

Overview of Rural Water Supply Sector in West Bengal, India: Challenges and Concerns

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ABSTRACT:Objective of this study was to reconnoitre existing rural water supply infrastructure in West Bengal between 2009 and 2014, which is indispensable for laying out the strategies for sustainable water management and human development but currently is lacking. Results indicated that West Bengal ranked 21st in India in 2014 in terms of receiving ‘full coverage’ (FC: 40 litres of piped water supply per capita per day; lpcd) as compared to 11th in 2009. In districts of Bardhaman, Birbhum, Cooch Bihar, Hoogli, Puruliya, Dinajpurs, over three-fourth of blocks lacked FC in over 50% of rural habitations. Additionally, in 14 districts water supply services have ‘slipped-back’ between 2012 and 2014: dropping from 40 lpcd (FC) to <40 lpcd, which challenges well-being of a vast cross-section of populace. Overall, the study indicated growing concerns that need to be addressed with region-specific knowledge of natural and human-induced factors. Such studies should also be performed in other parts of India, threatened by similar ‘inadequacies’.

KEYWORDS:National Rural Drinking Water Supply (NRDWP), slip-back, spatial, water source, sustainable development, operation and maintenance, West Bengal.

I. INTRODUCTION

Over 70% of India’s population live in villages that struggle to meet basic requirements to sustain livelihood, including safe and sustainable potable water [1]. Since the 1970s, however, the collective effort to improve/augment rural water supply infrastructure in India has undergone through several reformative plans of which the most promising was the Accelerated Rural Water Supply Programme (ARWSP). The ARWSP was introduced in 1972-73 by the Government of India to accelerate the pace of coverage of drinking water supply across the nation (Chatterjee, 2008). Major objectives of the ARWSP were to (1) ensure coverage of all rural habitations with access to safe drinking water, (2) ensure sustainability of drinking water systems and sources, (3) address issues of water quality in affected habitations and (4) institutionalize the reform initiative in rural drinking water supply sector in India. To ensure the above-mentioned, norms established were (i) 40 litres per capita per day (lpcd) of drinking water for humans, (ii) one hand pump or stand post for every 250 persons, and (iii) availability of water source within the habitation or within 1.6 km in the plains and 100 meters elevation in hilly areas. The entire programme was given a mission approach with the launch of the Technology Mission on Drinking Water and Related Water Management. Following the International Drinking Water Supply & Sanitation Decade (1981-‘91), National Drinking Water Mission (NDWM) was developed and was later renamed as Rajiv Gandhi National Drinking Water Mission (RGNDWM) in 1991 with the aim of encouraging local communities in participatory actions to ensure proper functioning of rural water supply schemes [3].

In 1999, Department of Drinking Water Supply (DDWS) was created under the aegis of the Ministry of Rural Development. Concurrently, a variety of reforms in the rural drinking water sector were put in place through the Sector Reform Project (SRP), which later was scaled up in form of *Swajaldhara*, in 2002. With the introduction of the Sector Reform Project (SRP), the rural water supply sector became the world’s largest, Government sponsored demand based and participatory drinking water supply program [3]. By 2004, all drinking water programs in India were brought under the umbrella of the RGNDWM. In 2010 the DDWS was renamed to Department of Drinking Water and Sanitation and in the following year was upgraded to the Ministry of Drinking Water and Sanitation (MDWS).

The collective effort to ensure improved rural water supply services reached its peak with the establishment of the National Rural Drinking Water Program (NRDWP) in 2009 [4]. Alongside, a comprehensive rural water database namely, Integrated Management Information System (IMIS), was launched with the aim of conducting annual

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monitoring of drinking water coverage, water quality, and related program components [5]. All these programs literally marked a paradigm shift from supply-driven to demand-driven decentralized approach, transforming the government's role from service provider to facilitator [6]. Recently, the norm for piped water supply to rural areas has been scaled up to 55 lpcd to support sustainable development in rural India [7]. In this regard it is important to note that recently, WHO has recommended 50 lpcd water supply for sustainable development.

Present study offers a qualitative summary of the rural water supply infrastructure in the state of West Bengal, India, between 2009 and 2014, assessing the water supply services against two norms 40 and 55 lpcd. An effort was also made to identify the districts which have 'slipped back' from FC to partial coverage status (PC: <40 lpcd piped water supply) in the recent years and highlight potential factors (natural as well as human-induced) leading to such debacles.

