Drinking water sources in India: how safe is safe?

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Under the loom of extreme climatic perturbations, human expansion and rising demand, world's freshwater reserves are expected to suffer severe setbacks in the coming years. A major task for the international authorities in this regard is to develop a reliable inventory of existing potable water sources and identify the challenges therein. The main objective of this study was to present a spatial summary of 'safe' water sources in India using the most 'authentic', cross-sectional, open-sourced census database for 2011 ranging from household to state level. Under the present circumstances, we urge the authorities to revisit potable water source classification scheme in India, acknowledging water quality issues and devise strategies for catchment-scale protection with special emphasis on real-time continuous monitoring and assessment of the peri-urban water resources.

Keywords: Arsenic, groundwater, fluoride, millennium development goal, safe drinking water.

UNDER the ominous loom of extreme climatic shifts, population outburst, dwindling natural resources and raging demand, a question that has taken the centre seat in most high-level policy briefs at international environmental summits in recent times is probably the availability of safe and sustainable potable water. It is indeed now a major milestone to be achieved for nations around the world, as stated emphatically in the United Nation's Millennium Development Goal (MDG), Target 7C: 'by 2015, reducing by half the proportion of people without sustainable access to safe drinking water and basic sanitation'[1]. The significance of MDG 7C is that it overlaps with several other MDGs, such as MDG1: poverty; MDG2: education; MDG3: gender equality, and MDG4: child mortality due to waterborne disease[2].

Even though the WHO–UNICEF's Joint Monitoring Programme (JMP) – official committee that watches over the global progress – reported, that a majority of the countries have already achieved this goal, it also found that about 75% of world's total population still face tremendous water scarcity while 660 million lack access to safe potable water[3,4]. WHO recommends 50 litres of water per capita per day (lpcd) to sustain health, hygiene and all domestic chores[5]. In India, however, at about Re 1/litre, it might mean 17% wages of low-income class[6]. Presently, India totes the largest bag in Asia – about 75.8 million people without access to safe potable water, even ahead of China (68 million)[4].

Water-climate and water-population nexus is being researched upon extensively around the world to ensure sustainable human development in the coming years. However, the first step in doing so is to develop/refine the inventory of 'safe' water sources presently available to the citizens. This is of tremendous importance to a country such as India that is already challenged by multiple infrastructural inadequacies, especially for its rural areas, coupled with prevalence of a diverse array of waterborne diseases[7]. In the light of the above observations, the present study aims to assess the potable water sector in India with reference to (a) MDG's target, (b) South Asian countries, and (c) the states/UTS internally, using the census of India database. A conscious attempt has been made to introspect the conditions of potable water sector with reference to groundwater arsenic and fluoride contamination in the state. In the process, we carefully re-examined the basic foundation of 'safe' water sources in India to bring forth critical issues therein. The outcome of this study might influence the concerned authorities to reassess the basic classificatory scheme of potable water sources across the nation and prompt them to carve out necessary policy reforms and/or management strategies.

MDG target 7C: World view

The recent JMP report suggested substantial improvement worldwide. Within two decades (1990 and 2010), world population receiving piped water supply (PWS) increased from 45% to 54% while those accessing 'other improved' water sources increased from 31% to 35% (WHO/UNCEF, 2010). Coupled with this, drinking water coverage by 'unimproved' sources dropped significantly from 18% to 8% and surface water (deemed particularly unsafe) usage dropped from 6% to 3%.

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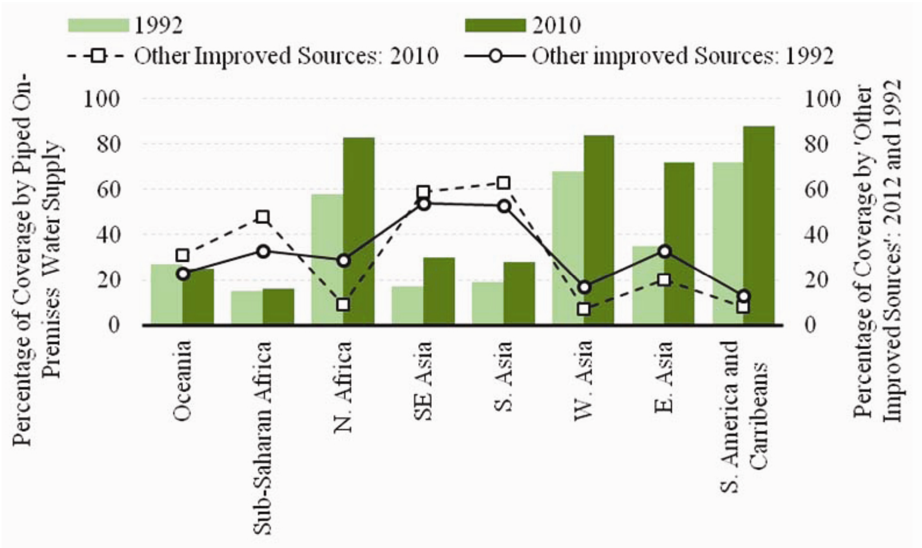

Figure 1. Decadal changes in percentage coverage of drinking water by piped water on premises between 1992 and 2010, and other 'improved' water sources in the same years (Source: JMP).

