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53

Non-formal Water-mining in Urban Sprawl
A case of Susuwahi, Varanasi

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The unmonitored individual water-mining poses threat to environment. Further, in urban sprawl poor sanitation results in contamination of groundwater. The both processes together have an adverse impact on the vulnerable section of society, who are not extracting resource (water), because of incapability to invest and they only will be victims, when the quality deteriorate to the extent of unusable resource because of high expected price of rare commodity. Based on the survey of 240 households in Susuwahi, the paper discusses household's adaptation strategies in meeting the demand of water in light of the two outlined conditions. The existing private arrangement for water in the sprawl driven by multiple factors: availability of water; almost zero operational cost and the issue of identity. In such situation, political ecology approach can be of vital use to analyze the systems of political and economic control over environmental resources, existing power relation that define such control and also socio-political and environmental implications in water-rich region.

Keywords: Political Ecology, Urban-sprawl, Water-supply, Water-mining, Sustainability.

Introduction

Planners and managers of the cities of the developing countries like India face an enormous task due to increasing demand of infrastructure owing to fast growth of cities (Devas and Rakodi, 1993). With continuous growth of urban population demand for urban water has been increasing. The problem is fueled with unplanned outward expansion of Indian cities, where population moves towards the areas which are formally villages not covered by municipal service provision, but functionally part of the city. The challenges related to water, associated with broader environmental concerns are quality and quantity and therefore put a challenge to the efforts of sustainable urbanisation (Lahiri-Dutt, 2008; Smith 2001). As, water-supply is a basic service the growing crisis of it poses huge challenge to urban municipal and planning bodies (Amos, 1993; Sarangi, 2002).

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54

URBAN INDIA

Water is normally considered a ubiquitous resource that is available and accessible to all with a certain degree of variation. In India, on the one hand providing water to thirsty is the noblest work, on the other hand most brutal treatments have been given out to the section of society on the issue of water. *A walk through an India village and peripheral area of a city or town reveals the hard fact that on one hand there is charity counters for water and on the other in the morning or evening most noisy place (quarrel) is around public water tap. With expanding cities, the ecological footprint of water is becoming ever-expanding that even goes to sea and draws attention from various quarters. Water is now used as basic necessity, provided as basic services, discussed as scarce resource that needs to be preserved and has become an issue of contention due to undefined rights on water. This crisis situation and its implications has been part of a larger global debate related to water, and ecology, which cannot be isolated from larger political questions regarding right to this basic resource, its ownership, the methods of extraction, access and pricing (Dwyer, 2006; Lahiri-Dutta, 2008; Fisher, 2008).*

There is plethora of literature that debate the issue of water supply in urban areas to depleting ground water level in various regions to also the rights on water in water-scarce areas (Anand et al. 2005; Ashana, 1997; Drew, 2008; Dwyer, 2006; Fisher, 2008; Gosh, 2008; Hajkowicz and Collinson, 2007; O'Hara and Georgakakos, 2008; Smith, 2001). These studies have raised range of issues that can be simplified in to three main issues viz. supply, demand and sustainability. There have been institutional efforts to study water supply, mismatch between water supply and demand, estimated future scenario, and so on (ADB, 2007; CDP, 2006; UNESCO, 2007; WHO, 2002). However, most of the studies have remained confined around two themes: 'cost-benefit analysis', and 'sustainability'. Both groups of the studies have at best broadly ignored the conceptual aspect of the dynamic inter-relationship between nature and society and try to propose solutions for 'municipality' or for the 'poor'. Suggestions for municipality has been of good engineering and management especially recovering cost, not providing free water to all, and minimizing losses (ADB, 2007; Ashana, 1997; Dwyer, 2006; Mitra, 2008). The arguments for the poor have been from two corners: one that tries to see that the fundamental right of water and sustainable water supply remains with the poor (Drew, 2008; Fisher, 2008), the second group of study tries to provide free or comparatively cheaper safe drinking water to the poor (Kundu, 1991; Lee, 1997; Smith, 2001).

The situation is more complex for water supply especially in the 'water-rich' regions where water is not 'scarce' due to ecological conditions. Ecological conditions are often appropriated by economic, social, political and cultural needs or ignored in lieu of the other mainstream debates involving institutions and donors. Ecological aspects of water are included only when the situation reaches to the alarmingly dangerous condition either due to deterioration in quality or excessive draw owing to unchecked water-mining by individuals and firms at no cost to them. With such unchecked non-formal extraction of water, the quantity and quality both deteriorates and the direct impact in near future is high cost of water to the users and in distant future it is depletion of resource to the level that is not repairable. In both the scenario, the victims are always the poor and as they are comparatively more vulnerable and are less empowered to influence the decision making.