In face of extreme climatic shifts predicted to affect water resources availability and vulnerability, it is quintessential to weigh achievements against shortcomings in the national water supply services to strategize cost-effective action plans. To best of our knowledge, however, such efforts are rare, if not entirely lacking in India. This study will contribute to future decision-making for sustainable water management strategies in West Bengal by envisaging spatial patterns of 'lag' in the existing rural water supply services, identify 'hotspots' of slip-back in the water sector, and assess the key adversities therein that need to be addressed by implementing region-specific policies and stringent regulatory measures. It is our argument that similar studies should also be performed in other parts of India to identify pitfalls in existing rural water supply sector to strategize line of action for sustainable water management and human development in future.

II. RELATED WORK

West Bengal is among the 29 major states in India and among the mostly densely populated states in the country with the population being doubled between 1971 and 2001 [8]. The state is constituted of 18 districts¹, 341 blocks² and about 42,200 villages. Demographics of the state is dominated by rural population (Figure 1). In Cooch Bihar, North and South Dinajpur, Maldah, Murshidabad, Birbhum, Puruliya, West and East Medinipur districts, rural population accounts for over three-fourth of total population of respective districts. Rural population in Murshidabad and South 24 Parganas districts account for about 9.17% and 9.77% of the total rural population of India, respectively. Rural population in West Bengal increased from 80,176,197 in 2001 to 91,276,115 in 2011, accounting for about 68% of the total population of the state and about 7.5% (ranking 3rd) of the total rural population in India. Between 1971 and 2011, rural population of the state has increased by about 300 lakhs.

As of 2014, there are about 98,120 (approximately) rural habitations³ in West Bengal (SC: 27.2%; ST: 9.3%; General: 65.4%) which account for about 6.3% (ranked 9th) of total rural habitations in India. As of 2014, there are about 38,724 villages in the state, with about 3340 Gram Panchayats. Presently, amount of annual replenishable groundwater resources in the state stand at 30.36 billion cubic meters (BCM), with net annual groundwater availability and draft averaging around 27.46 billion cubic meter (BCM) and 11.65 BCM, respectively. Stage of groundwater development presently stands at around 42% [9]. Agricultural water demand dominates the current and futuristic projection in the state [10].

Information about rural water supply for India and West Bengal were obtained from the National Rural Drinking Water Supply database between 2009 and 2014. Percentages of rural habitations covered by 40 and 55 lpcd piped water supply for each year were calculated at state, district and sub-district-level (block). In addition, data for water quality was obtained from the Central Ground Water Board (CGWB) database for West Bengal for 2010. Data were integrated into a dynamic GIS system to identify spatial patterns therein.

¹Presently there are 20 districts in West Bengal with the recent addition of Alipurduars. This study, however, is confined till 2014 when there were only 19 districts in the state.

²A block is a sub-district-level administrative unit in India with jurisdiction mainly restricted to rural areas. Each district may have more than one block

³A term used to define a group of families living in close proximity to each other within a village in India. It could have homogenous or heterogeneous demographic profile. There can be more than one habitation in a village but not vice versa.