Regional estimates revealed highest improvement for East Asia (by 37 percentage points between 1990 and 2010) and Northern Africa (25%) (Figure 1). But a vast fraction of the world still lacks PWS. In Oceania, and South and Southeast Asia, barely 30% of the population have access to PWS and in sub-Saharan Africa the number is less than 20%. By contrast, in North Africa, West and East Asia, the PWS estimates stand at around 83%, 84% and 73% of population coverages respectively. In Oceania, sub-Saharan Africa and Asia (south and southeast) 'improved' sources account for about 31% (combined total of PWS + other improved sources stand at about 56% in 2010), 48% (64%) and 60% (90%) respectively.

MDG target 7C: India

The census estimates of 2011 suggest that well over 50% of households in major parts of India had access to 'safe' drinking water, thus satisfying the relevant MDG target. This appeared quite a big milestone when judged against the fact that in 1991 only 10 such states/UTs enjoyed similar luxury. It would perhaps sound even more encouraging to learn that even in 1991, most of the states/UTs in India had surplus coverage against the MDG's target, as 62.3% of the nation's total households had access to 'safe' water sources (urban: 81%; rural: 55%). In Punjab, Haryana, Chandigarh and Puducherry, over 90% of the households 'enjoyed' safe water sources in 1991 (Figure 2).

A comparison with other countries in South Asia (10 countries, as following the country-wise groupings of JMP), however, shoots up a comparatively impoverished scenario for India. Even with a nationwide tally of 85.5% households having safe drinking water sources, India ranks 8th on the list of South Asian countries, trailing even countries like Bhutan (97%) and Sri Lanka (92%), with significantly smaller budgetary provisions and lesser infrastructural capacity. Of course, since 1992 (62% of all households), the Indian scenario has improved significantly ($p < 0.05$) by about 23 percentage points. But countries like Afghanistan (29 percentage points), Bhutan (25 percentage points) and Sri Lanka (24 percentage points) have scored 'better' over the years. Currently Maldives tops the list with near complete nationwide coverage while Afghanistan appears the most 'underachieved' with just a little over 50% population coverage.

India: Urban versus rural

A major hurdle in establishing nationwide sustainable potable water infrastructure is appalling urban–rural disparity ($p < 0.05$): about 91.5% of the urban households 'enjoyed' access to safe drinking water sources in 2011 as against about 82.7% of their rural counterparts[8]. About 65% of rural households in India banked on groundwater resources for potable purposes compared to only about 26% of urban households. These figures bring to light some critical issues. First, the urban–rural difference appeared most striking in the north-eastern region (NER) that is already challenged with multiple economic and socio-political issues that deter sustainable human development. In Manipur, Mizoram, Tripura and Meghalaya, the difference ranged from 24 to 45 percentage points for 'safe' water sources when compared to their urban counterparts (Figure 3). In Jharkhand, Rajasthan, Jammu and Kashmir and Madhya Pradesh, the trail ranged from 20 to 26 percentage points indicating raving inequality and

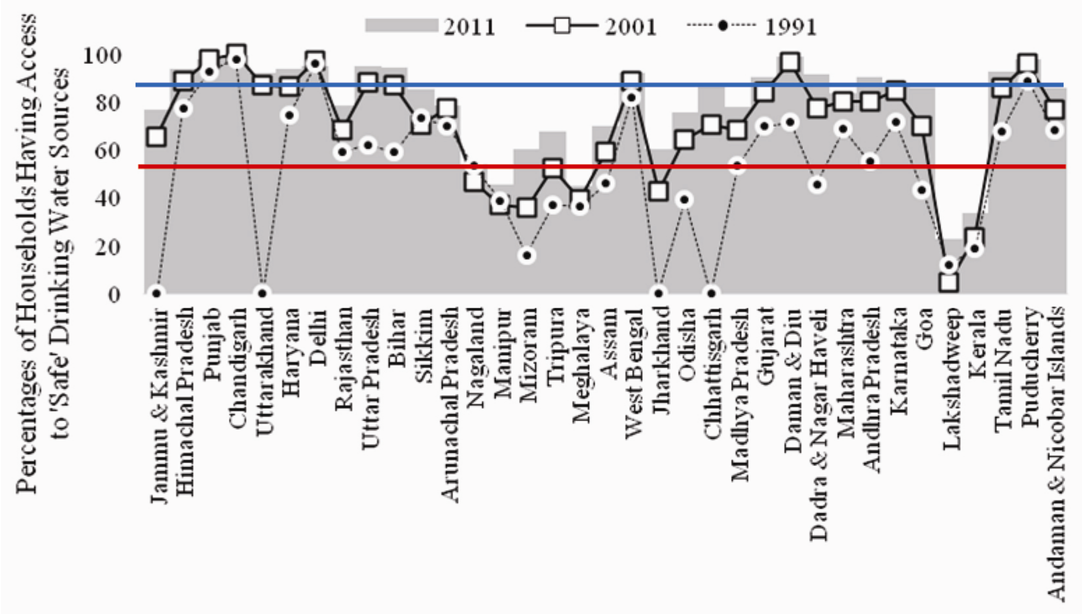

Figure 2. Percentages of total households (urban + rural) having access to 'safe' drinking water sources in India between 1991 and 2011. Blue line indicates national tally of households (85.5%) with safe drinking water in 2011. Red line indicates MDG's Target 7C (source: Census, India).

high urban–rural disparity in basic infrastructural facilities available to the citizens.