Written by Administrator

Wednesday, 10 April 2013 07:49 - Last Updated Thursday, 25 April 2013 05:58

NON-FORMAL WATER-MINING IN URBAN SPRAWL
A CASE OF SUSUWABI, VARANASI

55

In the context of the above, the paper tries to analyze the dynamic and intricate issue of water resource in an unregulated water-rich region taking the case of water management situation in Susuwahi, an urban sprawl in Varanasi. Based on the survey of 240 households in Susuwahi, the paper examines the household's adaptation strategies for meeting the demand of water. An analysis has been done comparing the actual municipal cost of water and the actual cost incurred in procuring safe drinking water. Political ecology approach is taken into account for a discursive analysis of the existing situation of urban water supply in peripheral area. So far, political ecology analysts have tried to study the scarcity or conflict of resource distribution, and the possible historical reasons for that. This work is different in this sense as it tries to analyze the water supply of a region that is not water scarce in terms of groundwater potential, but the potential threat to human health and the critical natural resource is far-reaching.

Political Ecology of Urban Sprawl

Growth of cities often produces a paradoxical picture. On the one hand is interpreted as sign of growing economy, while on the other it is believed that 'the sprawling giants of the twentieth century city was leading to inexorably to megalopolis and thence to necropolis, the death of the city' (Mumford, 1960; Wilson, 1995). Therefore, the planners have their task cut out to expand the phase of megalopolis to the maximum possible extent so that necropolis stage is delayed. This has to be done by reducing the ever-increasing pressure on infrastructure including water-supply and deteriorating environmental conditions like saving water-table apart from maintaining ambient air quality and keep pollution under check.

Urban areas are better explained as spaces of contradiction (Lefebvre, 1991; Wilson, 1995) so are the peri-urban areas. Urban thinkers have tried to explain the outskirts of urban areas as the centre of flourishing economy, lush green environment, the expected new face of city and so on. They derived such conclusion by basing their studies mostly of few western cities like Los Angeles and Las Vegas (Dear, 2000; Harvey, 2001; Soja, 1997). Some of the 'global cities' of the Third World also present almost similar picture, for example development around suburbs of Greater Mumbai and Delhi in India. It is commonly understood that suburbanization happens in class wave where bourgeoisie followed by middle class began to live away from the city center (Savage and Ward, 1993). Till nineties, suburbanization was understood as representation of meeting of particular type of demand and supply of housing and residential environments, which in 21st century changed with shopping malls and large food and dance joints getting developed on the periphery of the city. However, dualistic developments within almost all the cities of India can be explained through existing phrases like 'garden city vs. garbage city'; 'prosperous city vs. fading city'; 'thriving outskirts vs. pitiable periphery'.

The city of Varanasi, like any other third world city, presents the picture of this contradiction vividly.

56

URBAN INDIA

This contrast is visible in terms of available physical infrastructure, provision of basic services to the citizens, landuse planning and environmental conditions in the two different physical entities. On one side of the city the suburb is an ensemble of large Malls, elegant housing complexes, gigantic hotels etc.; while on the other one encounters, irregular streets with no sanitation, no sewerage, conspicuously absent public water-supply system and completely absent waste collection system. This contradiction results in different standard of urban environment in perception and in reality both. There is waste-water flowing over the roads and streets, degradable and non-degradable waste make a heap of garbage in the neighborhood, moreover, the modern city especially suburbia has become a locus for changed situation with animals and plants. This different standard of urban environment across city and its periphery is primarily an outcome of the fact that spaces are occupied differently by different class and are produced owing to hierarchical mode of production in highly hierarchical social structure (Dear, 2000; Harvey, 2001; Lefebvre, 1991).

