Trans.Inst.Indian Geographers
ISSN 0970-9851

Groundwater Scenario in Kolkata Metropolitan Area

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Abstract

Safe drinking water is the cardinal pillar of urban infrastructure. Unfortunately domestic water supply is becoming a critical issue in most urban complexes of our country. Kolkata Metropolitan Area (KMA), the third largest metropolis in India is no exception. The alarming population increase in the metropolitan area has put an immense pressure on all available water resources both groundwater and surface water. Having a share of 52%, groundwater plays a pivotal role in municipal water supply infrastructure. Out of 41 municipalities, except for one all other municipalities and the surrounding rural areas are dependent on groundwater either fully or partly. Though groundwater is used extensively, there is no data on the total number of tubewells and thus on the quantum of groundwater abstracted over the region. During last three decades innumerable tubewells are sunk without any management and prospective planning. Consequently groundwater level is depleted and arsenic toxicity in aquifer has emerged sporadically in parts of KMA. In this back drop it is essential to initiate groundwater management practices on the basis of sound data base.

Kolkata Metropolitan Development Authority (KMDA) has proposed the ultimate option to reject groundwater as a whole and switch over to Hooghly River water. There is no detailed study to evaluate and understand the role of groundwater in the water supply system of KMA. As such the decision is not rational. Through this study a maiden attempt is made to collect all the tubewell data available with public institution; outline the role of groundwater in present infrastructure; find out areas of supply demand gap at present and project actual demand profile. This paper concludes with explicit views on role of groundwater over KMA area and future management requirements. The role of groundwater for future use cannot be gainsaid.

Key Words: *groundwater, falling trend, contamination, supply demand gap, per capita allocation, conjunctive use*

1. Introduction

Results and Discussion

Treated water from Palta WTP (Water Treatment Plant), the first in KMA supplied water mainly to Kolkata city and to a small number of residents of Baranagar, South Dum Dum, and the garrison of Barrackpur and Dum Dum cantonments. Dug wells and hand pump fitted tubewells were a common source of potable water in the entire region. Until late 70s groundwater was extensively used to support urban, industrial and agricultural needs without any reports of falling groundwater level (GWL) or arsenic contamination.

Groundwater still plays an important role in the water supply system of KMA inspite of introduction of many surface water supply schemes. Out of 41 municipalities of KMA, except for one municipality, groundwater is supplied to all other municipalities. In 16 municipalities and in the rural counterpart public water supply is entirely groundwater dependent and in the remaining 24 municipalities groundwater in combination with surface water is supplied (**fig.2**).

The demand supply gap with respect to surface water considering KMDA supply norm for the population of 2011 census year is presented in **table 1**. In 19 out of the 41 municipalities the gap with respect to surface water is over 80%. While projecting the demand supply gap for the year 2025, a questionnaire survey is conducted on actual water consumption pattern across different sections of people living in different parts of the metropolis. Results of the survey indicate that the norm fixed by KMDA (200 lpcd/150 lpcd/135lpcd) is fixed on adhoc basis without considering any ground realities. On the basis of the household survey conducted and various national recommendations, domestic water supply norm of 225

