (CBOs) appears to be a bad practicewith respect to Raladinugama STPs, since they neither have trained personnel nor the required institutional capacity. Health hazards and conflicts within the community due to the overflowing of untreated sewage and resulting bad odour are some relevant examples, taken from the Raladinugama housing scheme that is managed by a CBO especially established to manage it.

Important aspects in establishing an STP

This section briefly describes some of the essential criteria to be considered in establishing a properly functioning STP based on the observations in the study. They are discussed as technical, socio economical, and institutional aspects.

Technical aspects

Foul odours and the resulting negative impacts from waste-water collection and treatment plants are a primary concern for many communities served by the STPs under study. Raladinugama and Hantana STPs produce a highly concentrated bad odour due to the anaerobic condition in collection tanks.

Strict rules and regulations from the Ministry of Environment are required to control odours and nuisance conditions in an STP. It has been reported that bad odour from STPs could cause health issues, environmental degradation, property devaluation, and on overall quality of life (Witherspoon et al. 2002). Each O&M agency of STPs should prepare an odour management plan to a) identify the sources of odour, 2) find failure of the treatment process leading to problems associated with it, 3) take action to reduce odour and implement the measures, 4) keep records and settle complains from the community.

Sewage overflow from STPs enhance the contamination of soil and water resources. Frequency and volume of sewage overflow from an STP should be assessed to address this problem. In this regard, it is necessary to design and upgrade the collection system with an increasing number of connection tanks to avoid overflow. Sewage overflow is found to be a common experience at Zoysapura STP, especially due to flooding in the surrounding areas.

The treatment nature of a STP will be changed from time to time due to new connections with industrial waste-water and varying waste-water coming from different industries affecting the performance of the STP.

The Raddolugama plant had been designed only to treat domestic waste-water. At present, a number of gully trucks brings waste-water from different factories and dispose it into the plant altering waste-water characteristics from domestic to domestic and industrial. Therefore, it has become necessary to redesign the plant structure to accommodate these changing waste-water characteristics.

The Zoysapura STP had also been designed only for domestic waste-water. A number of factories have been operating in the surrounding area since its construction. These wanted to use the same STP to treat their industrial waste water. To address this issue, the NWSDB has planned to replace the old STP with a newly designed one,
capable of treating both domestic and industrial waste-water.

Waste-water treatment effluent quality is variable because of varying organic loads, changing environmental conditions, and new industrial discharges. For example, STP in the Earl’s Regency Hotel in Kandy had been using a rotating biological contractor (RBC) technology, but it had failed with time due to the destruction of active micro-organisms by detergents and other chemicals used for cleaning.

It has been reported that sodium dichloroisocyanurate, quaternary ammonium salts, and bi-quaternary ammonium salts had a better killing effect on sulphate reducing bacteria (SRB), while the bactericidal effect of formaldehyde was the worst (Xiao-juanet al. 2008). The Hotel management had replaced the previous RBC technology with an aerated lagoon, which is functioning well at the moment.

Obviously, then, it is necessary to select the best suitable technologies for implementation by considering all the factors mentioned before.

Further, countries like Sri Lanka should use energy efficient technologies to reduce O&M costs. For example, a large amount of energy is used for an aerated lagoon and activated sludge process of which one half of the entire plant electricity usage is for aeration (Tchobanoglous et al. 2003). The energy requirement can be reduced by a correct site selection, using energy efficient equipment and designing the plant to conserve energy.

Most operating agencies in Sri Lanka do not use a chlorination plant for disinfection. As a result, water sources get contaminated with effluent discharges from STPs. Therefore, it is a must to use a chlorination plant in the treatment process to disinfect the treated effluent.

Return flow treatment (RFT) is found to be another major concern when treating waste-water by using STPs. Almost all evaluated plants in this research did not use treatment of return flow. The management at Hanthana STP is planning to introduce an RFT on its STP. RFT reduces nitrogen levels in treated effluent. In addition, it promotes the removal of ammonia, fine settlers, and soluble heavy metals (Tchobanogous et al. 2003).

Socio-economic aspects

A technically perfect STP alone does not guarantee its successful operation over time. Funds are required to pay personnel and cover other operational expenses. In addition, regular repairs need to be carried out to guarantee good performance. Results show that two STPs in private-sector institutions are performing well, since they have the required funds for a smooth operation. Quite contrarily, the community-managed STP at Raladinugama faces difficulty in collecting required payments from the community. This has affected functioning of the STP very badly.

The other 5 STPs managed by the NWSDB, MASL and Dental Faculty have serious problems with fund allocation for personnel, repairs, and O&M. Therefore, the aspect of cost recovery needs to be looked into more detail before installing an STP in Sri Lanka.

Institutional aspects

It is important to identify the institutional roles in operating and managing an STP to provide a better and sustainable service to the people while protecting the environment. Local authorities along with the support of the Environmental Ministry should be entrusted with the monitoring of performance of the STP under their jurisdiction. Air and water quality parameters along with disposal of sludge need to be regulated in this regard. The permission to operate an STP should be granted only after assessing the capability of the relevant organization. Submission of annual reports to local authorities should be made mandatory.

In addition, it is necessary to maintain records of all special events such as physical defects, pump repairing, overflowing of STP, and complaints made by beneficiaries and outsiders. At present, implementing agencies do not practise record-keeping due to a lack of awareness of O&M and the paucity of regulation.

Feasibility of the proposed STP for Kandy

The proposed STP for Kandy City is a large-scale project, which consists of a pipe system laid along the road, three pumping stations, and a treatment plant. Sewage from each household will be collected by electric pumps located at Kandy Lake, Bowala, and Gatambe (see Appendix 1). These three pumps should be working in tandem in order to pump the sewage collected from households to the treatment plant located at Gatambe. The technology to treat sewage is called the oxidation ditch system.
But Narayanan & Thrikawala (2011) showed that the project has some negative implications such as inappropriate technology, institutional weakening, lack of social acceptance and political backup, and economical non-viability due to increased debts and high O&M costs.

**Economic feasibility of the proposed STP**

A cost-benefit analysis was done using estimates from a feasibility report prepared by a consultancy firm called SAPROF (SAPROF 2005) and secondary data on the monthly consumption of water by people in Kandy district.

The SAPROF report had estimated the financial and economic costs and benefits assuming a project life of 30 years. Financial costs referred to construction, O&M, and loan repayments. Economic costs related to loss of land for the treatment plant, pump stations, and laying of pipes, to waste of fuel due to traffic jams, and to health costs due to dust and vehicle emissions during construction. For our analysis, the estimates of SAPROF report were used.

There are two types of benefits of a project, financial and economic. Financial benefits are the incremental revenues from an additional sewage tariff, which is going to be imposed on the consumer. The NWSDB had proposed a discriminating tariff system for the sewage system according to the usage and type of users (Table 2). In deciding the sewage tariff, it

<table>
<thead>
<tr>
<th>Customer category</th>
<th>Water Usage Pattern (m$^3$/month/conn.)</th>
<th>Average Water Use (estimated) (m$^3$/month/conn.)</th>
<th>Sewage Tariff calculated on operational cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low usage</td>
<td>&lt;10</td>
<td>7.62</td>
<td>50 (Rs/connection)</td>
</tr>
<tr>
<td>Medium usage</td>
<td>11-20</td>
<td>16.57</td>
<td>100 (Rs/connection)</td>
</tr>
<tr>
<td>High usage</td>
<td>&gt;20</td>
<td>38.60</td>
<td>13.80 (Rs/m$^3$)</td>
</tr>
<tr>
<td>Commercial</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low usage</td>
<td>&lt;40</td>
<td>17.82</td>
<td>23.00 (Rs/m$^3$)</td>
</tr>
<tr>
<td>Medium usage</td>
<td>41-150</td>
<td>76.45</td>
<td>28.75 (Rs/m$^3$)</td>
</tr>
<tr>
<td>High usage</td>
<td>&gt;150</td>
<td>589.19</td>
<td>34.50 (Rs/m$^3$)</td>
</tr>
</tbody>
</table>

Source: NWSDB 2009

<table>
<thead>
<tr>
<th>Percentage of connections</th>
<th>Low water consumers</th>
<th>Medium water consumers</th>
<th>High water consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>33</td>
<td>45</td>
<td>22</td>
</tr>
<tr>
<td>Number of connections</td>
<td>3045</td>
<td>4140</td>
<td>1985</td>
</tr>
<tr>
<td>Volume of water (m$^3$)</td>
<td>278432</td>
<td>823245</td>
<td>919357</td>
</tr>
<tr>
<td>Sewage tariff</td>
<td>Rs.50/connection</td>
<td>Rs.100/connection</td>
<td>Rs.13.50/(m$^3$)</td>
</tr>
<tr>
<td>Revenue (Mill.Rs.)</td>
<td>0.15</td>
<td>0.41</td>
<td>12.41</td>
</tr>
</tbody>
</table>

Table 3. Revenue from each user category from the domestic sector

Source: Authors' calculations
hadd 
divided domestic and commercial consumers into three categories: low, medium, and high water users.

In estimating the financial benefits, our study used the monthly water-consumption data over one year (2009) from the NWSDB database to calculate the percentage of consumers in each category. These percentages were then used as a proxy to calculate the volume of water consumed at each user level and, consequently, to calculate the revenue (Table 3).

Revenue in the commercial sector was calculated using a weighted average of the tariff rates proposed by the NWSDB. Again, we used the estimated values of economic benefits by the SAPROF (Table 4).