Any generalization about city is not universal as geography is so diverse that changing spatial location changes the entire economic, social and ecological structure. It is here that the political ecology approach becomes imperative. Political ecology as a framework tries to capture these divergences of ideas and allows a deconstructionist analysis. Political ecology in recent literature has gained much attention since late eighties in resource management and rural development studies (Atkinson, 1991; Escobar, 1999; Keil et al., 1998; Martinez-Alier, 1995; McCarthy, 2002; Peet and Watt, 1996; Stott and Sullivan, 2000; Strange, 1996; Zimmerer and Bassett, 2003), but recently though not at large scale the framework has also been applied in urban studies (Carle 2000; Moffat and Finnis, 2005; Njiru, 2006; Smith 2001; Swyngedouw and Heynen, 2003). Political ecology research normally focused on resource and its impact of everyday life and social relations (Blakis and Brookfield, 1987; Peet and Watts, 1996; Rocheleau et al. 1996; Stott and Sullivan, 2000) with an emphasis on poststructuralist theories and discourse analysis (Beakhuist; Escobar, 1999; O'Connor, 1994; Lipietz, 1995; Peet and Watts, 1996; Swyngedouw and Heynen, 2003) and the discourse of environment and its relationship to the economy becomes a feature of superstructure. Urban political ecologists also accept that the socio-ecological footprint of the city has become global in real sense, there is no limit to the city and the urban process harbours social and ecological processes that are embedded in dense network of local, regional and global connection (Swyngedouw and Heynen, 2003). There is a need to look at the urban as a process of socioecological change rather than spatial transformation or economic transformation or economic restructuring. A small case of non-formal water-mining in the city of Varanasi is thus taken to understand the variant of the intrinsic interrelationship between resource and population and the obvious and prospective implications on environment.

Susuwahi represents a mixed characteristics of rural-urban economic, sociological, ecological value and systems. Location of the area is along the artery connecting the city with the newly constructed highway that connects two major nodes (Delhi and Kolkata) of the country. Owing to proximity to the Banaras Hindu University, it has been choice of residence for the retired people, who understand importance of fresh air. They do believe that the social power will have an impact on municipality to

NON-FORMAL WATER-MINING IN URBAN SPRAWL
A CASE OF SUSUWABI, VARANASI

57

provide physical infrastructure and basic services later on. The importance of social power structure and its expected long term impact on the socioecological settings of the suburban area has been of little attention in urban studies so far. The area experiences (unequal) power structure and politics that has determined various processes of environmental changes. This unequal power relation has strong implications on the ways changes in allocation and utilization pattern of natural resources (water) are taking place in this area. Mitra (2008) in a similar work used political ecology approach to analyze the ways in which natural resources got allocated and managed with particular emphasis on the interests of weaker social actors. In this study, socio-ecological setting of the suburb is analyzed to develop a framework to study the conflicts over access to environmental resources. The political ecologists have tried to analyze this linking to the system of political and economic control that determines environmental relations (Bryant and Bailey, 1997; Keil et al., 1998; Swyngedouw, 1997). Keil (1994) has argued that environment is not just an ideological construct but is also an articulating ideology and a material praxis an active part of political economy. The way we conceptualize nature, ecology or environment is part of the material praxis of reorganizing the societal relationship with nature. This understanding emphasizes primarily on resource scarcity and environmental conflicts and crisis in society and the relation that determine the distribution of limited resources. The case of Susuwahi, Varanasi takes up the issue of non-scarce resource and its implication of urban sustainability for a mid-level city of large populous country of India, as there have not been many studies in this framework, especially in mid-level cities of third world countries.

The Study Area

Varanasi is one of the 35 urban agglomerations with more than a million populations in India (Census 2001). The city is situated on unconsolidated formation in middle Ganga valley on the left bank of river Ganga (Fig. 1). The city is the district-headquarter of Varanasi district of Uttar Pradesh spread over an area of 112.26 sq. km. and consists of 7 urban sub-units. Varanasi town lies between the 25°15' to 25°22' North latitude and 82°57' to 83°01' East longitude. The city is situated along the river Ganga in between Assi and Varana with new areas expanding and amalgamating in the city beyond these two streams. Geologically it is situated in the fertile alluvial Gangetic plains and is under laid with sediments deposited in successive stages. Average annual rainfall of the city is about 120 cm and is sufficient for recharge of soil and groundwater for normal extraction of water. Being an old religious centre, it attracts large influx of tourist that adds to its floating population. The city has expanded like any other the country and has grown along main roads in almost all direction, with no distinctively identifiable suburb except the one that is yet to be developed 'Sahara City'.