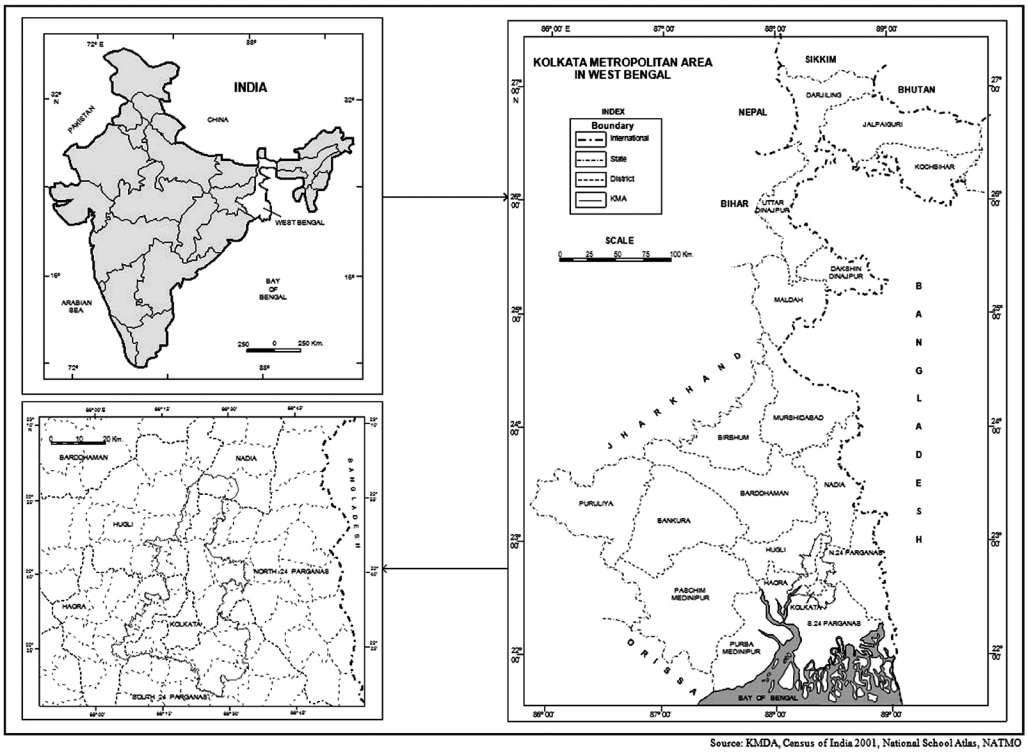

Fig.1. Location of Kolkata Metropolitan Area in West Bengal

Source: Authors Own

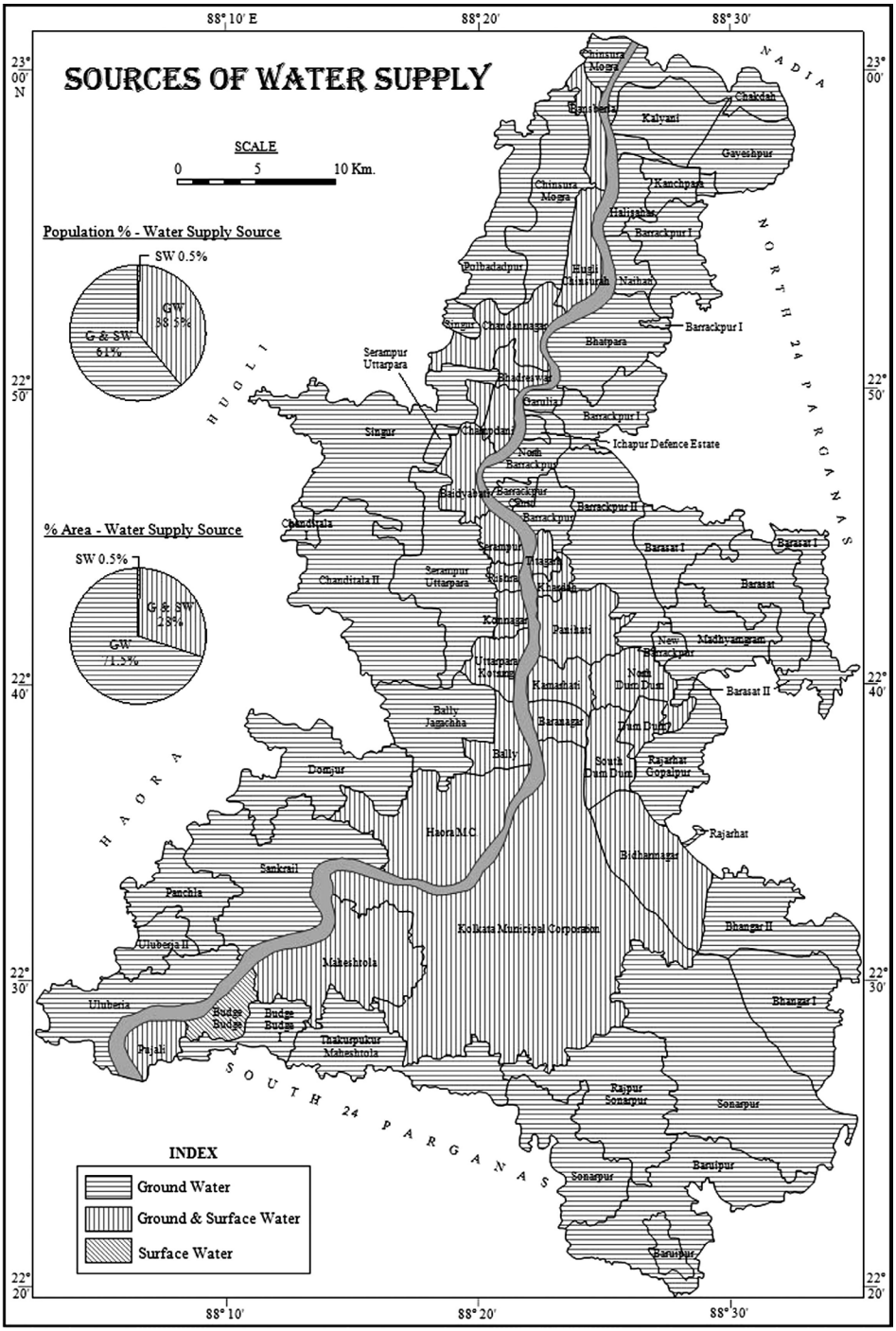

Fig. 2 Source of Water Supply in Kolkata Metropolitan Area

Table 1: Supply Demand Gap with respect to surface water supply (present population) @ KMDA supply norm (200lpcd for Kolkata M.C/150lpcd for Haora M.C/135lpcd for rest of municipalities of KMA)