Secondly, the urban households in the nine states/UTs featured substantially below the corresponding national benchmark (91.5%) which indicated high regional variability across the country with certain states/UTs suffering a 'lag' that need to be studied. The whole of NER is characterized by this state of impoverishment. None of the 'seven sisters' (except Arunachal Pradesh) had over 80% coverage for even their urban areas. Other such states include Jharkhand and Odisha with about 79% coverage for urban households. Surprisingly, in Kerala, only about 40% of urban households appeared to have access to safe drinking water, which was even below that of the MDG's target 7C.

Thirdly, rural households in 17 states/UTs were below the corresponding national rural benchmark (82.7%) for 'safe' water source, as against only 9 states for urban counterparts (Figure 3). A critical concern in this regard is the NER. In Manipur, Mizoram, Meghalaya and Kerala only about 38%, 43%, 35% and 28% of rural households respectively, accessed safe drinking water sources (Figure 3 *a*), far below the national benchmark (82.7%) as well as that of the MDG's target. Interestingly, even the urban households in the above-mentioned states were below both benchmarks (Figure 3 *b*), indicating a holistic state of infrastructural inadequacy that might be deleterious to public health and hygiene.

A key feature that sets the NER states apart from the rest of the country is their higher percentage of dependence on surface water resources. Except for Assam, between 25% and 60% of rural households across the NER rely on surface water sources (e.g. springs/rivers/ponds) (Figure 3 *a*). No state in India is so heavily reliant on surface water bodies. Ironically, surface water sources are rarely included, as 'safe', in the MDG framework which underlines added concerns for NER over public health and hygiene.

Overall, the figures indicate high regional variability spiked with stark urban–rural disparity in the potable water sector that need to be addressed in days ahead. As of 2011, about 30% of rural households in India had privilege to tap water sources (treated + untreated), as compared to about 70% for the urban areas. Moreover, only about 18% of rural households accessed 'treated' tap water as against 62% for urban households. About 65% of rural households relied on shallow groundwater sources [well (covered + uncovered), hand pump + tube-/bore-well] compared to only about 20% for urban areas.

Potable water sources in India: how safe is safe?

In India about 53% of households rely on groundwater resources for potable water need while about 2% rely on surface water (Figure 4). About 43.5% of households access tap water (treated + untreated) for potable purposes. Reliance on groundwater is significantly ($p < 0.05$) higher in the rural areas with about 65% of households banking on it. To reiterate the urban–rural disparity further, only about 26% of urban households depend on groundwater. On the other hand, about 70% of urban households have tap water for potable purposes as against only about 31% for rural areas.