Susuwahi as an urban-sprawl

In the master plan of 1971, the area of Susuwahi was identified as the area that was to be developed as an institutional area. The master plan never got implemented and the villagers continue to sell the land to different people depending upon the various primordial associations and identities. Consequently,

Written by Administrator

Wednesday, 10 April 2013 07:49 - Last Updated Thursday, 25 April 2013 05:58

the areas got converted to a residential hub but without streets, sewage or other amenities. The plan under JNNURM (2008) aimed to upgrade Varanasi as a metropolitan region incorporating villages around it. Susuwahi is to be adopted by the municipal body, though; any evidence is yet not visible on the ground either in terms of provision of basic physical infrastructure or in terms of evaluation of property tax or enhancement of circle rate for land. The survey suggests that most of the house owners in the region are retired staff members of the university. The tenants are either students or newly joined staff members of the university as the university has limited residential capacity in the campus. The area is classified as village (the last Panchayat election was held in 2010) in all official documentation including census and as best can be called *sprawl* or the out-growth for practical purpose.

Social Profile of the Study Area

As discussed above, majority of population in Susuwahi are other than original inhabitants. Out of 240 households, about 60 percent were reported to have migrated in last 10 years. About 30 percent surveyed households were found to be the original inhabitants and remaining 10 percent have settled in the area prior to 10 years. Out of the 30 percent original inhabitants, about 40 percent belonged to upper caste (*Bhumihars*). These upper caste *Bhumihars* (a sub-caste of *Brahmins*) are the land owning caste in the area. About 20 percent of the original inhabitants were from different castes of dalit community; while remaining 40 percent reported to belong to middle caste namely, *Yadavs*, *Kurmis* and *Baniyas*. It was interesting to notice that caste remained a considerable factor while selling off land. The migrants purchased land from these upper caste *Bhumihars*, who decided to sell land only to the selected caste, as this was going to decide their prospective neighborhood. Land was sold either to the persons belonging to same caste or to the occupational elites (as perceived by the villagers) like university faculty, bank employees, retired defense personnel and so on. The question about income was most uncomfortable one; as the caste elites are still not ready to accept that the people who are settled on their land have higher actual earning than them. The standard of living amongst the migrant households was better compared to land-owning villagers. The majority of original inhabitants were not having gadgets like washing-machines and water-purifiers. Some of them were found to be unaware about the water-purifier and rest opposed on the basis of old existing traditions. Majority of non-migrant households (about 60%) showed unwillingness to use washing machines; while rest revealed their inability to pay for that. Moreover even they were not interested in having a washing-machine despite having sufficient income. Majority of migrant households did have water-purifiers and the affluent ones reported to have washing machines.

Water supply services in Varanasi vis-à-vis Susuwahi

City water-supply system is more than 100 year old. The municipality does not have sufficient storage capacity for extension of water-supply. The inhabitants of villages have only choice to resort to private procurement through informal water-mining. The 'utility profile of municipality of Varanasi' (2007) indicated about 114, 907 connections in the city, though, *population of about 1.6 million in the city*

NON-FORMAL WATER-MINING IN URBAN SPRAWL. A CASE OF SUSUWAHI, VARANASI 59

means about 400,000 connections. The Varanasi Jal Sansthan (VJL) claims to have 69 percent metered connection; the available records reveal that there is no metered collection of tariff (VJL, 2007). Institutional and commercial connections are billed every two months while household collections are billed annually. The annual charge for household is about 480 INR per connection, though there is little data on the collection of revenue from tariff.

Adaptation Strategy and Outcome

'24x7' water supply is a distant dream for city; the expectation for a non-irritant water-supply to outgrowth remains far from reality. Though the mission statement promises it; yet the sprawl has no hope from the urban local body. Normally infrastructure improves progressively, but in Susuwahi a reverse trend is witnessed. Municipal water-supply line along the roadside existed till 2005; but even now only 8 public hand-pumps are functioning. This is an unusual reality that the inhabitants of this area have to face. As the problem related to water-supply aggravated, there has been an increase in number of private bore-well. The survey shows that 20 percent of household especially the poor depend on public hand-pumps, while 10 percent of households own hand-pumps. Another 10 percent of the household in the study area is dependent on small motor-pumps, and about 50 percent on deep bore-wells. The deep bore-well is in the second strata (60-70 meters) identified by Central Water Commission. The average cost for installing a deep bore-well was reported to be about 55,000 INR. When asked about their willingness to pay (WTP) for regular water supply, the answer was obviously in affirmative for all the respondents. The households were asked question about their WTP for metered and unmetered connection both. They were skeptical about having the metered connection by the VJL, but for the hypothetical rate based in other city the respondents showed their WTP. For metered connection, the WTP is calculated more than .02 INR per liter, which is higher than the estimated WTP for other cities (Roy et al. in 2002 calculated for part of Kolkata as .002 to .017 INR/liter). For unmetered regular supply the average WTP for the area is calculated as 600 INR.