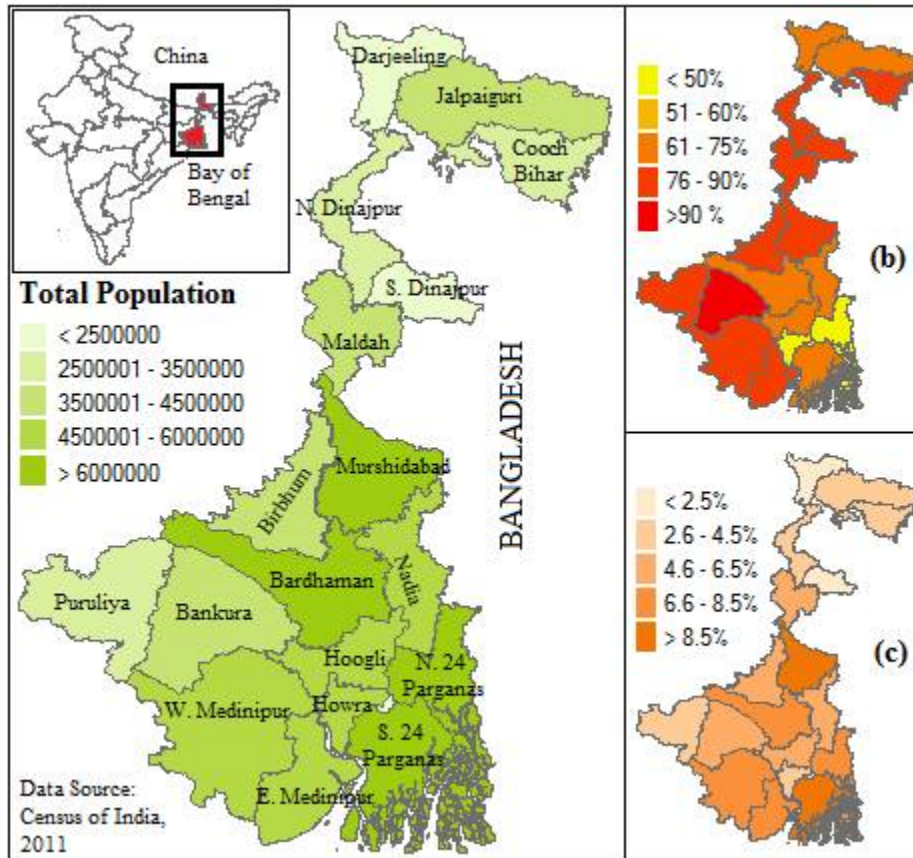


Figure 1: District-wise (a) total population (rural + urban), (b) rural population expressed as % of district-wise total population, and (c) rural population expressed as % of state total population in West Bengal

III. EXPERIMENTAL RESULTS

An appraisal of district-wise percentages of rural habitations with full coverage status (FC: 40 lpcd piped water supply) reveal a distinct spatio-temporal trend (Figure 2a-c). In 2009, 17 out of 18 districts in the state had FC in over half the rural habitations (Figure 2a). Five districts namely N. Dinajpur (99.8%) S. Dinajpur (95.5%), Bardhaman (92.8%), Hoogli (93.6%) and W. Medinipur (94.8%), had FC in well over 90% of total rural habitations. It was only Nadia where FC was found in about 45% of rural habitations. Situations improved since then until 2012. In 2012, 15 districts in the state had FC in over three-fourth of their rural habitations (Figure 2b). Only in the Murshidabad district, the tally fell between half and three-fourth. Eight districts had over 90% of their rural habitations with the FC status. In N. Dinajpur and Bardhaman districts, over 99% of rural habitations had attained the FC status. In general, each district had registered significant increases in FC between 2009 and 2012, with Nadia topping the list with about 34% hike (79% rural habitations attaining FC status in 2012 as compared 45% in 2009).

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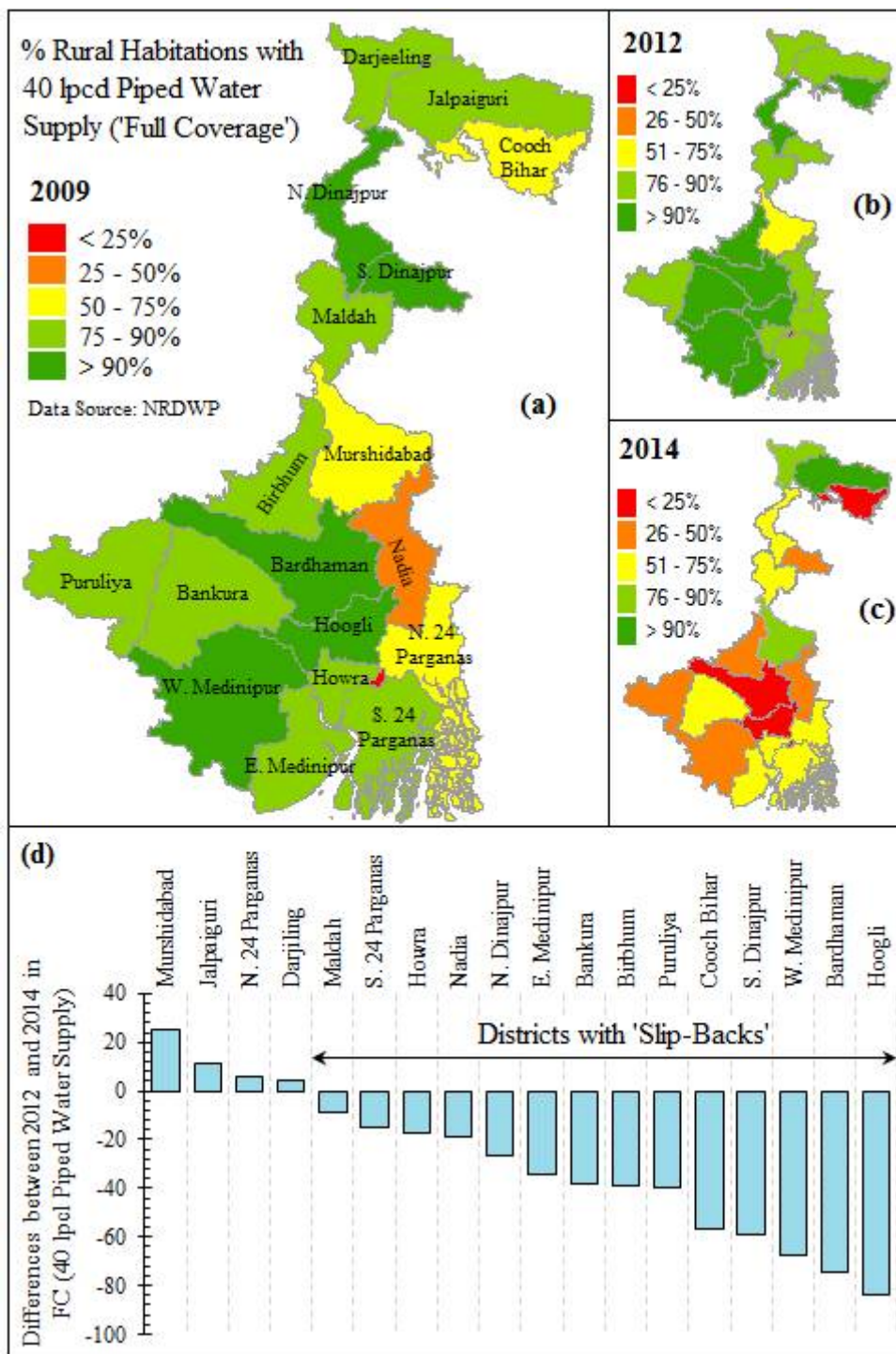