With the help of these temporal costs and benefits values, a financial analysis and economic analysis were performed. Sensitivity analyses were also carried out with different discount rates, tariff rates, and payment scenarios. Two payment scenarios were tested. One in which only those consumers who would be connected to the STP, would have to pay the incremental sewage tariff and one where all piped-water consumers in the municipal area would have to pay it. This could be justified, since all consumers were contributing either to pollute the Mahaweli water or to use its purified water.

Financial analysis

The project would take 12 years to complete the construction and Table 5 shows the costs and

<table>
<thead>
<tr>
<th>Benefit item</th>
<th>Revenue at the Fifth Year of Construction (mil.Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved Tourism</td>
<td>275.00</td>
</tr>
<tr>
<td>Improved Health</td>
<td>5.00</td>
</tr>
<tr>
<td>Increased Land Value</td>
<td>304.00</td>
</tr>
<tr>
<td>Improved Recreation</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Source: SAPROF report

<table>
<thead>
<tr>
<th>Tariff payment scenario</th>
<th>Million Rupees</th>
<th>Percentage Recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>O&amp;M Costs</td>
<td>131.7</td>
<td></td>
</tr>
<tr>
<td>Revenue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Only those who connected to the STP will pay the tariff</td>
<td>8.91</td>
<td>8%</td>
</tr>
<tr>
<td>All pipe water consumers will pay the tariff</td>
<td>21.82</td>
<td>18%</td>
</tr>
</tbody>
</table>

Source: Authors' calculations

<table>
<thead>
<tr>
<th>Tariff payment scenario</th>
<th>Proposed tariff rate (Rs.)</th>
<th>Breakeven tariff rate (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumers &lt; 10 m³/month</td>
<td>50</td>
<td>270</td>
</tr>
<tr>
<td>Consumers 11-20 m³/month</td>
<td>100</td>
<td>540</td>
</tr>
<tr>
<td>Consumers &gt; 20 m³/month</td>
<td>13.50/ m³</td>
<td>72.90/m³</td>
</tr>
<tr>
<td>Commercial</td>
<td>33.74/m³</td>
<td>181.21/m³</td>
</tr>
</tbody>
</table>

Source: Authors' calculations
benefits at the 12th year under these two scenarios of payment. Thus, at the 12th year, the revenue from the sewage connection would be 9 and 22 million rupees, respectively, following these two scenarios. The break-even tariff rates for different categories of water consumption are given in Table 6 assuming that all pipe water consumers pay the sewage tariff. This shows that financially feasible tariff rates can be way above proposed rates. Further research is needed to determine whether these rates are affordable to consumers and whether they would agree to connect to the system at such rates.

Table 7 depicts the results of the sensitivity analysis done for various tariff rates, discount rates, and the two payment scenarios for sewage treatment. The financial analysis shows that the project is not financially viable at the tariff rates proposed by the NWSDB (see Table 4). Compared to the additional revenue, which could be gained from the sewage tariff, the construction costs are several times higher. Even if the capital costs are ignored, the O&M costs are much higher than the benefits.

The sensitivity analysis shows that the Net Present Value (NPV) of the project becomes positive, when only the proposed tariff rates are increased by 175% and at 22% interest rate (Table 7). Then low, medium, and high water consumers will have to bear an additional payment for sewage treatment of Rs. 137.50/month, Rs. 275.00/month, and Rs. 37.13/m³, respectively. At Rs. 37.13/m³, a 20 m³ consumer will have to bear a sewage tariff of nearly Rs. 750 per month.

Table 7. NPV (Rs. million) at different tariff rates and discount rates

<table>
<thead>
<tr>
<th>Alternative tariff rates</th>
<th>Proposed Tariff</th>
<th>Proposed tariff is increased by 175%</th>
<th>Proposed tariff is increased by 190%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Proposed</td>
<td>is</td>
<td>is</td>
</tr>
<tr>
<td></td>
<td>Tariff</td>
<td>by 10%</td>
<td>by 15%</td>
</tr>
<tr>
<td>Discount Rate</td>
<td>10%</td>
<td>15%</td>
<td>21%</td>
</tr>
<tr>
<td>Tariff is only paid by those who are connected to STP</td>
<td>-350</td>
<td>-178</td>
<td>-88</td>
</tr>
<tr>
<td>Tariff for all pipe water consumers</td>
<td>-268</td>
<td>-134</td>
<td>-65</td>
</tr>
<tr>
<td>Cost-Benefit Ratio*</td>
<td>0.93</td>
<td>0.96</td>
<td>1.00</td>
</tr>
<tr>
<td>IRR*</td>
<td>20.78%</td>
<td>12.70%</td>
<td></td>
</tr>
</tbody>
</table>

*Cost-Benefit Ratio and Internal Rate of Return (IRR) were calculated only when all pipe water consumers pay the sewage tariff

Source: Authors’ calculations

in addition to the water tariff. Yet, all water consumers in the KMC should pay for sewage treatment. Further, the STP becomes feasible at discount rates as low as 10%, if the tariff rates can be increased by 190% (Table 7). Then low, medium, and high water consumers will have to bear an additional payment for sewage treatment of Rs. 145.00/month, Rs. 290.00/month, and Rs. 39.15/m³, respectively (the sewage charge alone is going to be Rs. 780.00/month for a 20 m³ consumer of water). This is way above the proposed tariff rates (see Table 4).

Economic analysis

The results of the economic analysis with several sensitivity analyses are given in Table 8. As expected, the NPV decreases with an increasing discount rate. The project has a positive NPV, greater than the benefit-cost ratio, and the IRR is at an acceptable range. However, the results of the sensitivity analysis with varying tariff rates show that the parameters, i.e. NPV, Cost-Benefit Ratio, and IRR are sensitive to the tariff rate. This is due to the high cost of implementation and high O&M.

Overall, the proposed STP is not financially feasible if the capital costs are taken into account.
consideration. Since sewage supply is a service, it is justifiable to ignore the capital costs in the analysis. But, even after ignoring capital costs, the project becomes financially only viable when the tariff rates are increased by 190%. This can be a huge burden to any level of consumer irrespective of the amount of water consumed.

The economic analysis on the other hand shows that the project is economically viable, when the project benefits are considered for the society as a whole. However, the results depend on numerous assumptions, which sometimes may not be realistic. Further, the cost of dust and traffic jams during the construction period were not included in the analysis. Nevertheless, huge O&M cost makes the IRR insensitive to changing tariff rates. Therefore, it is impossible to determine an optimal tariff rate for the proposed STP with the benefit-cost analysis alone.
Stakeholder consultation is needed in this regard.

The third cost item is identified as loan repayment. The NWSDB had worked out an appropriate repayment schedule for the term loan, keeping the period of loan maturity shorter than the economic life of the project (SAPROF 2005). As indicated earlier, there was an assumption of eight years of construction of the STP and three types of economic costs, i.e. loss of land for the treatment plant and pump stations, waste of fuel due to traffic jams, and health costs due to dust and emissions from construction vehicles as well as the extra traffic. However, cost of fuel waste and health cost were ignored, because they turned out to be insignificant.

Comparison of small and large-scale STPs

The results from the first part of the study show that small-scale STPs are feasible provided that shortcomings identified during the evaluation are addressed. Capacity development of personnel appears to be the most important intervention in this regard.

The second part of study, which dealt with the feasibility of a large-scale STP for Kandy City, indicates that the proposed STP seems to be economically and financially not viable. In addition, the sustainability of such large systems is questionable in view of the operation and maintenance of the plant. Further, the KMC and the NWSDB would need to depend continuously on donors for spare parts, chemicals, expertise, etc.

Conclusions and recommendations

In general, the construction of technically sound STPs does not necessarily guarantee its success. The non-availability of personnel to manage STPs is the major constraint in the present situation. Therefore, the most promising approach would be to handover such a system to a competent organization such as the National Water Supply and Drainage Board (NWSDB) or a private operator for to conduct O & M. However, securing adequate funds remains a major challenge. One long-term solution is to charge extra from users. The money thus collected could be used to pay the organization, which operates and manages the system. Another option, now in operation, is to allocate funds from the government, but this is not a sustainable option.

It is unfortunate that the government has overlooked these important issues and has not addressed them. Thereby many environmental issues have been created, which affect not only beneficiaries of the system, but also many others, such as downstream users of (polluted) water resources.

The feasibility of large-scale STPs such as the one proposed for the Kandy municipal area seems to be financially not viable at sewerage tariff rates that are affordable to consumers (as proposed by the NWSDB). The break-even tariff rates are also much higher than the proposed rates.

The affordability, applicability, and willingness of the public to connect to the system should be studied further, if these higher rates are going to be implemented. The project becomes economically viable, only if expected benefits from improved tourism, land values, and environmental benefits are justifiable. In addition, there are concerns regarding its long-term sustainability. This would mean that decentralized sewerage treatment appears to be a much better strategy compared to large-scale centralized STPs in Sri Lanka.

Many aspects require further research. Among them institutional arrangements, policy guidelines, the regulation of proper sewage management, regular monitoring of plants, and cost recovery from the beneficiary communities are perceived to be priority areas.

Acknowledgements

The authors wish to acknowledge the Crossing Boundaries Project of the PGIA, University of Peradeniya Sri Lanka, SaciWATERs, Hyderabad, India, and the Government of The Netherlands for proving funds and facilities to undertake this research.

References


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2 Personal communication, Mr. Jayalath, Project Director, Kandy City Sewerage Treatment Project.