A comparison of the municipal cost of water and the actual procurement cost shows that actual expenditure exceeds the production and maintenance cost of potable water-supply scheme. When actual annual municipal charge of 480 INR is compared with the exonerated one time investment of about (55,000 INR) in establishing the private bore-well; it is explicitly clear that there is always going to be higher WTP. The existing scenario suggests that a water tariff is economically justifiable, and socially desirable if decided on rationalized pricing based on uses. However, the issues are not limited to pricing and sustainability of municipality by reducing cost and making them capable to extend the existing water supply structure to newly growing area. The pattern of use and expected environmental condition needs a deeper analysis that is rooted in socio-ecological settings.

The electricity connection in the area is mostly unmetered incurring no specific cost on running pumps leading to unlimited use. The households were not very keen on having a storage citing additional cost for construction of a tank (5000 INR). There were tanks in about fifty per cent of the

households having deep bore-well for more than 5 years. The rest of the households in this category replied that 'it goes on so there is no need for a storage tank'. The absence of storage tank in the area does not allow us to estimate the actual extent of water-mining by individual households. Nevertheless, the outfall of this is dangerous in two ways, first, excessive exploitation of water and second is indirect. Due to absence of sanitation and sewerage, the waste water slowly percolates from undefined accumulation and pollutes the first strata of ground water.

Discussions

Water supply and sanitation in India were added to national agenda during the first five-year plan itself. Provision of safe drinking water has long been recognized as a 'basic need' at international level (ILO, 1976) and India being a signatory vowed to achieve universal coverage by the year 2000 (Athana, 1997). Despite this declaration and the pledge to fulfill the Millennium Development Goal; universal coverage of safe drinking water remains an unfulfilled task in both rural and urban India. The major bottlenecks are effective policy formulation and implementation within existing institutional set-up, which is not only inefficient in meeting demands for water across cities especially through outskirts but also incapable of generating adequate revenue for improvement of existing system and timely expansion of the same to newly added territory to the towns. The declaration of universal coverage, a supply driven programme of the 'welfare state', was criticized by the neoclassical economists and the donor institutions like World Bank (World Bank, 1993). The role of state and society in defining and promoting public interests started being contested and reshaped with global campaign of privatization (Lee, 1997). Privatization was seen as a way to help the shortfalls in urban infrastructure including water supply and sanitation, well supported by current and formal municipal officials. The privatization of urban services were motivated by the considerations of reduction of cost of public service to consumers, relieving the financial and administrative burden of the government, satisfying the unmet demand, increasing productivity and raising efficiency by promoting competition, adopting innovation and new technology (McMaster, 1991). However, the experience of private water supply has also been equally questionable in the parts of the world where privatization is old enough to test the efficiency criteria. Karp (1995) used an example to highlight this quoting the situation from Macao, where water supply has been privatized since 1920s but was managed as inefficiently as many public run utilities and the performance finally improved only after a public outcry pushed the owners to bring outside expertise. The main argument in favour of privatization of urban infrastructure and basic services has been that poor people also have shown their willingness to pay (WTP) for better services. This assertion was certified by various field based research conducted in different parts of the world (Athana 1997; Gosh 2008; Jalan and Somnathan 2004; Marie 2002; Roy et al. 2003; Singh 2003). However, the issue of water-supply in the cities of developing countries is not as simple as made out by some of these scholars. The conclusion that poor people have shown 'willingness to pay' needs to be examined carefully as most areas where they live are not served by the municipal water supply and they buy water from private vendors at higher cost. When questions are asked on the hypothetical municipal rate for regular water supply, the obvious

Written by Administrator

Wednesday, 10 April 2013 07:49 - Last Updated Thursday, 25 April 2013 05:58

answer is 'yes', in the hope that they (poor) will get safe water supply as part of the primary circuit of urban water supply. Primary circuit of urban water supply covers elite residential areas and rest of the city is served by a secondary circuit that is run by private vendors (Smith 2001). As, in the Third World cities even a combination of primary and secondary circuit is unable to serve the population, people tend to opt individual water-mining. This unchecked water-mining by individuals and firms leads to long-term environmental problems. The nature of environmental problem is such that it will continue to affect entire city population and also the population of surrounding areas in near and distant future. Moreover, the irreversible effects of such changes affect the environment itself. The effect of such change in terms of higher cost of resource is most common as water is turning out to be scarce.