Gap (%)	Municipality / Municipal Corporation
No gap	Titagarh, Khardah, Kolkata, Pujali, Budge Budge, Konnagar
1 – 20	Bhadreswar
21 - 40	Bidannagar, Maheshtala, Rishra, Haora
41 – 60	Kamarhati, Baranagar, North Dum Dum, Dum Dum, Champdani, Serampore, Baidyabati, Uttarpara-Kotrung, Bally
61 - 80	Panihati, South Dum Dum
81 - 99	Bansberia, Hugli - Chinsurah, Chandernagore
100	Kalyani, Gayeshpur, Kanchrapara, Halisahar, Naihati, Bhatpara, Garulia, North Barrackpur, Barrackpur, Barasat, Madhyamgram, New Barrackpur, Rajarhat - Gopalpur, Rajpur -Sonarpur, Baruipur, Uluberia

Source: Computed by author

Table 2: Supply Demand Gap with respect to surface water supply (for projected population of 2025) @ recommended supply norm (225 lpcd/160 lpcd)*

Gap (%)	Municipality / Municipal Corporation
No gap	Titagarh, Khardah, Dum Dum, Kolkata, Budge Budge, Bansberia, Champdani, Konnagar
1 – 20	Gayeshpur, Kanchrapara, Naihati, Bhatpara, North Barrackpur, Bidhannagar, Baruipur, Baidyabati, Rishra, Haora, Uluberia
21 - 40	Kalyani, Halisahar, Kamarhati, Madhyamgram, Pujali, Hugli-Chinsurah, Bhadreswar, Uttarpara-Kotrung, Bally
41 – 60	Garulia, Panihati, Baranagar, Barasat, New Barrackpur, North Dum Dum, Serampore
61 - 80	Barrackpur, South Dum Dum, Maheshtala, Chandernagore
81 - 99	Rajpur - Sonarpur
100	Rajarhat - Gopalpur

Source: Computed by author

*@ 225 lpcd for Kolkata, Haora, Chandernagore, Kalyani, Barrackpur, Barasat, Madhyamgram, New Barrackpur, North Dum Dum, Dum Dum, South Dum Dum, Baranagar, Bidhannagar, Rajarhat – Gopalpur, Rajpur – Sonarpur, Hugli – Chinsurah, Bhadreswar, Serampur, Rishra and Konnagar

@160 lpcd for rest of municipalities of KMA including rural areas

lpcd/160 lpcd is considered while projecting the demand supply gap with respect to surface water for 2025 (table 2).

Institutionally there is no record about the number of tubewells operative under private ownership and thus groundwater draft over KMA is not known. Hence for demand side management there is no other option but to accept that allocation is the actual use even though there may be countable differences.

Though groundwater is used in large quantum, the present constraints of groundwater use arise from: a) declining/falling trend of GWL due to close spacing of tubewells and indiscriminate use; b) high stage of development (SOD) when the urban allocation is considered and c) arsenic toxicity in groundwater. Moreover, the southern part of the metropolitan area has the problem of salinity.

Table 3: Role of groundwater in Kolkata Metropolitan Area

Name of Municipality/ Municipal Corporation	Gap(%) wrt surface water for projected population of 2025	SOD% with respect to groundwater availability and groundwater draft	GWL Trend		Contamination		Recommendation
			Pre	Post	Arsenic (As) affected units	Salinity (S) affected units	
1	2	3	4	5	6	7	8
1. Kalyani M	37	59%	NF	NF	As	-	Insignificant Role
2. Gayeshpur M	4	59%	NF	F	As	-	Rejected
3. Kanchrapara M	2	85%	NF	NF	As	-	Rejected
4. Halisahar M	24	85%	NF	NF	As	-	Restricted
5. Naihati M	20	85%	NF	NF	As	-	Restricted
6. Bhatpara M	18	85%	F	NF	As	-	Restricted
7. Garulia M	56	85%	F	NF	As	-	Restricted
8. North Barrackpore M	19	85%	F	F	As	-	Restricted
9. Barrackpore M	67	111%	F	F	As	-	Restricted
10. Titagarh M	0	111%	F	F	As	-	Rejected
11. Khardah M	0	111%	F	F	As	-	Rejected
12. Dum Dum M	0	111%	F	F	As	-	Rejected
13. Panihati M	47	111%	F	F	As	-	Restricted
14. Kamarhati M	32	111%	F	F	As	-	Restricted
15. Baranagar M	43	111%	F	F	As	-	Restricted