Figure 2: District-wise percentages of rural habitations availing of 40 lpcd piped water supply (Full Coverage; 'FC') for (a) 2009, (b) 2012, (c) 2014 and (d) districts registering slip-backs between 2012 and 2014 (Data Source: NRDWP)

Over time, however, the situation has changed as a large number of districts in recent times have started 'slipping back' from full coverage to 'partial coverage' status (PC: < 40 lpcd piped water supply) (Figure 2c). Eight districts in

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2014 enjoyed the FC status in less than half of the rural habitations while three districts namely, Cooch Bihar (17.5%), Bardhaman (18.6%) and Hoogli (10.2%), had less than a quarter of their rural habitations with FC. Between 2012 and 2014, 14 districts in West Bengal suffered ‘slip-back’ from FC to PC status (PC: partial coverage of <40 lpcd piped water supply) raising much concern over sustainable development for rural areas in the state (Figure 2d).

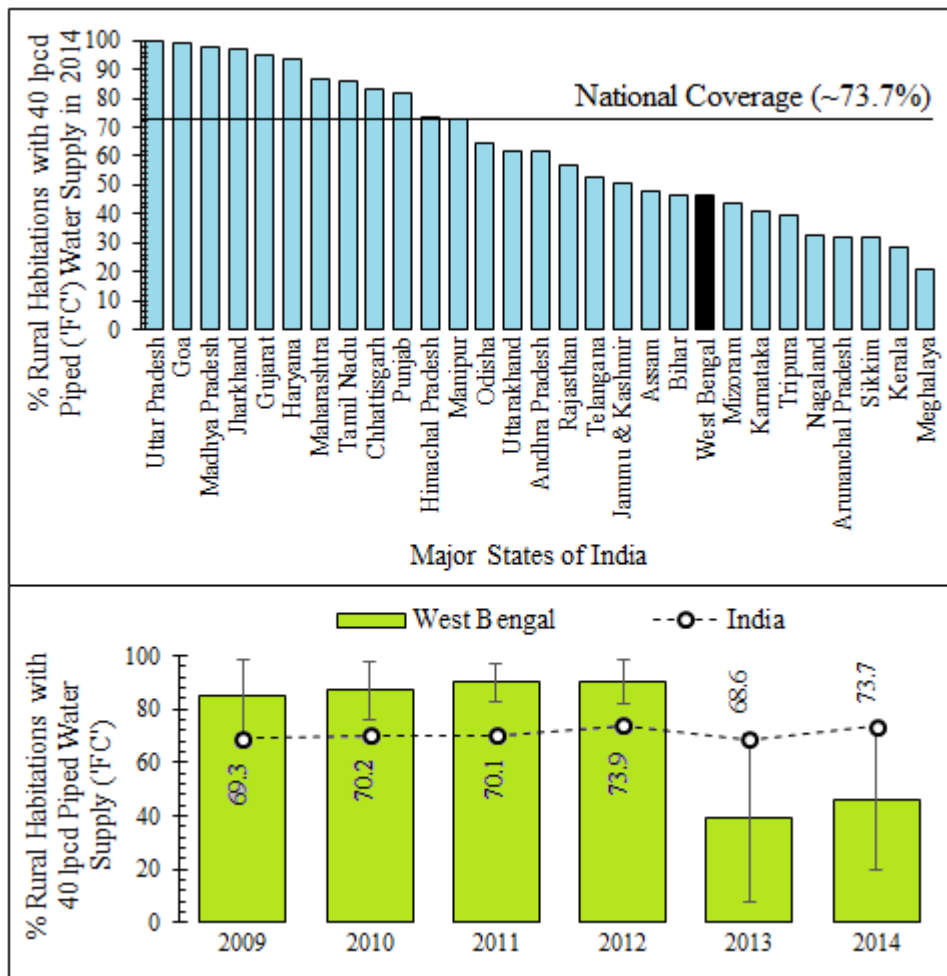


Figure 3: Percentages of rural habitations with 40 lpcd piped water supply (FC) for (a) 29 major states in India for 2014 and (b) West Bengal between 2009 and 2014 with respect to national scenario (Data Source: NRDWP)