Appendix 2. Distribution of construction costs over the construction period

<table>
<thead>
<tr>
<th>Item</th>
<th>Years of construction</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year 1</td>
<td>Year 2</td>
</tr>
<tr>
<td>Construction Contracts</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Provisional Sums</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Physical Contingency</td>
<td>0</td>
<td>56</td>
</tr>
<tr>
<td>Engineering Services</td>
<td>34</td>
<td>393</td>
</tr>
<tr>
<td>Project Admin. Cost</td>
<td>6</td>
<td>50</td>
</tr>
<tr>
<td>Land Acquisition Cost</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Custom and Duties</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Value Added Tax (VAT)</td>
<td>6</td>
<td>66</td>
</tr>
<tr>
<td>Total</td>
<td>46</td>
<td>509</td>
</tr>
</tbody>
</table>

Source: SAPROF Report 2007

Appendix 3. Basic statistics on water and sewage connections

<table>
<thead>
<tr>
<th></th>
<th>Domestic</th>
<th>Non-domestic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of water connection</td>
<td>21,169</td>
<td>3,555</td>
<td>24,724</td>
</tr>
<tr>
<td>Number of sewage connection</td>
<td>9,170</td>
<td>3,451</td>
<td>12,621</td>
</tr>
<tr>
<td>Water sales volume ('000 m³/year)</td>
<td>6,053</td>
<td>3,114</td>
<td>9,167</td>
</tr>
</tbody>
</table>

Source: SAPROF Report 2007
Introduction

This article is concerned with the need to recognize the peri-urban as a frontier of urban sustainability, and to build a deep engagement with the processes of peri-urbanization into formal structures, governance arrangements, and other decision making processes in order to realize urban sustainability transformations.

Those of us who are concerned with the peri-urban can take some comfort in a noticeable shift in policy discourse. Until quite recently there had been little regard for the peri-urban. This has been apparent in my own experience. When we initially sought official engagement in our studies to look at threats to peri-urban agriculture and associated livelihoods in the late 1990s, there was limited interest. It took intensive empirical studies, which proved that the majority of perishable vegetables reaching wholesale markets in Delhi and Varanasi were from districts adjoining the municipality (Bhupal et al. 2002; Marshall et al. 1999), to provoke any attention. We then demonstrated the contamination of this produce with heavy metals from unregulated peri-urban industries (Marshall et al. 2004; Sharma et al. 2008). The results caused a media splash, and suggestions of remedial action to address the contamination in parliament. Yet there was little engagement with the key underlying issues that require a move away from a crisis-responsive mode to considering the important interactions between alternative possible urban development trajectories, changes to the peri-urban environment, and the multiple impacts on livelihoods and health.

Now there is an increasing appreciation of the significance of the peri-urban. While decisions relating to the peri-urban still appear to be driven largely by land markets and private investment opportunities (for examples, see Dutta 2012, Narain 2009), the importance of peri-urban natural resource management is beginning to gain traction. This is particularly so in terms of peri-urban food production (Zeeuw & Dreschel 2015).

Periurbanization and sustainability

Peri-urban was, and often still is, regarded as a process. This is linked to particular ideas of transition zones, where the retirement of rural activities is inevitable and therefore requires little attention. It might also be described as a periphery, which in the context of exclusionary urbanization processes plays out both in geographic and sociological terms. Also it might be looked at as a site of expulsion from the city, to make way for visions of modernity. Occasionally it might be seen as a threatening urban fringe, where communities become associated with health and environmental hazards that require some form of control (Marshall et al. 2005).

As time goes by, patterns of peri-urban exclusion and environmental degradation are reinforced. This has been exemplified in our own work over two decades. As part of our early research studies, a participatory research team led by the late Neela Mukherjee worked with 1200 farmers across 24 villages in the NCR and in Varanasi in the late 1990s (Mukherjee 2001). We were concerned with nature, the extent and significance of peri-urban agriculture, the constraints on peri-urban...
agricultural livelihoods, and the impact of environmental degradation of air and water resources on them.

Concerns over lack of infrastructure and agricultural support were paramount among the farming communities involved at that time, along with the water shortages linked to energy supply and air pollution. But there was also hope for new urban employment opportunities and recompense for agricultural land thanks to rising prices.

The villagers were also asked about what they thought the future would bring (Marshall et al. 1999). On reflection, it appears that the dismal scenario that many of these communities feared, is being realized in many ways.

Our recent studies in Ghaziabad and Varanasi demonstrate increasing groundwater contamination from local industries and landfill sites, increasingly hazardous strategies that have to be employed to access water, and traditional uses of waste-water for irrigation and groundwater to support dairy herds facing new chemical food safety hazards, all affecting peri-urban and urban residents. (Randhawa & Marshall 2014) There is a plethora of other concerns including loss of diversification in agricultural products, lack of access to grazing land and other community resources, increasing social fragmentation, and limited access to employment, due to very low wages accepted by incoming migrants in local industries. (Unpublished ESPA project report)

A growing body of peri-urban literature is providing insights into the multiple interacting drivers that are contributing to this disappointingly widespread scenario. We are also learning much about local power relations, politics, institutions, and governance arrangements, and how they contribute and respond to the situation faced by peri-urban dwellers in various income groups.

Multiple government schemes, as they unfold—often under the banner of sustainability—, further tend to exacerbate peri-urban inequalities. For example, by creating exclusive city forests and recreation parks at the expense of community farms, agricultural land, or by developing industrial enclaves away from the middle-class areas of the city.

Of course there are multiple interacting social, political, and economic reasons for it. These include the fact that planning is heavily influenced by land markets and the drive to attract foreign investors, the continued drive to promote cities as engines of economic growth, and environmental management initiatives, with stretched resources, focussing largely on monitoring and emission norms.

The question is how the debates might be reframed such that critical peri-urban areas are recognized as frontiers of sustainability and urban development. What sort of new knowledge and understanding are still required, and what sorts of partnerships and alliances have potential to make an impact?

As peri-urban researchers, we are often asked how we could begin to engage with ideas of 'sustainability' in such transitional places, for it appears to some as contradictory. Yet it also appears that denial of sustainability in relation to the peri-urban is a major contributor to the ongoing processes of exclusionary urbanization. It is also a barrier to building resilient or sustainable urban food, water, and energy systems, which are now prevalent in national and international policy discourses.

As a working definition we have been considering the peri-urban as a condition that encompasses aspects of rural and urban activities and institutions, influenced by rapid social, environmental, and technological changes and increasing marginalization.

But we also recognize peri-urban areas as hot spots of social learning and innovation, and as frontiers of transition and transformation. They are the places where the dynamics of sustainability are being worked out in conflict, through negotiation, or through chaotic evolution.

Here we find an extreme set of perspectives, heterogeneous societies with widening inequalities, and clashes of tradition with modernity. These poorly studied situations provide excellent opportunity to learn the lessons of recent urban development interventions and their implications for the environment, health, and social justice.

We have also a great deal to learn from these situations about adaptation to social and environmental change. Perhaps the rapid innovations that are necessarily undertaken by peri-urban residents provide vital current day lessons for other circumstances, such as adaptation to climate change.
A growing body of peri-urban literature also indicates that greater insights into these peripheries, which are subject to ambiguity, informality, and illegality in the context of formal planning processes, can elucidate alternatives to dominant planning and management trajectories.

Through a long-term set of transdisciplinary initiatives working with peri-urban communities, we have been examining how urbanization processes and particular technological interventions unfold in peri-urban settings and the implications for the environment, multiple dimensions of poverty, and social justice. We have sought to enhance understanding of the interdependencies and trade-offs that occur, when diverse stakeholders prioritize, gain access to, and utilize food-water-energy and environmental resources. And we have looked at implications for the health and livelihoods of vulnerable communities (particularly those of the poor).

Further, we have been trying to understand the wider implications of these particular peri-urban socio-ecological system dynamics and their outcomes for residents, of all income groups, in the urban core and rural hinterland. For example, how the lack of attention to the degradation of the peri-urban environment and its links to human well-being also undermines the ability to develop sustainable urban water and food systems.

Urban policies for the provision of essential services such as food and water draw upon ecosystem services from the peri-urban zone and from even further afield. At the same time, the export of polluting activities and domestic waste to peri-urban localities degrades these ecosystem services, with adverse implications for urban and peri-urban communities.

This in turn has multiple adverse impacts on the urban core and rural hinterland. For example, through the emergence of new health hazards such as the transfer of contaminated food and water to urban populations, and the deepening of exclusionary processes of urbanization.

But there is also immense opportunity in building synergies across the urban-rural continuum such as with urban waste management. For example, with appropriate support for community based initiatives, and financial incentives to produce compost, considerably more urban waste in Indian cities could be put to productive use in urban and peri-urban farms –preserving soil structure and fertility and potentially reducing water demand. This is just one of many examples where, with appropriate support, safe and productive peri-urban agriculture could support sustainable urban development.

For water we find that important linkages between water, health, agriculture, and the environment are also disregarded, while invisible/informal/illegal water uses are ignored. This can result in policies that completely fail to address emerging and growing threats to human health (such as through the use of contaminated waste-water). An issue that is very apparent in the limited choice of chemical contaminants that are regularly monitored.

There is also a need to re-conceptualize notions of risk, quality, and waste in dynamic peri-urban localities. While peri-urban farmers see waste-water as a resource, the formal system completely separates issues of waste-water supply and water disposal. While the concept of the ‘food-water-energy nexus’ (as initiated by the World Environment Forum in 2008) is seen as holding potential for integrated planning for water, food, and energy, critics warn that the current approach is dominated by particular, powerful interest groups, and technocratic and managerial solutions. Therefore, there is need to elucidate the inter-linkages in the context of sustainable urban planning through widening and deepening the content of ‘the nexus’ and the dimensions it addresses, including environmental health and multiple dimensions of poverty.