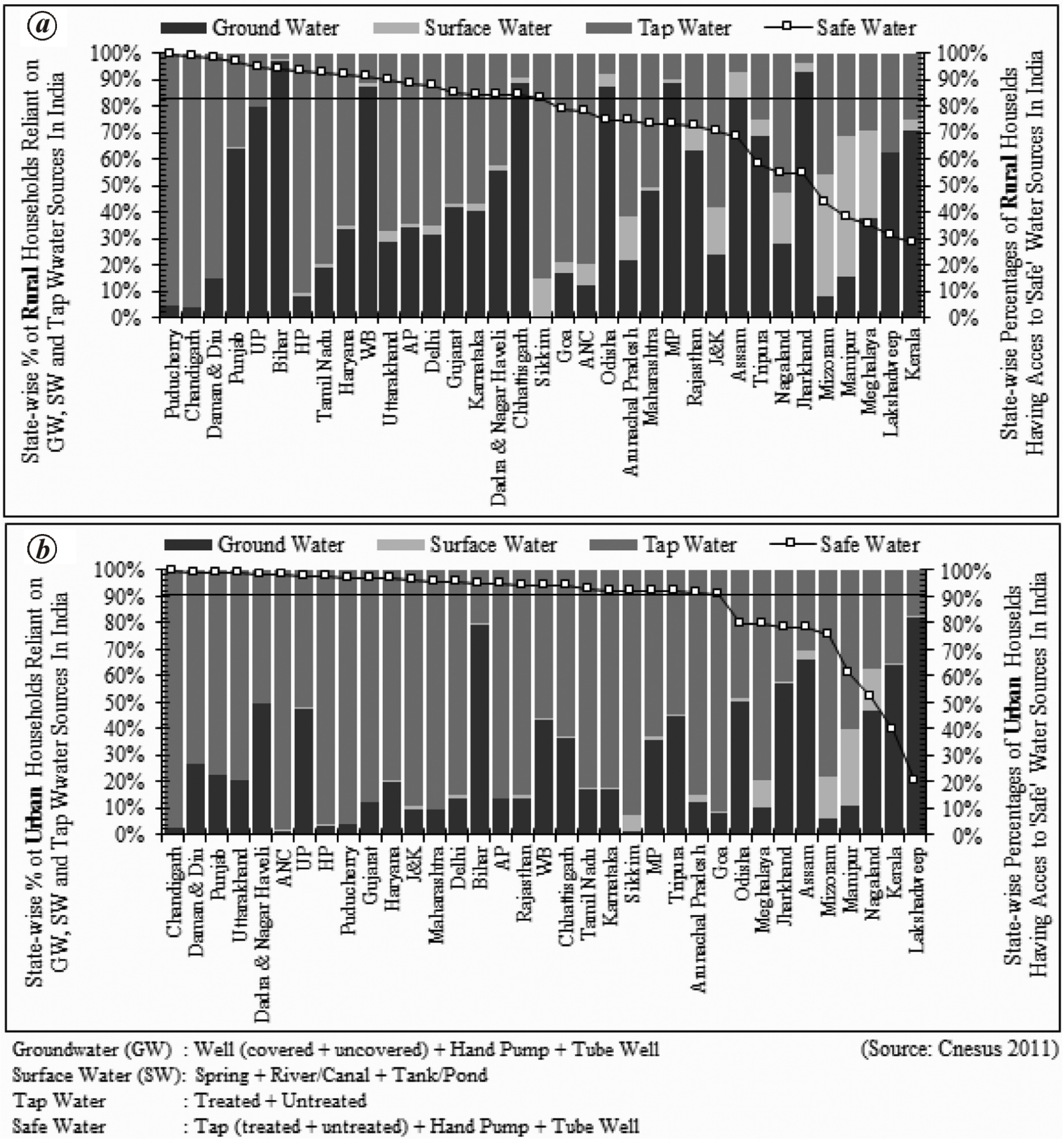

Figure 3. State-wise percentages of (***a***) rural and (***b***) urban households for India having access to 'safe' water sources. Also shown are the relative percentages of rural and urban households reliant on groundwater, surface water and tap water. The bottom panel also presents the state-wise percentages of total households having 'safe' water sources. The solid black lines in (***a***) and (***b***) represent national statistic for percentage of households accessing 'safe' water sources.

Overall, in about 12 states/UTs, over 50% of households rely on groundwater. In Bihar, Jharkhand, Odisha, Assam, Chhattisgarh, MP, over 75% of households depend on groundwater for potable uses (Figure 4). But a major concern about depending on groundwater resources is pollution by multiple species occurring above their Maximum Permissible Limits (MPL)[8]. For example, iron and nitrate occur above MPLs throughout India. High groundwater salinity is reported from Rajasthan, Gujarat, Maharashtra, Karnataka, Andhra Pradesh, Telengana and Tamil Nadu. Elevated groundwater fluoride levels occur in 20 states/UTs in India, affecting about 66 million people[9].

In India, drinking water sources are grouped in eight categories: (1) tap water (treated and untreated), (2) well (covered and uncovered), (3) hand pump, (4) tube-/bore-well, (5) spring, (6) river/canal, (7) tank/pond, and (8) others. Interestingly, untreated tap water, hand pumps and bore-/tube-wells are all included in the estimation of 'safe' drinking water sources. The latter two are entirely