Urban environmental problems result from intricately intertwined economic, political and cultural process. While ecological processes contribute to the transformation of urban environment; it is economic, political and cultural processes that create and re-create and maintain unequal and unjust urban environment (Njeru 2006). Urban environment or for that matter any environment need to be understood as discursive struggle for the control of resource and establishing identity. Water is normally taken as a universal resource, and resource is whether public or private is an ongoing debate. Water as a public resource or say as a common resource means that the state or community has the right over water and it is controlled through common decision. For surface water it is more commonly said but then water is also considered a free universal resource and anyone can use it without paying or getting discriminated in any 'civilized society'. Owing to various causes, disputes for water in historical past in different societies have been evident. At certain places it is social structure at other place it is more related to limited resource availability. The welfare state under the Keynesian model took the onus for providing basic physical (water supply, sanitation, electricity, housing, etc.) and social infrastructure (health, education and so on) to citizen especially in urban area with the dual purpose of inviting investment and creating a goodwill amongst working class. Provision of safe drinking water has become the responsibility of urban local body (municipality) in lieu of certain tax to maintain the structure. With increase in population and unreserved tariff for water supply, it started becoming increasingly difficult for the urban bodies to expand the supply network to the expanding urban areas. Water as an essential public service in urban areas of the developing countries is confronted with various issues:

• Availability – abundance/scarcity

The first and foremost issue for water-supply is availability in or around city area. It can be supplied from surface water sources like river, lakes and springs after treating it properly or it can be supplied using groundwater if the city is located over unconsolidated formation. City like Varanasi has advantage of having both the sources of water and primarily for this reason unchecked water-mining does not seem to pose an immediate threat to the urban environment and sustainability. Groundwater levels are estimated to be fast declining all over the world due to the over draft from the tube-wells, increasing demand from growing

population and also due to non-portability and non-availability of surface resources (Anand and et al 2005; Drew 2008). Surface water sources are getting polluted due to waste-water and other chemical discharges from industries to water on the logic that it will get diluted and will not adversely affect soil. The problem is getting compounded due to climatic change and mismatch in demand and supply of water that necessitate storage (O'Hara and Georgakakos 2008). The problem is more alarming in the cities, as most of the cities are increasing its ecological footprint of water to hundreds of kilometers.

• Accessibility – free/priced

The second most important issue is pricing as commodity. Logically more is the extraction cost more should be the price of water and rationalization or tariff should be based on quantum of use and purpose for which it is used. The major problem the developing world is facing is that the poor people end up paying more for water in most of the cities, as in most cases they buy water from informal market, where subsidy is given (but largely appropriated by the suppliers) as they supply to poor areas. So the poor are facing double edged sword: economic and social wrath. Water primarily has remained a supply side issue and has been discussed with greater elaboration (Kundu 1993; Gilbert 1992; WHO 1995; World Bank 2000). Smith in her work on Cape Town has discussed the work of Marvin and Laurie (1999), who have argued that water resource in developing countries point to the productionist's logic of dual circuits of supply. *Often two circuits of supply are noticed across the cities of developing countries where primary circuit is served by the state through a public utility and secondary circuit is run by informal vendors.* Montgomery (1988) had discussed the spatial location of each circuit on the basis of geography in the city and it is noticed here too that poor people and unplanned periphery along with squatter settlements are served by the secondary circuit.

• Ownership – public/private/corporate/state

Ownership determines control that has been a symbol of social and political power across the world. Water belongs to the people but rights are often bargained by the state at times to supply water to ever-growing cities or sometimes to the corporate to earn money from bottling water and in the process depleting ground-water. In either case, due to expanding ecological footprint, the water level of the area gets affected. This often leads people to organize and protest against the exploitation of water from their region (Drew 2008). The major part of academia is also involved in the debate about ownership of water in a different way. The mainstream debates in the field involve the providers i.e. public or private. Whether state through its agencies municipality or others should have the ownership of water and supply to the citizens, or it transfer the ownership to private corporate with or without monitoring the amount of draft from tube-well in case of groundwater and amount of treated

and untreated water in case of surface water. The public-private debate, however, should be wider than that exist today; as water is not only a commodity it is also the culture, the value system and life. Studies in rural sociology suggest the caste is an integrated aspect of Indian cultural system. The present study indicates that caste plays an important role when source of water-use is analyzed. The upper caste of indigenous population along with the new elites amongst migrant community does not use public tap if it is located outside the premise of house. In periphery areas, where municipal supply is limited to the roadside water-supply network, taps are in open along the main arteries and not inside the premise. That led upper-caste and new affluent migrants to adopt alternative means of water-procurement like bore-well.