This means engaging with local practices, alternative forms of knowledge and technologies, and understanding of ecology from the perspectives of diverse socio-economic groups. Through an enhanced understanding of nexus interactions both in the peri-urban and across the rural-urban continuum there is tremendous potential to build positive synergies. These synergies will support multiple sustainable development goals (for example, enhanced access to safe and nutritious food for the urban poor), and integrated city-region planning approaches.

The mechanisms for realizing these urban sustainability transformations need far greater attention. Integration of diverse knowledge and experiences of urban nexus interactions into decision-making processes could make significant contributions. This would help open up new pathways of development that built upon the skills, ideas, and experiences of diverse
stakeholders who are generally absent from formal decision-making processes, and would bring together often divergent initiatives.

Local innovations, new engagements across the formal and informal sector, and social and political mobilizations, often in informal settings, have already resulted in the emergence of multiple alternative practices. These have potential for enhanced social justice, environmental integrity, and synergies across the urban-rural interface. There may also be alternative forms of the 'smart city' associated with diverse technology options. For example, through the development of appropriate local, low-cost community-based environmental monitoring, and networks for mutual learning about social innovations that promote positive nexus synergies in the peri-urban.

A development of this sort of approach would also suggest that, alongside support for local innovation, there is a need to establish development indicators and planning tools relevant to the specific challenges of transitional spaces. There is also a need to engage with sectoral policies and programmes such as the socio-material flows of food, water, and waste across the rural-urban continuum together with multiple dimensions of poverty.

It is also important to work towards planning approaches that make crucial links between the disparate policy fields of environment, health, agriculture, and urban planning. Ultimately, a constructive dialogue that engages with new approaches and new politics of city-region planning is essential. This would involve the firm integration of peri-urban landscapes, environmental change ecosystem services, and health systems into the planning frame.

These issues, as with all key sustainable-development challenges, cut across disciplinary and sectoral divides and policy siloes. There is immediate need to find some means of supporting trans-disciplinary co-operation for the understanding of urban/peri-urban sustainability dynamics in particular settings.

While some excellent, new interdisciplinary university programmes are emerging, there is much more to do. Alliances between the formal and informal sector are crucial, and there are important lessons from emergent urban alliances, for example in the waste sector. It is also crucial to continue to build alliances across environment, health, water, and other domains in education and formal policy circles to continue to raise awareness, challenge, and promote dialogue around alternative technologies and planning approaches.

**Acknowledgement**

This commentary is based on insights from two decades of transdisciplinary peri-urban research in collaboration with many friends and colleagues in India and the UK. It includes ongoing work in peri-urban Delhi funded by the ESRC STEPS programme and an ESPA project 'Risks and Responses to Urban Futures' [http://steps-centre.org/project/urban-futures/?referralDomain=project](http://steps-centre.org/project/urban-futures/?referralDomain=project) with Ritu Priya, Ramila Bisht, Linda Waldman, Pranav Desai, Jorn Scharlemann, Milap Punia, Jonathan Dolley Priyanie Amerasinghe, Ravi Agarwal and colleagues.

**References**


Introduction

The aquifer system of the Ganges delta is one of the world’s largest. Here, groundwater plays a major role in the agricultural economy and rural livelihoods (Taylor et al., 2013; Shah, 2009; Zahid & Ahmed, 2006). A significant portion of the delta’s population also depends on it for drinking and domestic purposes (Khan, 2007). Urbanization is currently responsible for major changes within the delta. As a result, rapid and largely uncontrolled urban expansion of Khulna city, Bangladesh and Kolkata city, India poses a threat to the sustainability of groundwater management. Resulting groundwater scarcity is especially severe for peri-urban areas of these expanding cities.

This article describes some of the key features behind this growing pressure on groundwater resources in peri-urban areas and shows how an institutional lens can help analyze the evolution of these groundwater issues in Khulna and Kolkata. Selected case study examples highlight peri-urban features of dynamism and heterogeneity as relevant to the study of institutions in this context. The paper also presents a way forward for peri-urban institutional analysis, drawing from the insights offered in the field of New Institutional Economics (NIE).

Peri-urbanization in the Ganges delta

Peri-urban areas can be defined in several ways. Conceptually, they represent the transition zones in processes of urban expansion (Narain, 2010). They display a blend of rural and urban activities due to increasing links with urban centers, which they are in proximity to (Narain & Nischal, 2007; Thissen et al., 2013).

In the Ganges delta, we find that peri-urban areas reflect a transition fueled by a combination of factors. The first is aforementioned urban expansion around cities like Kolkata and Khulna. In the peri-urban block of Sonarpur (India), government financial and tax incentives have promoted the growth of micro, small, & medium sized enterprises as well as infrastructure development for industrial parks in the area (Gomes, 2014). With it, block administration is slowly evolving from village to municipal. Similarly, in Khulna, we find formal and informal expansion processes underway beyond Khulna city limits (Gomes, 2015). Second, peri-urban areas in the delta have experienced population changes due to coastal migration from the Sundarbans for education, livelihood opportunities, and following major cyclones like Ila (2009) and Sidr (2007) (Gomes, 2014, 2015; Kundu, 2015; Vavier, 2014). Third, they have changed significantly in terms of land use. We see a shift from traditional rice cultivation and fish farming for infrastructure development and the emergence of industrial activities including dyeing, beverage, food processing etc. (Gomes, 2014, 2015).

Peri-urbanization in the Ganges delta thus reflects an evolving socio-economic context. This has implications for the regions aquifers. Ongoing research reveals a concern among local actors of growing competition over groundwater access (Kumar et al, 2011). In peri-urban Kolkata, this is due to the rise in industries whereas in Khulna, conflicts have emerged due to urban pressure (Roy, 2013; Thissen et al., 2013). It has created inequity among local users with and without access to tube wells due to limited formal services and varied capacity to invest in other options (CSE, 2005; Gomes, 2015). Furthermore, overexploitation due to growing demand in peri-urban areas, over time can mobilize contaminants, which deteriorates groundwater quality (Foster & Chilton, 2003). The region is already facing seasonal scarcity and contamination from arsenic and salinity (Gomes, 2014, 2015). Overall, it highlights the unsustainability of existing groundwater management approaches in these peri-urban transition zones (Kumar et al., 2011).
Dynamics and heterogeneity of peri-urbanization

Peri-urban dynamics

The dynamics of peri-urbanization make resource management a complex task. Over time, rural to urban transition often leaves peri-urban areas with a dichotomy of urban and rural institutional arrangements. This leads to an unclear definition of roles, responsibilities, and rules for service provision and resource management (Allen, 2003). Its effect is evident in a recent conflict between the peri-urban block of Phultala and Khulna City Corporation (KCC).

It began in 2005 following KCC attempts to abstract groundwater from Phultala to bridge their gap in supply and demand. Phultala residents self-organized and filed a legal case against KCC stating that project construction to extract around 10 million litres/day of groundwater began without community consultation or environmental assessments. In 2010, the high court ruled in Phultala’s favour issuing a court order, requiring KCC to seek other alternatives to address urban demand (Gomes, 2015).

One important source of these conflicts are thought to be the unclear abstraction guidelines for urban municipalities (Gomes, 2015). Phultala is currently located outside urban boundaries, and hence beyond the formal jurisdiction of KCC. A formal extension plan for Khulna city has been developed and is likely to come into effect in the near future. This will give KCC jurisdiction over peri-urban areas such as Phultala. However, its official approval has been delayed at the national level (Gomes, 2015). In the interim, this administrative ambiguity has been a source of conflict between urban and peri-urban actors over access to local groundwater resources.

Heterogeneity of peri-urbanization

Like dynamism, heterogeneity of peri-urban areas is another feature complicating groundwater management. Peri-urbanization implies a mixed and evolving socio-economic landscape. Farmers, industrial entrepreneurs, informal settlers and urban middle class are just some of the social groups found here (Allen, 2003). Economic activities around Khulna and Kolkata are in transition from traditional irrigated agriculture and shrimp farming to small scale industries (Gomes, 2014, 2015). Heterogeneity means that peri-urban users differ in their lifestyle, economic, and education background, which reflects in their individual needs and objectives. It also means changing demands for peri-urban resources.

Need for research on peri-urban groundwater management

Through peri-urban features of dynamism and heterogeneity, we see that they display unique characteristics from their urban or rural counterparts. Focused research on peri-urbanization is therefore needed for three reasons. First, competition over resources has socio-economic implications for local communities, which in the long run threatens successful poverty reduction and development (Thissen et al., 2013). Second, with urbanization expected to increase in the coming decades, particularly in countries like India and Bangladesh, managing urban transitions will continue to be relevant from a research context (UN DESA, 2014). Third, supporting sustainable urban transition requires shifting away from traditional planning along a rural-urban divide (Narain, Banerjee & Anand, 2014). For these reasons we need to develop a robust understanding of resource management in this context. Here, peri-urban research can benefit from an institutional lens, the added value of which is described in the following sections.

Institutions as coordinating rules for society

Institutions as key to understanding coordination problems

The groundwater situation within the peri-urban Ganges delta can be described as a coordination problem between local actors involved in distributing, managing, and appropriating groundwater. These coordination problems in water management are not resolved in a vacuum, but their resolution is embedded within existing social structures and patterns of interaction. Generally, this is being referred to as the institutional context. One important question for the peri-urban areas is how this institutional context influences the resolution of coordination problems, and thus shapes the access to, and management of, groundwater resources.