16. South Dum Dum M	61	111%	F	F	As	-	Restricted
17. North Dum Dum M	44	111%	F	F	As	-	Restricted
18. New Barrackpore M	47	111%	F	F	As	-	Restricted
19. Barasat M	41	58%	F	NF	As	-	Restricted
20. Madhyamgram M	37	58%	F	NF	As	-	Restricted
21. Rajarhat Gopalpur M	100	42%	NF	NF	As	S	Restricted
22. Bidhannagar M	19	42%	NF	NF	As	S	Restricted
23. Rajpur Sonarpur M	87	No Assessment	F	F	As	S	Restricted
24. Baruipur M	14	No Assessment	F	F	As	S	Restricted
25. Budge Budge M	0	No Assessment	F	NF	As	S	Rejected
26. Maheshtala M	67	No Assessment	F	F	As	S	Restricted
27. Pujali M	22	No Assessment	F	NF	As	S	Restricted
28. Kolkata MC	0	No Assessment	F	F	As	S	Rejected
29. Hugli Chinsurah M	31	40%	NF	F	-	-	Significant Role
30. Bansberia M	0	40%	NF	F	-	-	Significant Role
31. Chandernagore MC	72	31%	NF	F	-	-	Significant Role
32. Bhadreswar M	24	31%	F	F	-	-	Significant Role
33. Champdani M	0	31%	F	F	-	-	Significant Role
34. Baidyabati M	3	46%	F	F	-	-	Significant Role
35. Serampore M	52	46%	F	F	-	-	Significant Role
36. Rishra M	18	46%	F	F	-	-	Significant Role
37. Konnagar M	0	46%	F	F	-	-	Significant Role
38. Uttarpara Kotrung M	26	46%	F	F	-	-	Significant Role
39. Bally M	26	No Assessment	F	NF	-	S	Restricted

40. Haora MC	10	No Assessment	F	NF	-	S	Insignificant Role
41. Uluberia M	16	No Assessment	NF	NF	-	S	Insignificant Role

Note: GWL Trend : Falling (F) – slope of trend line greater than 20 cm/annum; No Falling (NF): slope of trend line greater than 20 cm/annum as per methodology recommended by Groundwater Resource Estimation Committee (GEC) – 97.

Source: Coloum 2: Computed by author; Column 3: Computed as per methodology recommended by GEC – 1997; In Bhangar I & II, Baruipur, Sonarpur, Budge Budge I, Thakurpukur Maheshtola, Bally Jagachha, Sankrail, Panchla and Uluberia II blocks groundwater predominantly occurs under confined condition and are not considered in present estimation of available groundwater resource as GEC – 97 methodology is not applicable for these areas.

Column 4&5: State Water Investigation Directorate, Kolkata and own filed survey;

Column 6&7: Public Health and Engineering Department and School of Environment Studies, Jadavpur University.

In this context, the future role of groundwater if any to supplement surface water supply for the estimated population of 2025 is studied considering the following four parameters. a) The gap with respect to surface water to meet the per capita allocation norm considered for the estimated population (2025) of KMA (**table 2**); b) the stage of groundwater development in each unit (municipalities, corporations and rural area) (**table 3**); c) the state of the dynamic resource (GWL trend in **table 3**) and d) contamination with reference to arsenic and salinity (**table 3**), the future role of groundwater in KMA is ascertained. The constituent units of KMA are categorized (**fig**. **3**) into the following four classes of groundwater use. i) Significant role of groundwater – share of groundwater may be substantive in addition to surface water. ii) Restricted role of groundwater – groundwater abstraction in case of non availability of any alternative source with proper spacing, design and regulatory discharge. iii) Insignificant role of groundwater – groundwater to be gradually replaced. iv) Total rejection of groundwater – total ban on groundwater abstraction.

Based on the above mentioned parameters, the future role of groundwater for each municipalities of KMA is discussed in **table 6.**

GWL Trend : Falling (F) – slope of trend line greater than 20 cm/annum; No Falling (NF): slope of trend line greater than 20 cm/annum as per methodology recommended by Groundwater Resource Estimation Committee (GEC) – 97.