In districts of Cooch Bihar, S. Dinajpur, W. Medinipur, Bardhaman and Hoogli, slip-backs amounted to about 56.8, 59.4, 67.7, 74.2 and 83.5 percentage points, respectively, between 2012 and 2014 (Figure 2d). In Cooch Bihar, Bardhaman, Birbhum, Hoogli, Nadia, Puruliya, South Dinajpur and West Medinipur districts, over three fourth of all blocks are only partially covered by piped water supply in 2014 (Table 1). In Hoogli, Nadia, and South Dinajpur districts, all blocks lacked FC. The situation appeared most alarming for the Hoogli district where several blocks had only one percent of less of their rural habitations receiving FC.

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Table 1: District-wise blocks with less than 50% rural habitations lacking FC (40 lpcd piped water supply) for 2014. Values in the parentheses indicate percentages of rural habitations with FC in each block in each district.

District	Total Blocks	Blocks with <50% Rural Habitations Without FC	Block with < 50% Rural Habitations Without FC
Bankura	22	10	Kotulpur (14.8), Mejhia (29.3), GangajalGhati (35.7), Indus (36), Onda (40.8), Chatna (42), Indpur (46.6), Barjora (48.3), Ranibundh (49.1), Sonamukhi (49.7)
Bardhaman	31	26	Manteswar (2.9), Ketugram 1 (3.4) & 2 (8.2), Galsi 1 (27.1) & 2 (3.7), Khandaghosh (3.7), Katwa 1 (3.9) & 2 (8.3), Kalna 1 (5), 2 (5.2), Bhatar (5.2), Jamalpur (6.3), Memari 1 (12.9) & 2 (6.8), Raina 1 (9.7) & 2 (9.4), Purbasthali 1 (14.5) & 2 (15.2), Bardhaman 1 (20.7) & 2 (15.3), Salanpur (21.1), Barabani (21.5), Ausgram 1 (27.4) & 2 (23.6), Mmagalkote (25.7), Kanksa (26.2)
Birbhum	19	13	Murarai 1 (32.6) & 2 (12), Bolpur (23.6), Nalhati 1 (39.8) & 2 (25.6), Illambazar (32.6), Nanoor (34.3), Mayureswar 1 (36.3) & 2 (35.5), Mohammad Bazar (37.2), Rampurhat 1 (44.5) & 2 (49), Sainthia (45.8)
Cooch Bihar	12	11	MathaBhanga 1 (5.6) & 2 (2.3), Sitalkuchi (2.4), Dinhati 1 (6.1) & 2 (11.2), Sitai (12.6), Mekhliganj (13.2), Cooch Bihar 1 (27.7) & 2 (15.8), Tufanganj 1 (30) & 2 (32.2)
Darjeeling	13	0	--
E. Medinipur	25	11	Moyna (3.3), Khejuri 1, (3.8) Bhagabanpur 1 (6.3), Mahisadal (26.1), Kolaghat (33.9), SahidMatangini (40.4), Panskura 1 (43.2), Haldia (43.9), Tamluk (49)
Hoogli	18	18	Chanditala 1 (0.52) & 2 (1.1), Haripal (0.63), Dhaniakhali (0.73), Jangipara (1.8), PolbaDadpur (1.8), Tarakeswar (2.6), Singur (2.6), Srerampr (3.6), Arambag (3.8), Goghat 1 (22) & 2 (8.9), Pursura (10.7), Khanakul 1 (20.1) & 2 (13.9), Pandua (15.3), Balagarh (27.1), Chinsura Magra (29.2),
Howra	14	2	Panchla (45.5), Sankrail (45.7)
Jalpaiguri	7	0	--
Maldah	15	1	Harishchandrapur 2 (5.64)
Murshidabad	26	4	Raninagar 1 (44.8) & 2 (34.3), Nawda (37.9), Lalgola (44.2)
N. 24 Parganas	22	1	Gaighata (49.1)
N. Dinajpur	9	0	--
Nadia	17	17	Nakashipara (1.26), Kaliganj (3.2), Krishnanagar 1 (40.4) & 2 (9.1), Chakda (11.3), Tehatta 1 (13.8) & 2 (25), Karimpur 1 (22.3) & 2 (46.7), Santipur (26.6), Nabadwip (29.1), Chapra (31.7), Ranaghat 1 (33.8) & 2 (45.4), Hanskhali (41.2)
Puruliya	20	16	Barabazar (11.1), Para (13.5), Puncha (21.1), Jaipur (24.6), Puruliya 1 (33.7) & 2 (23.1), Balarampur (24.1), Manbazar 1 (32) & 2 (31.7), Arsha (29.5), Neturia (44), Hura (42.3), Raghunathpur 1 (41), Kashipur (43.8), Jhalda 1 (47.5) & 2 (48.5),
S. 24 Parganas	29	7	Magrahat 1 (19.5), Falta (23.4), Kulpi (23.4), ThakurpukurMahestala (37.3), Jaynagar 2 (41.1), Basanti (49.2), Diamond Harbour 2 (49.4)