Institutions as rules for actors

One particular field of institutional theory is that of New Institutional Economics (NIE). NIE defines institutions as the rules that guide actor behavior
(North, 1990). Thus in coordination issues, an institutional approach offers insight into actors’ decision strategies. These rules include formal, consciously constructed laws, property rights etc. or informal, spontaneously emerging, socially transmitted norms, traditions, and values (North, 1990; North, 2001 cited in Pahl-Wostl, 2009; Williamson, 1998b). Peri-urban areas like Khulna and Kolkata have a unique set of rules that apply to groundwater management.

Understanding the impact of institutions on peri-urban issues, requires one to examine how rules are operationalized in practice. These rules include rules about the participants, their positions and the actions they may take (Ostrom, 2005). Their application thus may be observed through the behavior of social actors, which are those parties having a certain interest in a situation and an ability to influence it and its outcomes (Enserink et al., 2010).

In studying social actors, NIE presumes a rational actor perspective meaning it presumes that actors decide on their actions with an aim to achieve an outcome in line with their desired objective. This rational actor perspective is not to be mistaken for a narrow fix on social actors as perfect rational decision-makers. Constraints on information availability, diverse and ambiguous valuation schemes, and biases and heuristics in decision-making cannot be ignored (North, 1990; Ostrom, 2005). However, ultimately, actions are expected to be evaluated by actors for their contribution to the realization of their objectives. In the resolution of coordination problems, institutions determine what actions are permitted and prohibited. Water insecurity in peri-urban Khulna can similarly be described as a coordination issue where competing actors take strategies co-defined by institutional arrangements, to meet their water needs. In this way, peri-urban institutions are found to structure the groundwater outcomes observed.

**Institutions and change in NIE**

Theories also emphasize the role of actors in changing their outcomes through institutional change (North, 1996; Ostrom, 2005). Here, actors also become the agents of institutional change via feedback received from their decision outcomes. Positive feedback reinforces existing institutions and strategies but negative feedback is a signal for actors to invest in alternate strategies or institutions to reach their objective (Greif, 2006; North, 1996). Through this process, institutions are expected to evolve with actors’ needs. We see this in the emergence of new informal water markets in peri-urban Khulna.

Peri-urban communities in Bangladesh are formally served by public providers such as the Department of Public Health Engineering and the Bangladesh Agricultural Development Corporation (Gomes, 2015). Applications for tube wells are processed through a sub-district (upazilla) level Water and Sanitation (WATSAN) committee. The committee distributes tube well licenses allotted by government providers across villages within the sub-district (Gomes, 2015). Some villages further away from the sub-district, however, are unable to achieve water security via formal mechanisms despite tube well applications every year. This has led to the emergence of an informal market of local tube well owners that cater to the needs of irrigators in those villages (Gomes, 2015).

The issue of peri-urban institutional change is especially relevant to the dynamic nature of this context. It is studied in NIE, but there is no clear theory to explain the evolution and direction of these change-trajectories. For instance, unsatisfactory outcomes from existing rules may induce certain actors to strive for a change in institutions, but institutional organization and embeddedness makes it difficult and costly to achieve change (North, 1990; Williamson, 1998b). Also, the stability of rules is important as it becomes a prescriptive guide of what outcomes can be expected from a given action (North, 1990). Thus, although theories suggest that institutions are expected to evolve with actors’ changing needs, in practice there are costs, constraints, and thresholds associated with it. The current problems with groundwater management in peri-urban Khulna and Kolkata suggest that here, formal institutions have failed to keep up with changing demands. A challenge for transitioning peri-urban areas thus is how to achieve a balance between institutional change and the stability needed for coordinated decision making.

**Relevance of institutional theory to the peri-urban context**

By introducing the concept of the peri-urban context and introducing institutional notions, we now describe the relevance of institutional theory, especially the frameworks offered by New Institutional Economics, for peri-urban groundwater management.
Peri-urban problems explained through an institutional lens

Unique features of the peri-urban context have implications that found to pose challenges for the effectiveness of institutional arrangements. For one, the quickly changing, yet prevailing rural-urban dichotomy creates a lack of institutional clarity, which can be expected to lead to different interpretations by actors (Ostrom, 2005). This is especially true with the introduction of new rules that actors are unfamiliar with, or new situations for which it is not yet clear how and which rules apply. Moreover, the ambiguity of peri-urban boundaries can also result in overlapping rules, referred to as legal pluralism. The relationship between institutions in these complexes is important. Ostrom (2005) highlights that a limited understanding of the combined impact of rules in a particular context can produce unintended or even disastrous outcomes. In the groundwater conflict between Phultala and Khulna city, we see the impact of institutional ambiguity.

Peri-urban areas present a unique actor landscape. Ostrom (2005) explains that situations with heterogeneous, changing participants reduce the chances of cooperative strategies. A relevant observation for the peri-urban context, is made by North (1990, 1996), who highlights that in reality, institutions aren’t socially efficient and outcomes typically favour those with the most bargaining power. We see evidence of this in the access to tube wells in peri-urban Khulna that marginalized remote villages in the process.

NIE offers relevant direction but also warnings to avoid easy fixes

Thus, we see that many typical peri-urban water management problems can be explained through an institutional lens. Here, the field of NIE offers several coping strategies to operationalize this. For example, we applied NIE to describe how peri-urban features are found to hamper institutional effectiveness. Theories on institutions and actor behaviour are also highlighted for their complexity.

For instance, NIE suggests that in dynamic and heterogeneous contexts, enforcement of regulations in the Ganges delta, however, has resulted in a gross overexploitation of groundwater and has allowed some industries to benefit from institutional loopholes. In Kolkata, resource constraints of the State Water Investigation Board limit its capacities in the implementation of regulations for tube well licences (Gomes, 2014). Such gaps in enforcement and implementation capacity have led to further deterioration of groundwater aquifers in both quality and quantity aspects. Meanwhile, authors like Ostrom (2005) warn against a naïve belief in the effectiveness of new or changed rules as designed by objective external analysts. For instance, even if rule enforcement becomes important in heterogeneous and instable environments, the existing complex of related and partially overlapping and rules and institutions also makes it unclear what set of rules to enforce. In the Phultala case for instance, are the ‘old’ or the ‘new’ rules to be enforced?

Connecting theory and practice to support peri-urban institutional transitions

Thus, using these and other insights from NIE to better understand the institutional dynamics in peri-urban transitions may not lead to a clear design for new rules or regulations, but may help inform the search for new institutional arrangements by the involved actors. It may do so by pinpointing some of the key dilemmas and choices they face. At the same time, using the peri-urban zones as a study ground, is likely to further the insights in theory about the nature and evolution of institutional change processes.

Societal and scientific value of peri-urban research

Peri-urban institutional research offers both theoretical and practical value. Research on peri-urban institutions is scarce. Iaquinta and Drescher (2000) describe different institutions in various peri-urban typologies. However, it does not relate them to peri-urban issues like water management nor does it outline a conceptual approach to do so. Others that have explore institutions in relation to common property resources do so within a broader governance or urban planning lens (Allen, 2003; Vij & Narain, 2016; Allen, Davila, & Hofmann, 2006). Thus, greater efforts are needed to bridge this gap.

The uniqueness of the context, also suggests that research can further theories on institutional change particularly in transitioning areas. In
transitioning areas, where rules run the risk of becoming obsolete over time, peri-urban research helps examine how actors improve their outcomes in the interim when formal institutional change does not seem feasible and has not yet taken shape.

Literature also called for context specific institutions if they are to be effective in societal problem solving (Mattingly, 1999; Ostrom, 2005). Local peri-urban actors in Khulna and Kolkata have expressed concerns that existing institutions have failed to address their groundwater issues, suggesting a need for institutional reforms (Thissen et al., 2013). Here, research can bring practical value. Through action research, institutional analysis becomes a powerful tool to support peri-urban communities address existing water resource dilemmas. Sharing analysis of institutional arrangements and the outcomes they result in can help drive informed solution finding efforts that may include institutional reforms.

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References


The waterscapes of governance

Sahil Patni
Student, MA (SDP), TERI University

Kala Bada
Student, MA (SDP), TERI University

Introduction

This article traces the changing trajectory of water governance cast as a ‘wicked problem’, examining the role of the multiplicity of actors involved. It seeks to initiate a discourse on the role and effect of different actors in tackling water governance challenges in South Asia, who are deeply affected by increasing urbanization and peri-urbanization.

Urbanization is causing patterns of water allocation to change from rural to urban areas. This creates bases for conflicting claims and a need for platforms for negotiation and dialogue. This is happening within the larger context of commodification of water. In this backdrop, the article makes a case for polycentric governance to address this ‘wicked problem’.

The conundrum of governance

In recent years, the trajectory of governance in terms of definition, principle, and process has undergone reconsideration, given the extensive research in public policy making. Governments have increasingly been viewed critically in being accountable and efficient providers to the nation. This has come with the rise of new actors within the realm of governance such as private enterprises and civil society. This, in turn, has led to new conceptualizations claiming to solve problems of development.

Governance encompasses a vast range of institutions and relationships required to achieve collective objectives and conceptualized in terms of steering the economy and society (Pierre & Peters 2000).

Governments have been dislodged as the locus of power and authority, but they are still a major component of governance processes. This is despite the fact that their relations with other actors have transformed from merely governing them to influencing their agency to achieve a set of collective interests.

The nation-state has found itself increasingly intertwined in addressing the complexity of social problems and the internationalization of interdependencies, and dealing with the strength of organized interests (Chhotray & Stoker 2009).

Governments are necessary but not sufficient in governing essential natural resources such as water.