• Quality – safe/unsafe (contamination – deposition)

The water must be safe so that it can be used for drinking purpose. One of the major issues, that concern with water supply is contamination and consequent deterioration of the quality of water. In Varanasi, this is because of the fact that Assi Nalla discharges its waste $\frac{1}{2}$ to 1 km upstream. *Contamination of river water is compounded by throwing burnt/un-burnt human and animal dead bodies in to the river Ganga.* The river is further polluted due to throwing of flowers and garbage at the Ghat areas. In most of the municipal area of developing countries water-supply pipe network passes through drains and there are chances of contamination of supply water from the damaged portions of the line. The surface water sources are getting contaminated and households are resorting to the exploitation of groundwater. In the area where water is not scarce, it is tendency to go deep in search of clean water. *People perceive that due to poor sewerage conditions waste-water percolates down the ground so deeper one goes better quality of water' is extracted. However, this is a suicidal tendency as deeper the bore-well the possibility of accumulated salt in water increases.* Several cases of phosphorous and arsenic deposition have been reported from the districts near Varanasi namely Ballia, Deoria and some parts of Gazipur. The samples so far are negative in Varanasi districts. Increasing number of individual bore-wells and unchecked draft from tube-well leads to exhaustion of water from second strata (60-65 meter). Third strata (70 meter) is marked as vulnerable zone for drinking water purpose, but common people in the city are yet not aware of mineral pollution in water and are more concerned for contamination and water-level in summer. As they can not afford the dry well in summer after investing exuberant sum of money, there is a tendency to go deep. However, the researches on the quality of water from bore-wells suggests that there is increasing level of depositions of minerals harmful for human health in long run.

Arbitrary expansion of cities through surrounding villages turns these issues to a more complex situation. These new territories because of its proximity to city attained urban characteristics, but technically remain rural and municipal bodies easily shy away from their responsibility. The village

Written by Administrator

Wednesday, 10 April 2013 07:49 - Last Updated Thursday, 25 April 2013 05:58

64

URBAN INDIA

Susuwahi is an interesting case, as major issues that are common with regard to water supply are almost absent or present in variant form. Let us start with the first major issue that is availability. Availability is not a critical issue as Varanasi is located in middle Ganga valley over an unconsolidated formation with abundance of ground water. Only during summer months, water level goes down and water scarcity is faced in some of the shallow tube-wells.

The second issue, i.e., of water accessibility is even more important in deciding the socio-ecological settings. The availability pattern in the city shows more than two circuits. Primary circuit that is the areas of elite community is served by public regular water supply with taps inside the houses. In certain areas where obstruction in supply line is there or due to other problem public water is not available or at temporary (it can last for years) settlements the vendors supply. The third circuit or sub-circuit of the second circuit is more widespread in the city. The water from lone public tap or having private arrangement of water-supply through bore-well is present throughout the city irrespective of the class-structure of housing. The traditional city, where compact narrow streets are there with no space for bore-well, is dependent on the water from municipality. This means that there is no pressure on urban body for uninterrupted supply, as during the process of slum-urbanization, the bourgeois followed by middle class have moved out of the core of the city and settled in the areas which in due course gets recognized by municipality. In these sprawl majority household depend on private bore-well or non-formal water extraction. The cost of water at present is higher for those who are using it, as discussed earlier in the paper, but the future cost in terms of making the next generation vulnerable is much more than it seems today. The simple pricing, therefore does not explain the complexity of situation either for municipal based 'cost-benefit' analysis or user's WTP compared to actual cost.