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S. Dinajpur	8	8	Hili (0), Balurghat (31.4), Bansihari (23.4), Gangarampur (29.3), Harirampur (36.4), Kumarganj (44.6), Kushmandi (49.5), Tapan (36.4)
W. Medinipur	29	28	Daspur 1 (0.34) & 2 (0.47), Ghatal (1.72), Garbeta 1 (24.9), 2 (10.1) & 3 (4.8), Nayagram (7.8), Narayangarh (13), Medinipur (13.8), Datan 1 (48.5) & 2 (16.3), Gopiballavpur 1 (21.1) & 2 (17.6), Mohanpur (18), Jhargram (19.6), Kharagpur 1 (22.1) & 2 (40.1), Chandrakona 1 (24.1) & 2 (33.7), Salbani (25.1), Pingla (28.6), Keshpur (29.8), Debra (31.2), Jambani (35.1), Sabang (36.2), Keshiary (36.2), Sankrail (39.9), Binpur 2 (50)

Over the years the rural water supply services have taken a nosedive in West Bengal. In 2014, West Bengal ranked 21st, among 29 major states in India, in terms of receiving FC, as compared to 11th in 2009, which underscores the impoverished state of affairs and growing concern over sustainable development (Figure 3a). Between 2009 and 2012, the state-wide average for 40 lpcd piped water supply for rural areas in West Bengal consistently overwhelmed the national averages for respective years by substantial margins (Figure 3b). Surprisingly, in recent times (2013 and 2014), however, the state averages (39.3% and 46.2%) have plummeted, dropping significantly below corresponding national averages of 68.6% and 73.7%.

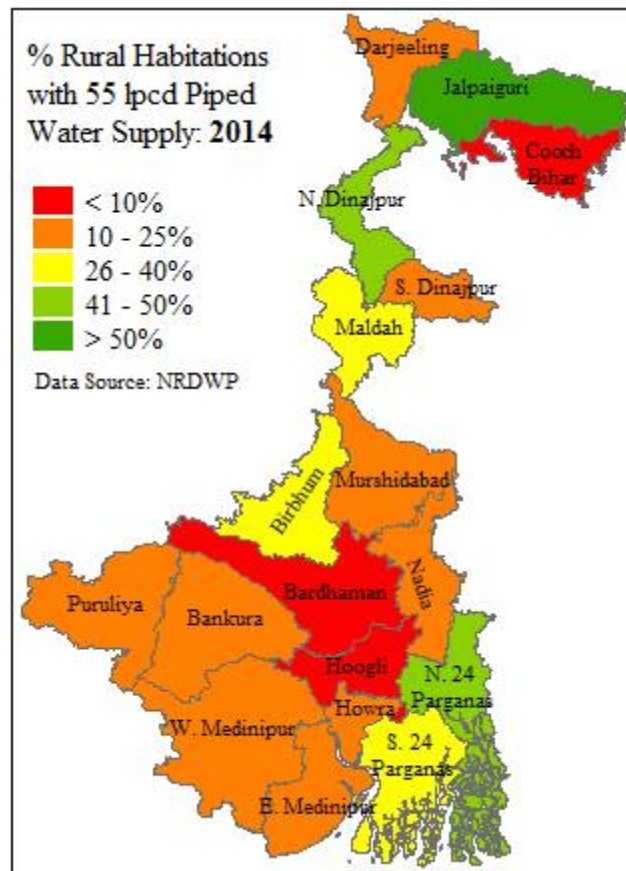


Figure 4: District-wise percentages of rural habitations receiving 55 lpcd water supply in 2014

Figure 4 assesses rural water supply sector, according to the recommendations (55 lpcd water supply) made by the 12th Five Year Plan (2012-2017). It appeared that in 12, out of 18 districts, less than half of the total rural habitations received 55 lpcd piped water supply in 2014, while 10 districts received 55 lpcd in only about a quarter or less of their rural habitations (Figure 4). Major ‘inadequacies’ were noted in Hoogli, Cooch Bihar, and Bardhaman districts where

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only about 3.1% , 5.3%, 8.6% and rural habitations received 55 lpcd in 2014. This also demonstrated how several districts in West Bengal is well short of the benchmark (50 lpcd) recommended by the World Health Organization for sustainable development.