The continual reconceptualization of governance has resulted in viewing civil society as an institution that bridges the gap between the public and private domains, striking a balance between democracy and the market. The consistent endeavour for ‘good governance’ attempts to ensure civil society participation, based on the assumption that power and exploitation is associated with the state, while freedom and liberty falls in the realm of civil society (Mathur 2001). The socially innovative figures of governance that appear to empower civil society in the face of an apparently overcrowded and ‘excessive’ state may prove to be the Trojan Horse that diffuses and consolidates the ‘market’ as the principal institution (Swyngedouw 2005). Hence, vigilance must be observed in viewing civil society as inherently democratic and independent from the State and from market forces.

Water governance characterizes itself as a “wicked problem”, since water management needs to account for water as ‘a natural and a social and an economic good’ (Rittel & Webber 1984). This ‘and-and’ nature of water is further complicated for the developing countries in South Asia, when national aspirations for economic growth and urbanization are at play.

The nature of common-pool resources like water is such that its management is governed by various actors at multiple levels. These actors may be formally independent of each other, while operating within the same interdependent system. Nobel Prize winner Elinor Ostrom termed such a system of governance, where
decisions by actors are affected by and affect those of others, as polycentric governance (Ostrom 2009).

She argued that humans have ‘more capability’ to solve social dilemmas and the potential to develop institutions that bring out the best in humans. These institutions and ‘best practices’ must be concretized through public policy and exhibited by actors at various levels.

For instance, NGOs and think tanks highlight the environmental impacts of inappropriate water management, and corporations encourage innovation to develop cost-efficient and environmentally feasible practices.

Given water’s poly-semantic nature, each actor, by exercising differential degrees of agency, must assume certain roles in attempting to tackle the complexities of water governance.

Urbanization and its trickling implications

Globally, over the twentieth century, urbanization has acquired a heightened momentum in the quest for development. The escalation of urbanization has led to the growth of rapidly multiplying peri-urban areas near cities that withstand the carry-over of urbanization.

The term peri-urbanization refers to a process, often a highly dynamic one, in which rural areas located at the outskirts of established cities become more urban in character (Webster & Muller 2009). The excessive pressure on urban infrastructure, services, and municipal corporations has led to an enormous informal groundwater market which has arisen in several cities to bridge the demand-supply gap.

Peri-urban areas witness change in two ways. First, they cater for the rising urban economic class that is ready to pay for a constant water supply through the sale of water fuelled by an informal water-tanker economy. Second, peri-urban areas and their inhabitants are at the receiving end of the wastewater produced by cities, and suffer the consequences in the form of polluted rivers, industrial and domestic waste, and a damaged urban ecosystem (Prakash 2014).

In a scenario such as this, water governance acquires greater complexity. Patterns of urbanization in the global South are marked by spatially uneven rates of development and growth, influenced by economic and socio-political drivers, (Mundoli, Manjunath & Nagendra 2014).

The access to water services in peri-urban areas is determined by ‘policy driven’ and ‘needs driven’ practices; the former sanctioned by the State, and the latter not having State support (Allen, Davila & Hofmann 2006).

Further, water needs of the peri-urban water poor are met neither by conventional approaches, such as the expansion of networked public utilities, nor through formal large-scale private sector companies. The peri-urban poor are exposed fully to market forces but they also deploy a broad range of individual and collective solutions to their water-related challenges, which operate on the basis of solidarity, reciprocity, or need. These are often manifested in the form of informal operators, privately operated wells, gifts from neighbours, etc., which conventional centralized approaches to service provision find complex to address.

This marks the importance of legal pluralism in water governance (Narain 2003).

Alternatives within water governance

As an antithesis to the growing perception of the ‘inefficient state’ in the 1980s, economic liberalization led to the emergence of private actors in the sphere of resource governance. The World Bank restructured the national fabric of the water sector in developing countries and promoted the use of the price mechanism, arguing that it is economically unfeasible for developing countries to provide water subsidies.

However, other concerns such as poor performance, disputes over price increases, issues with service quality, etc. led to the re-emergence of municipalities taking control over water supply. Remunicipalisation involves transferring the governance of water supply and sanitation services from private sector management to public administration. Corruption and inefficiency plague many water municipality systems. And, while water tariffs are necessary for the provision of water services, municipalities are still better contenders, since they are not motivated by profit maximization.

Although the ‘full-cost recovery’ argument is often used as a justification for privatization, it is important to recognize that recovering costs is the only baseline incentive for companies, while they want to maximize their profits (Urs & Whittell 2009). Private utilities often inflate water rates hurting the affordability for economically weaker sections, and aggravating
their disadvantaged position in society. This makes water reform a tricky project, while attempting to make it increasingly "poor friendly". A recent study showed that 180 cases of remunicipalisation have occurred since 2001 across 35 developed and developing countries, most occurring in the last five years (Lobina, Kishimoto & Petitjean 2014). In 92 cases existing contracts with private institutions were prematurely terminated by municipalities, suggesting that private control of water was unsustainable in the long-term, affecting both access and affordability. Only 44 cases occurred in low and middle-income countries, of which merely 5 were recorded in South Asia.

The scantiness of remunicipalisation cases in South Asia indicates that the free market ideology is deeply ingrained in this region compared to other regions in the world. In one of the cases highlighted by the report, a water concession in Selangor district (which includes Kuala Lumpur) held by Syabas, a private company, is currently being transferred to the state. Syabas was found to charge double the price for water compared to other states. Also, it appeared that 72% of its contracts had been awarded without an open tender (Lobina, Kishimoto & Petitjean 2014).

A critical review reveals that such issues can occur in any governance scenario, which contradicts ideating remunicipalisation as the silver bullet that counters privatization’s cons, or vice versa. Instead, as Ostrom argues, different actors hold various decision-making powers and can contribute toward building institutions that result in the best outcomes.

In support of Ostrom’s view, the development of Independent Regulatory Authorities (IRAs) in the water sector provides an example that upholds the idea of polycentric governance (Wagle, Wargha & Dixit 2009). Pertinent state-wide laws were implemented in Maharashtra and Uttar Pradesh in India, in 2005 and 2008, respectively. They follow the IRA model in an attempt to address the wicked problem of resource governance (resources of an ‘and-and’ nature discussed earlier).

The IRA model includes specific roles to address different layers of complexity. These roles are divided in the following manner: the State is responsible for developing a broad policy framework; IRAs are in-charge of the regulatory and decision-making tasks, and expected to be sector experts; the private sector is responsible for service delivery under the IRAs’ supervision; and end-users partake in community management of water.

Polycentric governance models would curb the pursuit of private interests by corporations, using regulatory mechanisms (such as IRAs), while retaining broad policy and decision-making powers with the State.

A further optimization of this model may involve encouraging another key actor – private enterprises – to pursue social missions instead of the traditional profit-maximizing businesses. Social enterprises (SEs) attempt to correspond to the social dimension of water, not only its economic dimension. Therefore, they are more likely to succeed than traditional businesses in curbing excessive marketization of water (Morgan & Seshadri 2014).

Examples such as the Grameen Veolia Water Ltd. (GVW) are currently in operation. The GVW is a pilot project aimed at using business models to resolve water-related issues for vulnerable communities in Bangladesh.

The three year action-research project aims to identify solutions for other SEs working on similar issues.

Projecting a way forward

The literature on environmental governance and participatory governance has led to the concept of collaborative resource governance (Neef 2009). The range of institutions that has stepped into water governance has altered their interdependent relationships within the dynamic realm of the market. Higher rates of urbanization and the increasing demand for water in peri-urban areas have further stressed governance systems.

In the pursuit of socially inclusive solutions, polycentric governance may be a suitable conception for research and consideration, in a scenario where governance is entrenched with differences of power and agency of actors.

The essence of polycentric governance does not necessarily call for decision-making at the ‘lowest possible level’. Instead, it allows for leveraging the opportunities and benefits of various levels and range of institutions.

Polycentric governance may seem cumbersome and chaotic in comparison to decision making that is broadly governed by the principles of
command and control. However, this form of governance offers advantages such as local knowledge, monitoring by interested stakeholders, the ability to customize rules to local conditions, easier adaptation based on learning from experience, and potential gains from multiple local ‘experiments’ operating in parallel (Yong, Burns & Randolph 2003). Institutions at varying levels, given their own dispositions, have attempted to tailor themselves in response to the commodification of water, fragmented access, and conflicts over access to water within this dynamic political scenario.

The merits of this model allow for a shift from absolute bureaucratic centralization, while simultaneously not spiralling into a discourse of governance solely executed by local communities, but instead paving a way for multiple stakeholders to assume a participatory role in governance.

The prevalent discourse not only on the need for accountability to citizens but also to assume environmental responsibility calls for a more comprehensive philosophy of governance. The administration of water resources is a highly complex project, given its uneven distribution, and its dire need for sustaining socio-economic activities of large-scale global economies. The challenges globalization additionally brings about, such as the tricky issues of Tradable Property Rights (TPR), patents on water technology, and illegal water use, call for an institutional diversity that can attempt to cope with the implications of such challenges.

References


India. Water Policy, 16(3), p.454.


Sustainable development as an emerging and evolving concept has been utopian and fashionable in both thought processes and approaches. As a part of the broader process of problematizing global survival, sustainable development induces the re-working of the relationship between nature and society (Escobar 1996). This re-working has been the core struggle of urbanization. Unplanned urban development has led to complex challenges with increasing population densities, collapsing utility services and infrastructure, constrained resources and inequitable distribution, unmet needs of vulnerable habitants living in informal settlements, and increasing risks of extreme climatic events.