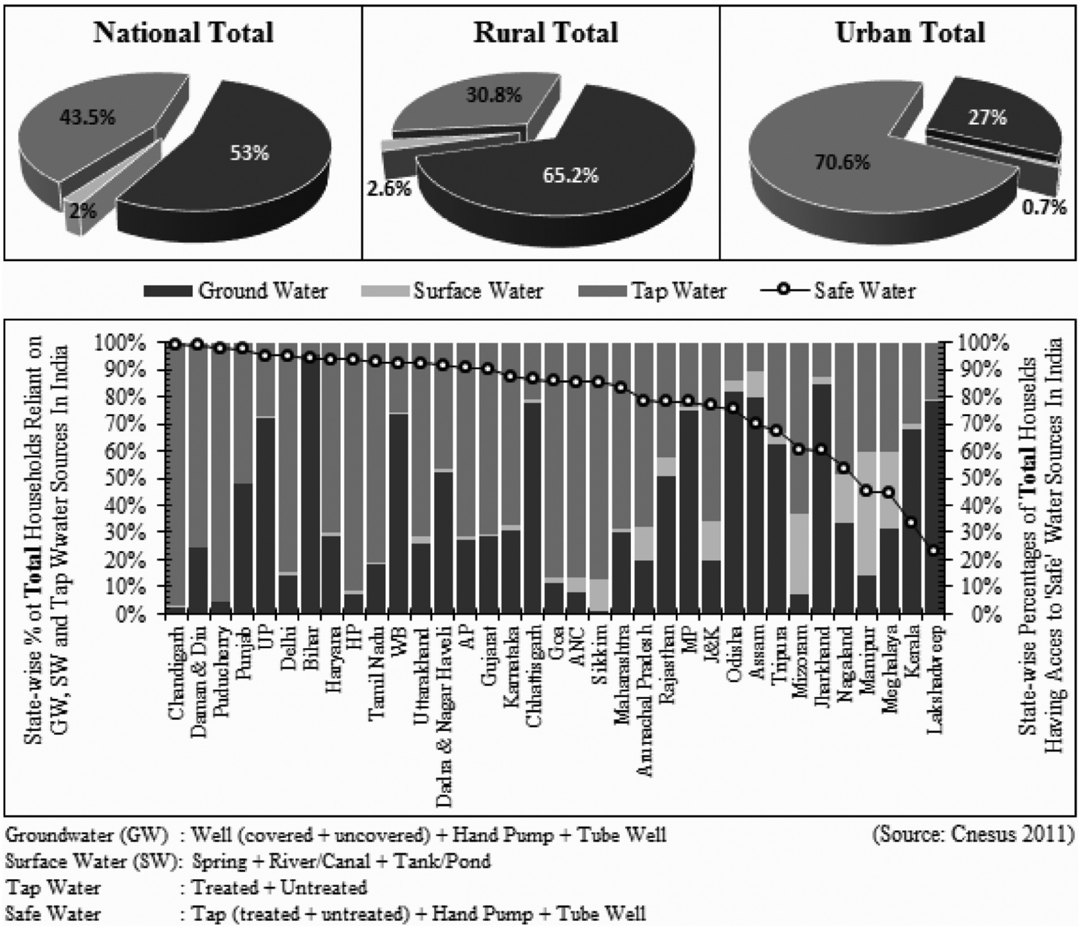

Figure 4. Percentages of households reliant on groundwater, surface water and tap water for national total, rural total and urban total for India (top panel), and state-wise (bottom panel) totals (urban + rural). The bottom panel also presents the state-wise percentages of total households having 'safe' water sources.

dependent on shallow groundwater resources. In the face of alarming groundwater quality degradation, the grinding question is, how safe is safe?

Rajasthan is among the prime states in India from where multiple pollutants, including fluoride[10] and nitrate[11], have been reported at elevated levels from groundwater. Even though about 78% of households in Rajasthan reportedly have 'safe' drinking water sources, over 48% rely on groundwater while only about 32% of households enjoy 'treated' tap water. In Gujarat, Andhra Pradesh, Karnataka, about 39–48% of households, while in Bihar, Nagaland, Lakshadweep, Assam, Odisha, Jharkhand, Chhattisgarh, Madhya Pradesh, less than 15% of households have access to treated tap water.

West Bengal: cat on a hot tin roof?

A menacing threat to groundwater quality in West Bengal, and for that matter potable water quality, is widespread occurrence of arsenic (>MPL) in the shallow Gangetic alluvium (<100 meter bgl). Eighty five blocks in eight districts of the state are under its loom which affect over 4.2 million people (Table 1)[12,13]. To aggravate the situation, high level (>MPL) of fluoride has been reported in groundwater from 42 blocks in 8 districts[9,14], with cases of fluorosis causing havoc in the rural areas[15–18]. In addition, 57 blocks in 4 districts of West Bengal have also been affected by high groundwater salinization.

The census 2011 reports claim that about 92% of households in West Bengal have access to 'safe' drinking water sources. What questions this claim, however, is that hand pump + tube-/bore-wells, which thrive on shallow groundwater resources of the Gangetic alluvium, serve about 66% of households. Moreover, untreated tap water accounts for another 4% of households having 'safe' water sources with treated tap water accounting for only about 21% of households, way below that of the national total (32%) for the same.

Over three-fourths of all blocks in Murshidabad and Nadia districts appear to be reeling under the burden of high arsenic in groundwater. However, it is groundwater that furnishes potable water to over 90% of households in both districts while less than 15% of households have