7. Conclusion

a) It is no denial that groundwater resource of KMA area though bountiful but is afflicted with the problems of heavy abstraction, depleting water level and geogenic arsenic toxicity.

b) From the existing scenario of urban water supply infrastructure, the role of groundwater cannot be gainsaid.

c) 71.5% of the total area of KMA is still groundwater dependent and 28% of the area is partially dependent on groundwater. 52% of the population is dependent on groundwater institutionally.

d) Groundwater use for urban water supply may continue on western bank of Hooghly River.

e) Restricted use of groundwater in some areas of eastern bank is a cautious task but not impossible.

f) Balanced conjunctive use of groundwater and surface water may mitigate falling trend of GWL.

g) Deserting groundwater cannot be a better option while little or no effort is exercised by any authority for implementing a meliorative groundwater management.

h) Recording of all mechanised tubewells within KMA should be a primary task of the competent authority under the new Act.

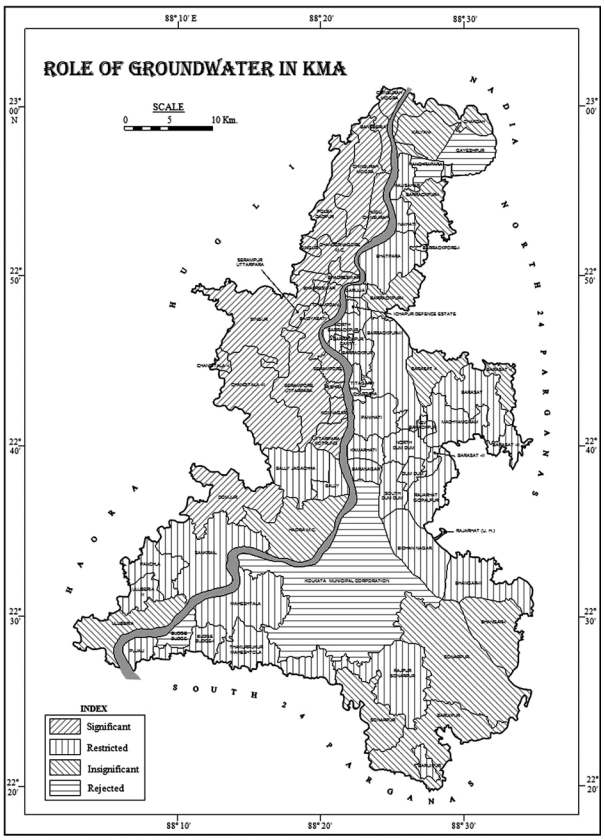

Fig. 3 Role of groundwater in water supply system of Kolkata Metropolitan Area

Acknowledgement

Author is grateful to Mr. Tapan Kr. Roy, retired Additional Director of Sate Water Investigation Directorate, Kolkata, for his guidance.

References

- Biswas, A.B. and Saha, A.K.(1986). The Groundwater Condition of Calcutta Metropolitan Area. CSME, Department of Geology, Presidency College, Calcutta.
- Census Reports, 1951 to 2011. Districts-Kolkata, North and South 24 Parganas, Nadia, Howrah and Hugli. Govt. of India, New Delhi.
- Chaterjee, G.C., Biswas, A.B., Basu, S. and Niyogi, B.N. (1964). Geology and Groundwater Resources of the Greater Calcutta Industrial Area, West Bengal. Bulletins of the Geological Survey of India, Series B, NO. 21. GOI, Delhi.
- Gleick, P.H. and IWRA, M. (1996). Basic Water Requirements for Human Activities: Meeting Basic Needs. Water International, 21 (2): 83 – 92.
- 5.Kolkata Metropolitan Development Authority (2007). *City Development Plan*. KMDA, Kolkata.
- Kolkata Metropolitan Development Authority. Vision 2025. (2005). A Perspective Plan of Kolkata Metropolitan Area. KMDA, Kolkata.
- Kolkata Metropolitan Development Authority. (2001). Population Profile of Kolkata Metropolitan Area. KMDA, Kolkata.
- Kolkata Metropolitan Development Authority. (2005). Master Plan for Water Supply within Kolkata Metropolitan Area, 2001 – 2025 (Draft Final). KMDA, Kolkata.
- Parua, P.K. (2009). The Ganga Water Use in the Indian Subcontinent. Springer Science & Business Media B.V. Publication, Dordrecht.
- Sengupta, S.(1966). Geological and geophysical studies in the western part of Bengal Basin, India. Bulletin of the American association of Petroleum Geologists, 50 (5), pp. 1001 – 1017.

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