Deconstructing the urbanization crisis is a challenging task, where sustainability gurus call for better planning and management with the broader dimensions of economic, social, and environmental change. However, planning and management itself embody the belief that change can be engineered, directed, and produced at will (Escobar 1996) through techno-managerial approaches.

These approaches have been challenged by emerging concepts and grass-root movements like ‘Slow’ urbanization, calling for intrinsic changes in urban behaviour and practices for the implementation of sustainability.

‘Slow’ as a concept evolved in the 1980s in Italy to revolt against the fast culture and lifestyle of the growing consumption economy with a social and environmental consciousness (Pietrykowski 2004). This came to be manifested in the form of ‘slow food’, with the promotion of local produce against the growing fast food culture.

‘Slow’ also perpetuated the interdependence between urban design and social construction of a place in the material world and the relationship between the pace of life and the capacity to facilitate routine encounters and shared experiences (Knox 2005). Studies, however, showcased that the movement had humongous challenges in overthrowing the establishment of the big industry to bring about widespread changes (Jones et al. 2003).

Nevertheless, the slow urban movement captured imaginations of sustainability practitioners through the symbols of slow food, limited material consumption, and effective spaces that facilitated a better urban lifestyle.

The practicality of ‘Slow’ became a reality when author William Powers lived the concept and documented it in ‘New Slow City’. Powers decided to experiment with minimalist living and an alternative to the consumerist and materialistic lifestyle of the American dream.

The paradigm shift came through a conscious decision to shift to a 350 square foot ‘micro-apartment’ in Greenwich Village, New York City. By downsizing the material stuff to 80% and downshifting to a two-day workweek, the author experimented with slow living elements or tools like silent meals and slow money, technology fasts, and urban sanctuaries.

He argued that the motto of less and slow with a promotion of community living was to bring in a change in mindset in the face of growing temptations of capitalistic consumerism.

Powers claimed that urban cultures ‘condition’ us to be busy, robbing the very thrust of human existence. But by practising efficiency and organizing time smartly around a busy city schedule, Powers demonstrated ways and means to explore and discover hidden cultures, and nurture positive qualities that define and bring in an intrinsic happiness to a rather stressful city life.

‘Slow’ thus gets defined as a self-paced minimalistic life through a production and consumption cycle that is strengthened by the practice of reuse and recycle. The tools adopted by the author for a slow, simple, and self-paced living are leisure ethics, slow food, yoga, daily mindfulness, right speed, appreciation of culture
through music and museums, natural time, urban sanctuaries, slow travel, and smart filters to avoid consumerist advertisings.

Powers emphasizes that slow brings in more time for relationships through connectedness with local characters like the fish seller, the rooftop farmers, the pigeon guy, the musicians, etc. He also demonstrates approaches through which food, money, and work are more planet and people friendly.

The book is divided into three seasons to demonstrate the transition and scheduling of self in accordance with seasonal moods and local happenings. Part I (Spring to Summer) is a narration of the author’s conflict in deciding on a transition lifestyle from the luxuries of a large home to searching for the ‘Natural City’ in New York, to apply the concept of slow and the physics of happiness through a myriad of conflicting choices, decisions, and experiences. He explores and discovers cultural hideouts like the Jam, rooftop agriculture, Tar Beach, and urban sanctuaries to keep him company on his five-day weekends. The concept of natural time is debated and argued against the set pace of industrial time in urban setups that leaves no time for cultural activities and relationships.

The author has explored different perspectives on the concept of slow food, where he looks at food being power, local social change-maker v/s status-maker v/s escapism to food being love. Part II (Autumn) is a debate on alternatives to growth through a paradigm shift, where the author narrates experiences of consumerism and a capitalistic lifestyle that engulf and tempt his daily life.

This part gives an explicit account of his encounter with Hurricane Sandy, and changing climatic conditions and growing vulnerabilities of local populations in the face of growing climate extremes.

He calls for a silent and conscious realignment of thought on a more self-paced, simple, and minimalistic life rather than the promotion of a fast-paced, consumerist, and consumption economy.

In Part III (Winter to Spring), Powers experiments with slow travel in Morocco while debating on transiting and setting up base at a new place with the experimental lessons on slow living learnt in New York. By living on the edge in New York, he justifies that a new and broader definition of space designed around essential and elemental living has prepared him for future challenges and resource constraints.

Written from a practical perspective on sustainability within boundaries of resource and space constraints, the book broadens the prospect of implementing sustainability in urban areas through a more social and cultural outlook combined with good technological and managerial advancements and practices. It is a practical guide on parameters for people researching and experimenting on slow cities and sustainable living.

Though the author has romanticized and idealized the concept to some extent, the experiment in itself is a massive and great start for the slow-city movement in a large city like New York. I would have appreciated if he could have woven into the concept of slow living aspects of water and energy efficiency, and other resource constraints that engulf large cities.

The concept, however, brings in a bit of scepticism and pessimism of practising this approach in developing countries and large cities of Asia and Africa. This would be due to large population densities, stressed resources, socio-economic and cultural challenges, a different work ethic culture, other development priorities, inefficient planning, and management tools that are more growth oriented with little or no afterthought for the interactions and relationships between social and environmental spaces.

Though evolving as a concept and rather far-fetched for full implementation, embracing the slow concept for newly planned cities could be a good start to sustainability planning. This would require a change in mindset, institutions and cultures with a strong co-ordination between top-down planning and management, along with grasp-root social and cultural changes.

References


The world is increasingly dotted with conflicts over natural resources, especially in the global South. Their increasing prevalence demands that approaches be developed to understand, and to resolve or manage these conflicts. Several disciplines have made inroads into the field. As a subject of social inquiry, conflicts raise questions cutting across disciplinary boundaries, demanding a multidisciplinary approach to blend theoretical frameworks as well as methods to gain perspectives on conflicts. A part of this academic pursuit is embodied in a recent volume, Conflicts over natural resources in the global south – Conceptual approaches, whose editors and contributors belong to a wide range of disciplines.

The research contained in the volume was conducted under the CoCoon project – Conflict and Cooperation over Natural Resources in Developing Countries –, which is funded by the Netherlands Organisation for Scientific Research (NWO). CoCoon, according to its website, seeks to provide and facilitate the use of evidence to aid conflict resolution, and also to find solutions that can help sustainable development and poverty reduction.

The volume, accordingly, has an express focus on how conflicts affect livelihoods of the rural poor –‘the troubles that prevail and the ways in which people cooperate to resolve them, for better or worse’ (Introduction chapter). Case studies form the core of the book, and theoretical frameworks emerge, as the chapters follow a ‘middle-range theory’ – a method to construct social theory by abstracting from empirical phenomena (Merton 1968).

One such framework found commonly in the volume is the legal anthropological notion of legal pluralism. De Theije et al. (Chapter 8) use this to understand conflicts in small-scale gold mining in Suriname, Brazil, and Colombia. In a weak state -regulatory regime, state law is accompanied by ‘parallel arrangements’ legitimized in customary law, and agents involved in mining are constantly negotiating their positions with reference to different systems. Conflicts emerge when actors base their claims to access to and rights over resources in legal orders of different systems of legitimacy.

This framework is also used by Bavinck, Sowman, and Menon (Chapter 9) to study exacerbation of conflict in fishing grounds of the South-Asian seas. While conflicts in the era of customary fishing laws were symmetrical and actors were on equal footing, the imposition of state laws (along with industrialization and globalization) has led to unequal interests among fishermen, who refer to different legal systems. The lack of consensus on rules complicates traditional conflict management and makes fishing conflicts ‘more explosive, of longer duration, and more difficult to resolve than they were before.’

Along the theme of law, Zaitch et al. (Chapter 6) offer an innovative approach in conceptualizing conflicts though ‘green criminology’. Such a perspective highlights the violation of peoples’ rights and, by identifying victims, perpetrators, and ‘harm’, can help effective interventions. With this approach, the authors seek to enhance the rule of law and good governance.

Two studies analyse the role of national ‘top-down’ politics in resource conflicts and governance. Arsel et al. (Chapter 7) describe changes following nationalization of mineral resources in Bolivia and Ecuador. They argue that these changes should not be seen just as transfers in property rights, but as a form of collective action, where the transformation of collective-choice rights brings the state and society into a confrontation.

Another such insight into the role of national politics is provided by Smidt et al. (Chapter 5), who analyse the role politics can play in groundwater governance through case studies of Ethiopia, Yemen, and Palestine. The study aims to uncover the relationship between the so-
called ‘political black-box’, conflict, and cooperation, in order to shape intervention strategies for improving groundwater governance. The authors also discuss ‘voids’ where resource degradation takes place without any (apparent) conflict or cooperation.

Similar broader notions such as ‘social contract’ and a nation’s economic dependence on natural resources are used to understand conflicts (Chapter 3). The ‘social contract’ refers to mechanisms in a society to deal with conflicts. When such an understanding over sharing of resources breaks down between members of society, conflicts may emerge. This is possible when the state’s capacity to provide welfare and also to maintain law is compromised, such as during transitions to or from democracy.

While the broad mosaic of themes and locations make a synthesis of the chapters difficult, the editors draw useful implications for the concept of conflict. Conflicts may not be an antithesis to cooperation, which may exist in a larger context of conflicts and still not lead to confrontation. Here a conflict is necessary, because it can change an unjust status quo. Conflicts also do not always arise from scarcity of a resource or from a resource at all. They may, instead, be due to social tensions, or arise from failings in institutions, or a combination of one or more of these factors.

These are critical insights, broadening the focus from the mere material realities of conflicts—resources or the expanding frontiers of extraction—to the arena of social relations. In fact, Frerks et al. (Chapter 2) assert that tensions over access to resources have multiple sources and need ‘multi-causal, multi-layered, and multi-actor perspectives’.