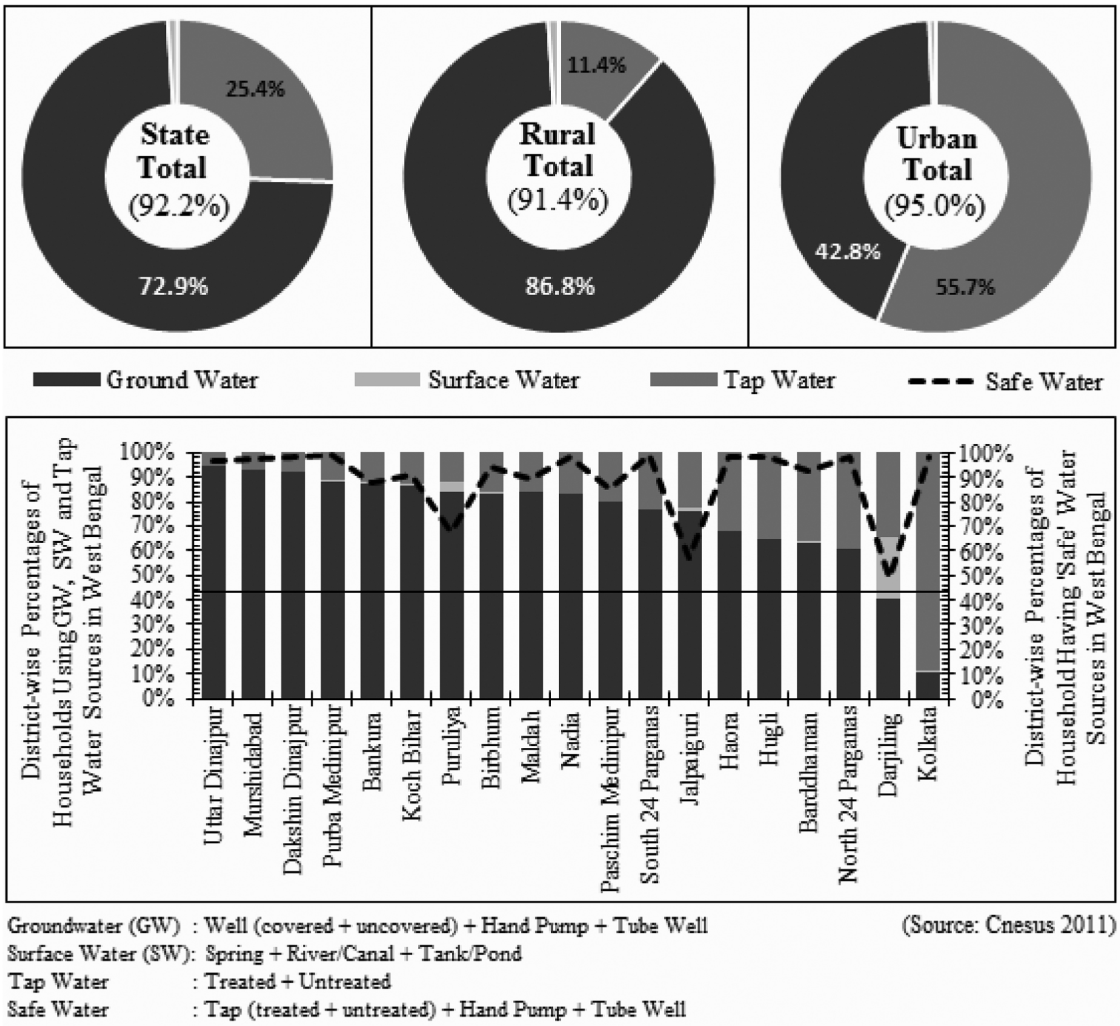

Figure 5. Percentages of households reliant on groundwater, surface water and tap water for state total, rural and urban households for West Bengal (top panel), and district-wise (bottom panels) totals (rural + urban). The bottom panel also presents the district-wise percentages of total households having 'safe' water sources. Values in parentheses in the top panel represent households having access to 'safe' water sources. Solid black line in the bottom panel (district-wise results) presents national statistic for percentage of households reliant on groundwater.

privilege to treated tap water (Figure 5). Similarly, even though South Dinajpur, Puruliya and Bankura districts have severe issues over fluoride contamination (Table 1), over 80% of households in these districts rely on groundwater sources. Interestingly, the census reports yet suggest that over 90% of the above-mentioned districts have access to 'safe' drinking water sources.

Estimates of the national health statistics reveal that about 11.5% and 27.8% of cholera cases in India in 2010 and 2011 respectively, were from West Bengal, along with about a fifth of all cases of acute diarrhoea in the country which further questions the claim of having safe drinking water sources. Overall, India ranks in the top quarter in the world in prevalence of waterborne diseases[19], including that in West Bengal[20,21]. In addition, a recent assessment made on the performance of the National Rural Drinking Water Programme (NRDWP) in West Bengal revealed that only about 43% of rural households in the state receive 40 lpcd of water supply, the benchmark deemed optimal for sustainable development[22]. The study also indicated lack of adequate water supply in the water quality affected habitations in rural areas of the state that further adds to the concern over public health and hygiene in the coming years.

Challenges to potable water resources

Coupled with a booming population and an ever growing water demand, it is now a great challenge for the government to ensure sustainable quantity of 'safe' drinking water. Two-thirds of world's population still lack access to safe[3] and adequate water supply[5], owing to a combination of natural and human-induced factors. The latter includes.

Table 1. District-wise number of blocks in West Bengal affected by elevated levels of arsenic and fluoride in groundwater (Source: WBPHED)