The private arrangements for water in this sprawl can be explained by taking three factors - the availability; the almost zero operational cost and the issue of identity. We have already discussed the issue of availability; the operation cost is basically for the payment of energy that is used for the pumping. In rural and sprawl area, electricity is charged not on the basis of actual consumption but rather at a fixed rate. Like most sprawls, people in Susuwahi pay a flat rate as user charge of electricity, meaning the payment is not based on actual consumption. This arrangement makes users care-free and power is liable to be misused. The focus of the paper is not the misuse of power, however, this adds to the over exploitation of water as there is no substantial cost for running the pump. So the households defer the installation cost for the storage and rely more on the running of the pump. The result is devastating with waste of water, waste of power and pollution of ground-water to a deeper level. In absence of sewerage facility, most households have open pit sewerage and sanitation system that allows water to percolate down due to the unconsolidated formation.

The most crucial of all this resource exploitation is the issue of identity. Having private bore-well is not only because of unavailability of water-supply to the household by municipality it also is driven by the fact that middle class identity is a crucial issue in taking decision. Walker (1981) while analyzing of the class dimension of the suburban areas argued the 'the suburbs are not middle class because

NON-FORMAL WATER-MINING IN URBAN SPRAWL
A CASE OF SUSUWABI, VARANASI

65

middle class lives there, the middle class lives there because the suburbs are middle class'. The middle class characteristics of the periphery have several social implications. These implications differ according to the larger societal values. *The practicing gender relation in Indian middle class society has evolved during colonial period having a mix of semi-feudal and semi-colonial value system, where women are confined to houses. Elites across the then British society enjoyed higher social status (if they could afford women confined to house; the same continued in India at least in the regions where Zamindari system (System of Land Revenue) was imposed. Residents of the region are a mix group representing elites who have moved from the congested core of the city; and the new migrants, who compare themselves with these middle class elites apart from the traditional village dwellers who also want to adopt new social value along with their existing practices, where women used to stay home. With urbanizing economy; the average wage grows which means 'maid servants' becomes more expensive. Women of these houses generally managers of the household activities, convert themselves to new domestic technologies inside house to manage the house without maid servants, but cannot afford to go out to fetch water.*

Conclusions:

The above discussions make it explicitly obvious that it is difficult to conclude the existing water scenario in any uniform way and an approach is needed that analyses the issue of water-supply beyond the demand-supply framework, as scarcity of water is associated with security and needs a discursive framework. Urban sprawls in India are most dangerous to the environmental sustainability and make more and more people vulnerable with little attention to the existing intricate socio-ecological dynamics. On the basis of above analysis of sprawl of Varanasi, three sets of concluding observations are made that need further investigation and more research to develop better theoretical models and approaches to solve the problem.

Water economy and ecology of Water-rich region

In brief, it can be concluded that unchecked water-mining poses threat to environment as quantity and quality of water is bound to deteriorate. It also has an adverse impact on the already vulnerable sections of society, who are not involved in water-mining today, as they do not have the capacity to invest. Nevertheless, they are the one, who will be victims, when quality deteriorates to the extent of unusable resource.

Public vs. private

The analysis shows that municipal cost of water (480 INR annually) is much less than the investment (50,000 INR) needed for assured water-supply. There is high degree of willingness to

66

URBAN INDIA

pay (WTP) and also evidence that they have the capability to pay. If a tariff is properly collected and managed, the operation and maintenance cost of the system could be covered. This will not only save the household's operational cost, but also reduce overexploitation of ground-water, which is otherwise environmentally unsustainable and dangerous in long run. The unfortunate part of the entire scenario is that the debate these days is centered on institutional arrangement of water supply. Attention should be paid to the fact that who owns the resource; it has responsibility of what and responsiveness to whom.

Social Identity vs. Resource Scarcity

Social identity is as important as the fulfillment of the basic needs in urban sprawl. Middle-class women who use to be house managers, supervising work by maid servants, had to take up the responsibility of household work due to increasing wage owing to changing urban characteristics. The traditional dominant caste landlords got extra money from the sale of the land and installed bore-well at high cost to insure that women are not seen as working. These women started working inside the house and retained the social identity by not going out to fetch water from public tap or public hand-pump. They want to maintain this social status and identity.

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Wednesday, 10 April 2013 07:49 - Last Updated Thursday, 25 April 2013 05:58

NON-FORMAL WATER-MINING IN URBAN SPRAWL
A CASE OF SUSUWAHI, VARANASI

67

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68

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Written by Administrator

Wednesday, 10 April 2013 07:49 - Last Updated Thursday, 25 April 2013 05:58

70

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