Over the years there has been a growing concern over ‘slip-back’, with habitations reverting from to PC from FC status. Results indicated that in 14, out of 29 major states in India, percentages of rural habitations with FC status has dropped substantially between 2012 and 2014 (Figure 5). In West Bengal, percentage of rural habitations with FC status dropped by 44 percentage points between 2012 (90.36%) and 2014 (46.28%). Additionally, West Bengal ranked 3rd (out of 29 major states) in its ‘magnitude’ of slip-back over thus period, only after Kerala and Mizoram in India. This indicated that over the years, increasing number of rural households lacked ‘adequate’ water supply to sustain livelihood and probably had to depend on ‘unsafe’ water sources for potable and other necessities.

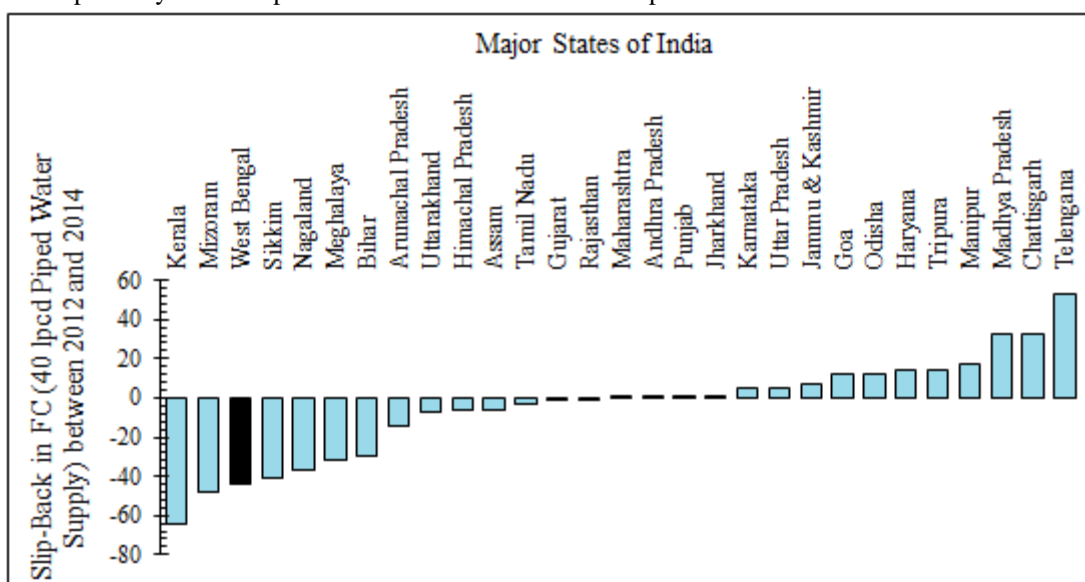


Figure 5: State-wise percentages of rural habitations suffering from slip-backs between 2012 and 2014 in 29 major states in India. (Negative values on the Y-axis indicate slip-back in the extent of FC received by state-wise percentages of rural habitations between 2012 and 2014 while positive values indicated improvements in the same)

Figure 5 also offers a glimpse of the striking spatial variability across India in terms of state-wise percentages of rural habitations receiving FC. For example, in about 12 states the rural water supply services have improved between 2012 and 2014. States of Telengana, Chhattisgarh and Madhya Pradesh registered improvements (in FC) by over 20 percentage points. On the other hand, a vast area in the north-eastern regions, comprising states of Mizoram, Nagaland, Meghalaya, Arunachal Pradesh, Assam, and Sikkim, water supply services have suffered slip-backs. This spatial ‘disparity’ in rural water supply sector across the country calls for in-depth investigation in future with appropriate strategies.