District	Total no. of blocks	No. of arsenic affected blocks	Blocks with arsenic level > MPL (0.50 ppm)
Bardhaman	31	5	Purbasthali I and II, Katwa I and II, Kalna II
Hoogli	18	2	Balagarh, Pandua
Howra	14	2	Uluberia II, Bally-Jagacha
Maldah	15	7	English Bazar, Manikchak, Kaliachak I, II, II, Ratua I and II
Murshidabad	26	21	Raninagar I and II, Domkal, Nawda, Jalangi, Hariharpara, Beldanga I and II, Suti I and II, Bhaganwangola I and II, Behrampur, Raghunathganj I and II, Murshidabad-Jiagang, Farakka, Samserganj, Lalgola
North 24 Parganas	22	21	Habra I and II, Barasat I and II, Deganga, Basirhat I and II, Swarupnagar, Sandeshkhali II, Baduria, Gaighata, Rajarhat, Bagda, Amdanga, Bongaon, Haora, Hasnabad I and II
Nadia	17	17	Karimpur I and II, Tehatta I and II, Kaliganj, Nakashipara, Nabadwip, Hanskhali, Krishnaganj, Haringhata, Chakda, Santipur, Chapra, Ranaghat I and II, Krishnanagar I and II
South 24 Parganas	29	8	Baruipur, Sonarpur, Bhangar I and II, Bishnupur I and II, Joynagar I, Mgrahat II
District	**Total no. of blocks**	**No. of fluoride affected blocks**	**Blocks with fluoride level > MPL (1.50 ppm)**
Puruliya	20	17	Jaipur, Puruliya I and II, Para, Raghunathpur I and II, Neturia, Santuri, Kashipur, Hura, Panchua, Arsha, Jhalda I, Bagmundi, Balarampur, Arabazar
Bankura	22	10	Saltra, Gangajalghat, Chatna, Indpur, Bankura II, Barjora, Taldanga, Simlapal, Hirbandh, Raipur
Birbhum	19	7	Nalhati I, Rampurhat I, Mayureswar I, Rajanagar, Suri II, Sainthia, Khoyrasol
South 24 Parganas	29	1	Baruipur
Maldah	15	2	Ratua II, Bamongola
North Dinajpur	9	1	Itahar
South Dinajpur	8	5	Khushmundi, Gangarampur, Kumarganj, Tapan, Bansihari

Institutional weakness

Lack of governmental 'push' and sustained political vendetta to ensure sustainable and 'safe' potable water to the masses, especially the underprivileged rural populace. Added to this is the lack of efforts for capacity building, by involving the local village communities, providing information, education and communication (IEC) to the villagers about operation and maintenance (O&M) of water infrastructure. This is further aggravated by corruption within local governance which restricts effective and 'impartial' policy-making and/or allocation of funds.

Financial constraints

A major impediment to adopting improved technologies and O&M of water supply networks is lack of adequate budgetary provisions. In this regard, delays in the release and allocation of central funds by local authorities cripple the village communities[2]. It also deters implementation of necessary technologies to ensure safety measures, for example, defluoridation, desalination, arsenic removal, etc. In addition, water tariffs often keep the users from availing adequate water supply connections at household/community levels. Moreover, it is not unusual to find that older budgetary schemes are not incorporated and/or accounted for in the newer ones leading to misappropriation of assets.

Water resources availability and vulnerability

Natural factors that debilitate drinking water supply include: (1) depletion and (2) contamination/salinization (discussed earlier) of groundwater resources. These events are triggered by a combination of natural (e.g. climate change) and anthropogenic (e.g. urban sprawl, industrialization) factors. The latter is a key driver of hydrologic processes and depletion/contamination of water resources in urban agglomerations[23,24]. Negative impacts of urbanization on water resources have been documented from all over the world, including India[25–27]. Research reveals that water-level drops in megacities such as Delhi, Hyderabad, Chennai and Mumbai, may leave the residents destitute within a decade[28].

As aggravation, quantity often influences quality, dropping water-levels frequently accentuates risks of water contamination/salinization[23]. In about 56% of the Indian landmass, groundwater levels are on steady decline[23]. This calls for an in-depth site-specific investigation into the quantity–quality nexus, especially in semi-arid regions (e.g. Rajasthan) where evaporative enrichment leads to high salinization.

We, the people…

What appears from the discussion is that drinking water sector in India is currently littered with hardships and inherent contradictions. To provide and maintain adequate infrastructural facilities at a sustained pace in a nation as diverse as India, is a handful for the authorities, if acting alone. It needs active participation of us, the people. However, an obstacle to this is the intersecting spheres of human dynamics and our commitment to the idea of long-term common-wealth. Added to this are lack of budgetary provisions and corruption at different levels of administration that often come in the way of timely implementation of necessary measures. But as responsible citizens, we have to remind ourselves that the onus is on us, to protect/preserve the existing 'safe' water sources, maintain the existing infrastructure, identify pitfalls therein, keep the authorities abreast with emerging needs in a way to help them bring about long-ranging policy reforms. Certain possibilities that might be pondered upon include (but not limited to):

- Shift from untreated taps, hand pump, tube-/bore-well sources to PWS;
- train the population on ideas as well as O&M of cost-effective water conservation/harvesting/recycling techniques;
- equip local communities with latest toolkits to monitor performance of water supply networks, especially in rural areas;
- restrain human activities (e.g. sanitary processes, bathing, cleaning of utensils and clothing, waste disposal) at/near water sources;
- estimate regional hydrologic budget and regulate groundwater drafting at rates;
- account for competing demands from other sectors, essentially from that of irrigation, in water resource management schemes;
- encourage conjunctive groundwater-surface water usage;
- build mass awareness against water wastage (e.g. use high efficiency plumbing fixtures); and
- explore alternate drinking water sources.