However, this is also the principal criticism of the book. Despite the broad mandate in the title, the volume actually gives a disproportionately large space to the perspectives of institutions and governance.

A glance through the volume’s index reveals that the term ‘governance’ appears on 38 pages (in six chapters), ‘institutions’ on 28 pages (nine chapters), and the phrase ‘resource governance regimes’ on 6 pages (two chapters). In comparison, political ecology is cited only in the study on fisheries (Chapter 9) to describe power relations that shape fishing policies, and the unequal impact of fisheries allocation on different groups. As the authors agree, this is an important paradigm in resource conflicts. Yet it has been ignored in the rest of volume.

For instance, the study by Timko on conflicts around the Jatropha plantation (Chapter 10) highlights the issues of land alienation and decrease in size of land holdings in locations where such plantations exist, but the analysis nevertheless assumes that ‘Jatropha must have positive household-level socio-economic impacts.’ Here the stated focus on livelihoods precludes any fundamental questions local communities may have such as biomass appropriation, diversion of water resources, as well as impact on gender relations, loss of rights to culture, etc.

‘Livelihoods’ is not the only concern in conflicts over natural resources. Ecological economics literature theorizes that different concerns expressed in such conflicts such as ‘ethnic identity’, ‘sacredness’, ‘community life’, and so on, are incommensurable values people place on nature (Martinez-Alier 2002; Avci et al. 2010).

In fact, the large body of research linking political ecology with ecological economics has made significant inroads into studying conflict over natural resources. Briefly, this paradigm argues that the social metabolism (the inputs of materials and energy, and the release of waste and heat) of economies causes potentials for conflicts at each of these two ends (input and output). This ‘physical basis’ links with social relations as differences in valuation of resources and with political ecology as how power relations affect which values take precedence over others. It defines ‘ecological distribution conflicts’ as conflicts arising from an unequal or unfair distribution of ecological ‘benefits’ (minerals, forests, energy sources, cultural identities) and ‘costs’ (such as pollution, ecological degradation). These could apply to many case studies in the volume, for example in small-scale gold mining conflicts (Chapter 8), the EAPCC case (Chapter 4), and also in questions of nationalization (Chapter 7). But the notion found no place even in the chapter that sought ‘conceptual clarity’ on the terms ‘natural resources’ and ‘conflict’ (Chapter 4).

Tools for ‘cooperation’ emanating from this paradigm, like social multi-criteria evaluation and other deliberative methods (Wilson & Howarth 2002; Munda 2008), can likely complement political and governance-focussed cooperation frameworks discussed in the volume.

Such insights also unpack the cooperative process by highlighting value judgements. When we speak of cooperation, what is the ‘right’ solution or cooperative outcome is an effort to
resolve or mediate incommensurable and incomparable values, especially with respect to natural resources (Martinez-Alier et al. 1998).

In fact, the volume touches upon several ideas from this field, without explicitly naming it. Examples include ‘social values’ as different from economic and financial values of ecosystems and relevant to different stakeholders (Chapter 4), and the various allusions to ‘political ecology’ described above. Why these perspectives were not included then, is an open question.

Arguably, there is much the CoCoon project can learn from ecological economics and political ecology. A union of the two would add to the multidisciplinarity and the improvement of interaction between research and non-research institutions (see Healy et al. 2012), an objective also of the CoCoon programme (Chapter 11). It remains to be seen if the project, and the book’s editors, are willing to take this up. (ENDS)

References


¹ The exclusion of ecological economics is the more surprising given that the Introduction chapter quotes Nicolas Georgescu-Roegen. His seminal essay Energy and Economic Myths (Georgescu-Roegen 1975) inspired the field of ecological economics. Yet the only sentence cited was a relatively minor observation on how conflicts are materially wasteful. While one might allow this oversight as a result of the book’s apparent tilt towards governance-based approaches, there is nonetheless a (single) chapter on an ‘economics perspective’ (Chapter 3) – which in reality is a ‘neoclassical economics perspective’.
Neoliberalism and Water: Complicating the Story of Reforms in Maharashtra


Aditya Kumar Singh
Student, MA (SDP), TERI University

The book under review is an analysis of the complication of reforms in the water sector in Maharashtra. Priya Sangameswaran, the author, is Assistant Professor, Development Studies, Centre for Studies in Social Sciences, Calcutta. She holds a Ph.D. in Economics from the University of Massachusetts Amherst, U.S.A.

This book illustrates the remoulding of urban and rural drinking water supply and irrigation with reference to various sub-sectors and institutions in the state of Maharashtra. The author has tried to describe the processes of water governance and their relationship with the economy. They are analysed through a prism of neoliberalism, which works in combination with other processes, namely, decentralization, commercialization, commodification, and pricing.

The book comprises six chapters. The introductory chapter presents the data on which the book is based. The author starts with a birdseye view of the discourses on water and development – GEM (Global Environmental Management) discourses, water sector reforms, their key elements, and general features.

The latter half of the chapter is on the principal concern, water reforms in Maharashtra. It touches on each sector individually: urban, rural, and irrigation. While providing the reader with a holistic outlook of the scenario, the author has also given critical remarks about it. She demonstrates the links between reforms and neoliberalism, and how neoliberalism and water reforms create a convoluted environment.

The author uses an anthropological approach with a ‘focus on processes, meanings, and subjective dimensions’, although it was ‘not possible to do ethnographies (in the strict sense of the word)’ (p. 50). The primary data collection was carried out between November 2006 and May 2008, and follow-ups were done until 2010. Developments after that are explained in a postscript.

Chapter two describes the shift to 24x7 water supply in cities and piped water in villages in Maharashtra. The author compares the waterscape of rural and urban spaces, generating an appealing understanding about the similarities and differences as well as the relationship between the two. She highlights the importance of political support in the success and failure of certain schemes. For instance, the BJP-Shiv Sena party rallied on the slogan of ‘Tanker Mukt’ (Freedom from tankers), and by 2000 Maharashtra was tanker-free and moved towards piped water.

Priya Sangameswaran describes the important strands like community, entrepreneurialism, vision of development, and their varying perspectives of water management in urban and rural contexts.

Neoliberal water reforms are demand driven. She explains this through an interesting case study from a village in Shahapur Taluka of Thane district. Under the Jalswarajya Scheme, community lunches were organized for the purpose of capacity building, but the villagers started getting their food from home and used the lunch money for the contributions to be made by them. The author argues that, firstly, they were not closely knit with each other and, secondly, the initial contribution at individual level was against their understanding of community living. (p. 65).

Chapter three focuses on discourses of self-sufficiency, depoliticization, and expertise, and the implications of these discourses for (processes of) decentralization. The three discourses are discussed individually.

The author explains that any number of inferences derived from the stress on self-sufficiency are not necessarily problematic, and changes have to be evaluated as much in symbolic terms as in material terms. In this context she refers to Coelho (2006): ‘the policy of eliminating public stand posts that was justified by a high-ranking official of the state government in terms of a more ambitious vision of promoting private water connection and private toilets in slums’ (p. 94).
Secondly, the author points out critically that desirability of attempts to be ‘apolitical’ is itself questionable, that either the decentralized institutions can co-opt with local powers or a newer form of politics will develop.

Thirdly, knowledge has inherent power dimensions and expertise is a created hierarchy within the knowledge domain of water reforms. As the author explains: ‘The experts were often young graduates of Masters in Social Work programmes’. At times, there were also people from other backgrounds (p. 113) and ‘the sector reforms in water have led to a change in the character of experts who now range from old government actors to newer private actors, and from those who focus on technical aspects of water provision to those dealing with its social and economic aspects’ (p. 117).

The author argues that the discourses of self-sufficiency, depoliticization, and expertise are not smooth and simple. Instead, they will burden rural and urban bodies with all the responsibilities of a project, since they may not have sufficient resources or mechanisms to provide basic services. Another tricky issue is to find the right combination between the decentralizing and regulatory tendency, as well as the division of labour and accountability. Lastly, decentralization has been more widely accepted, despite its fewer benefits, than centralization.

Chapter four brings out the other important processes that are part of water sector reform (i.e. commercialization, commodification, and pricing). These processes represent the most disputable facet of reforms in the water sector as well as the one most closely associated with neoliberal ideologies.

In tying the three ideas together, Priya Sangameswaran concludes the chapter by arguing convincingly that neo-liberalization has left nations with the dominant ideology of water as something that is commercial, and needs to be commoditized and priced. This hegemony has led to a particular perspective of water at a symbolic level as well.

Chapter five highlights the necessity for a more nuanced approach to privatization. It further draws attention to the difference in old and new forms of privatization and their interaction with newly emerging processes. The author explains that the problem of privatization discourse is the projection of itself as the only means of providing affordable water supply. It negates the discussion of other alternatives. In her opinion, the relationship between the public and private in the context of neoliberal development would also necessarily be complicated.

The understanding of such complexity is carried forward to the reading of chapter six, where the author concludes in uncertainty about the developments in the reforms of the water sector: ‘Whether such a more nuanced and progressive politics comes up in all instances of neoliberalisation of water and whether a new language and discourse of alternatives develops as well as what kind of a re-formed water sector these would lead to, remains to be seen’ (p. 279).

Much to its credit, the book provides both the eagle’s and worm’s eye view. It is indeed a timely contribution. However, the book leaves much to be desired in the style of writing. Information-based text can perhaps be written in a lively and lucid style. It is important to keep in mind that the target audience is referring to this book mainly in order to gain information and understanding. The use of simple language and comprehensible explanation of a complexity is indispensable.