A wide variety of factors such as geohydrology, agro-climatic, socio-economic, governance and competing water demand for other sectors influence slippage. Specifically, factors that lead to drop in water supply service levels below prescribed norms can be summarized as follows (Mali and Dwivedi, 2013):

Natural Factors:

- Limited water resources availability with high spatio-temporal variability
- Weird climatic patterns (reduced precipitation that reduces natural recharge) that affect overall hydrologic cycle
- Water pollution due to presence of multiple contaminants above their Maximum Permissible Limit (MPL)
- High groundwater salinization, especially in coastal areas of the state
- Frequent flood and drought events that adds to groundwater degradation
- Drastic land cover changes (e.g urbanization, deforestation) that negatively affect hydrologic processes – both freshwater availability and vulnerability and inturn, water supply services

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Anthropogenic Factors

- Over-reliance on groundwater resources for potable purposes
- Lower efficiency in water uses (damages in existing water supply machineries and lack of timely repairs)
- Illegal connection to water supply systems (leading to issues of ill management and equitable distribution)
- Lack in budgetary provisions (for emergency operation and maintenance)
- Poor institutional organization (e.g. lack of involvement from local village communities)
- Corruption in the water supply sector (*shortage means profiteering*)
- Increasing water conflicts between different sectors (e.g. irrigation)
- Lack of appropriate water conservation and recycle schemes (e.g. rainwater harvesting, grey/black water use)
- Growing population and water demand
- Increased number of rural habitations/households over time

An additional woe that might add to the worries of policy-makers and water resources managers in the state is raving water quality impairment by widespread occurrence of multiple chemical species (with demonstrated human health adversities) in groundwater (main source of drinking water in majority of the state, alike rest of India) at concentrations far exceeding their Maximum Permissible Limit (MPL) for drinking water. West Bengal is the most arsenic affected state in India and also ranks among the top states in terms of fluoride contamination. A glimpse at the existing state of drinking water supply in 'water-quality-affected' habitations in rural West Bengal reveals a grave scenario (Table 2).

Table 2: Number of water-quality-affected habitations in West Bengal and habitations covered by NRDWP scheme as of 2014. MPLs are according to Bureau of Indian Standard (BIS) (Source: NRDWP)

Contaminant Name	No. of Affected Habitations	No. of Covered Habitations
Arsenic (MPL: 0.05 ppm)	1124	144
Fluoride (MPL: 1.5 ppm)	251	24
Iron	10150	1076
Salinity	88	21
Nitrate	1	0

Out of a total of about 11614 water quality affected rural habitations in the state, only about 11% habitations are covered by the NRDWP scheme as of 2014. Only about 12.8% and 9.5% of arsenic and fluoride affected habitations, respectively, are covered by NRDWP which raises serious concerns over public health. Iron appears the most spatially pervasive species accounting for about 87% of all water quality affected habitations in the state (as of 2014). However, only 10% of these habitations are included in the current NRDWP infrastructure.

In a recent policy development the West Bengal Public Health and Engineering Department (WBPHED), however, has adopted a 'vision 2020' approach to address the rising concerns over water supply services as follows (Table 3):

Table 3: Framework of the 'Vision 2020' plan for the water supply sector in West Bengal adopted by the WBPHED

Major Objectives

- Ensure 70 lpcd piped drinking water for all (humans and livestock)
- Shift from hand pump/tubewells (existing mainstay of water supply services) to piped water
- Maintain water quality as par the Bureau of Indian Standards (BIS)
- Issues of potability, reliability, sustainability, convenience and consumer's preferences as guiding principles in designing community water supply services
- Help communities monitor water sources
- Ensure safe potable water to schools and anganwadi centres
- Provide online information archival/transfer systems accessible by public
- Creation of state water grid (to draw water from various sources via large diameter pipes)

Action Plans: Resource Generation

- Storm/flood water management
- Rejuvenation of surface water bodies

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- Encourage groundwater usage
 - Developing inexpensive water treatment technologies
 - Establishment of several water treatment plants across the state
 - Devise in-situ water conservation strategies
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Other proposed action plans in 'Vision 2020' include (1) use of renewable energy, (2) hazardous water management generated by water supply services, (3) management of wastewater effluents, (4) scale up existing water quality monitoring and surveillance program (WQM&SP), and (5) encourage more community participation to enact/maintain strategies.

IV. CONCLUSION

What undermines the rural water supply sector is widespread occurrence of slip-back which indicates, districts that had FC previously, now receive 'inadequate' supply in recent times. A variety of factors influence slip-back that comprise both natural and human-induced. The latter range from flaws within the basic design, planning, implementation of water supply schemes to subsequent management of water supply facilities. Added to it is the lack of awareness in the villagers in the operation and maintenance of water supply facilities, local hydrology, climate and spatio-temporal dimensions of human-environment interaction that frequently leads to overexploitation of water resources. Issues are further ramified as the water supply schemes frequently ignore completion from other water management leading to misappropriation of resources. Moreover, majority of the water quality affected rural habitations in the state lack appropriate water supply services that only adds to the worry over sustainable development in days ahead.

Overall, the study shot up an alarmingly 'under-provided' scenario in the rural water supply sector in West Bengal, which bears grave consequences and calls for substantial developmental reforms, region-specific strategic planning, and effective policy implementation in years ahead. Similar studies should be performed in other parts of India to evaluate existing rural water supply infrastructure and draw up future strategies.

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