Catchment-scale vulnerability assessment of freshwater resources

In addition to the above-mentioned, efforts will also have to be made to develop catchment-scale protection strategies to keep water resources from contamination/salinization events[29]. However, catchment-scale strategies are data-intensive processes that require spatio-temporal information about a variety of factors. For the specific case of groundwater, the factors should include: (a) depth to water table, (b) recharge, (c) characteristics of the porous media (hydraulic properties of soil/rocks, mineralogy, types and dispositions of geological structures, etc.), (d) regional topography, (e) vegetation type, and (f) water sinks/sources. To devise the same for surface water protection, information would at least include (a) precipitation, (b) topography, (c) volume of run-off generated with each rain vent, (d) stream discharge, (e) soil properties, (f) land use types, etc. In addition, a major chunk of information would involve accurate characterization of human dynamics within the catchment: land management practices, urban sprawl, industrialization, waste management, etc. and how it has changed over time. For agricultural nations, such as India, region-specific information about agricultural practices is a major requirement as it accounts for the transfer of huge pollutant load to water bodies, thus reducing its potability[30,31]. Once the information is available they can be used in one of the following ways to: (g) generate physical, process-based simulations to estimate pollutant transfer[32,33]; (h) conduct observation-based contaminant transport studies; and (i) statistical techniques to correlate chemical species with a variety of physical attributes of the catchment[34].

In this regard, a major challenge in India is the availability of continuous, real-time, reliable data. In developed nations, such information are open-sourced so that the research community can avail them for free, conduct necessary research and suggest to the authorities the best management practices to protect water resources. In India, however, most of this data is either unavailable, for major parts of the country, or only available at specific discretion of the authorities, which is a lengthy and cumbersome process. In the wake of extreme climatic events that affect freshwater availability and vulnerability, this matter calls for urgent deliberation on behalf of authorities as well as research communities to ensure sustainable human development. Again, intensive studies on water resources vulnerability at catchment level under expected scenarios of climate change are already available for various developing nations[35]. Is the same true to India as well?

Water resources protection for peri-urban communities

A growing challenge to freshwater resources in India is rapid urbanization/industrialization which gravely disrupts the natural hydrologic cycles in myriad ways, most important perhaps being significant reduction in groundwater recharge[36]. Reduction in groundwater recharge affects base-flow to streams and in turn affects the aquatic ecosystem. In addition, surface run-off from highly urbanized regions sweeps off hazardous waste into surface water bodies (non-point source pollution), adding to the pollution. In addition, waste disposal (point source discharge) from industrial areas, located in peri-urban regions, alters ambient physico-chemical characteristics (e.g. pH, temperature, BOD/COD, ionic strength) of surface water bodies, further degrading water quality[37,38]. Reduction in water quality also leads to loss of biodiversity in the riparian habitats adjacent to the surface water bodies. In India, a major challenge, however, is the increasing diversity of pollutant types and modes of pollution due to rapid and largely unplanned urbanization[39].

A key task for the authorities in the days ahead will be to appreciate groundwater-surface water nexus in peri-urban regions, develop methods to map the interface (in response to both climate change and drafting) and also to characterize spatio-temporal changes therein. Object-oriented, process-based models need to be devised to understand hydrologic processes and identify major 'stressors' (alongside sinks/sources of water) for the peri-urban catchments where landscape heterogeneity is large[40]. By the same token, efforts have to be designed to monitor land management history and land cover changes, especially the expansion of impervious covers over time, in the peri-urban regions that largely govern/dictate ground water-surface water interaction patterns. In addition specific budgetary provisions should be made to develop real-time, continuous monitoring assessment strategies for the peri-urban aquatic ecosystems for mega-cities, coupled with stringent policy reform to restrict urban/industrial waste disposal activities. The Central Pollution Control Board is doing a reasonably satisfactory job on this issue by establishing over 1000 stations nationwide, conducting monthly/quarterly monitoring of surface water quality and yearly for groundwater quality for about 28 parameters. However, what is still significantly lacking in the process is a well-devised scheme for bio-monitoring to address origin, transport and fate of various organic pollutants resulting from urban/industrial waste disposal processes[39].

Conclusion

One of the major arguments this study attempted to bring to light was the lack of consideration for water quality while estimating 'safe' water sources as against the MDG, which has been hinted upon by several studies[41–43]. Studies conducted around the world heavily criticize the UN's basic notion of safe/improved water sources where potable water quality degradation by a variety of chemical/microbial species is ubiquitous[44,41]. In India, where open defecation practices are rampant, especially in rural areas, the potential for microbial contamination of water resources is a dark reality. This is something that the authorities will have to ponder upon in the days ahead, especially for rural areas that draw heavily from groundwater resources or untreated taps. Interestingly, however, accounting for water quality will substantially lower the estimates for improved water sources and in turn governmental claims of having met the MDG target. For example, if treated tap water is taken as the only unambiguous improved water source then the percentage of improved water sources will take an alarming nosedive by about 55% from what is claimed in the official JMP reports for India.

Overall, this study revealed that even though census estimates claim to have 'safe' drinking water sources for bulk of India, it might be far from it as most sources heavily rely upon poor quality groundwater or even untreated tap water. As the time frame set out to seek sustainable means to ensure safe and adequate drinking water for all keeps zeroing in, it is high time to take inventory of existing drinking water source/supply facilities and take necessary action. But it is easier said than done. It ranges from high-level policy reforms to providing apt IEC at grassroot levels. But perhaps, it is our basic perception of 'safe' that will eventually decide the future course of action.

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