PhD Synopsis

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1. Title of the thesis: - STUDIES ON URBAN GROUNDWATER POLLUTION OF RAIPUR AREA

2. Introduction

The urban groundwater has emerged as one of the world's most challenging issues. The problems are numerous i.e. too little groundwater, large users, contamination of groundwater with industrial and domestic pollutants [1 - 3]. The quality of available groundwater resources is being increasingly degraded by geogenic and anthropogenic activities [4 - 7]. Asian countries faces serious water problems almost everywhere mainly due to explosive population growth, heavy seasonal rains, massive flooding, decreasing of water levels, mixing of waste water, etc. [8 - 9]. Groundwater has come to be the mainstay of irrigated agriculture in large parts of Asia [10]. Another dimension of Asia's groundwater irrigation is the large variation in use patterns.

3. A brief review of the work already done

In India, groundwater is used intensively for drinking, irrigation and industrial purposes. Several land and water-based human activities are causing pollution of this precious resource. The over-exploitation of groundwater is causing aquifer contamination in certain instances, while in others its unscientific development with insufficient knowledge of groundwater flow dynamic and geo-hydrochemical processes has led to its mineralization [11]. India is now the biggest user of groundwater for agriculture in the world [12]. Groundwater irrigation has been expanding at a very rapid pace in India since the 1970s. The most dramatic change in the groundwater scenario in India is that the share of tube wells in irrigated areas rose from a mere 1% in 1960 - 61 to 60% in 2006 - 2011. By now, tube wells have become the largest single source of irrigation water in India. The question of safety of the level of groundwater development in a district or block can be approached from another angle – that of water quality. Now, groundwater has a high incidence of water quality problems.

Official figures from DDWS state that out of 593 districts from which data is available, we have problems from high fluoride (203 districts), iron (206 districts), salinity (137 districts), nitrate (109 districts) and arsenic (35 districts) (DDWS 2006) [13 - 16]. Biological contamination problems causing enteric disorders are present throughout the country and probably constitute the problem of major concern, being linked with infant mortality, maternal health and related issues such as loss of valuable "work time".

The incidence of fluoride above permissible levels of 1.5 ppm occur in several states, namely, Andhra Pradesh, Bihar, Gujarat, Haryana, Karnataka, Kerala, Madhya Pradesh, Chhattisgarh, Maharashtra, Orissa, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, West Bengal, etc. affecting a total of 69 districts, according to some estimates. Some other estimates find that 65 per cent of India's villages are exposed to fluoride risk [17 - 24].

Present work

Limestone and dolomite are the carbonate rocks precipitated in identical environment to form widespread and continuous deposits. Limestone comprises of high calcium carbonate, while dolomite is a double carbonate with higher concentrations of magnesium carbonate (>19 % MgO) and calcium carbonate (20 ~ 35 % CaO). Limestone and dolomite deposits are known in the State located in Raigarh, Janjgir-Champa, Kabirdham, Bilaspur, Raipur, Durg, Rajnandgaon districts forming part of Chhattisgarh basin. They may contain fluoride minerals in traces. In addition, they are soft rocks with higher ease weathering.

Several steel, sponge iron, ferro alloy and cement industries using coal as fuel are running in Raipur area. Their industrial effluents are emitting elements such as F^-, Cl^-, SO_4^{2-}, As, Cr, Mn, Fe, Zn, Pb, etc. in the environment. Ultimatly, they may trape into the groundwater aquifers.

At least 15% population of the State resides in urban areas ranging from Raipur to Rajnandgaon. They need food, consumable and energy. Their productions generate environmental pollution. In this region, a lot of groundwater is consumed for domestic, agricultural and industrial purposes. These activities tend to increase concentration of Na^+, K^+, Mg^{2+}, Ca^{2+}, Fe, Mn, F^-, Cl^-, SO_4^{2-}, HCO_3^-, etc., in the water [25 - 30]. Therefore, physical parameters i.e. color, conductivity, TDS, alkalinity, hardness, etc. are increasing enormously.

4. Objectives

The objectives of proposed work to be carried out in the urban groundwater of Raipur, Bhilai, Durg and Rajnandgaon are:

- Measurement of physical parameters i.e. color, temperature, pH, DO, RP, conductivity, TDS, alkalinity, hardness, etc., and record their spatial and seasonal variations.
- Investigation of pathogenic bacteria contamination in groundwater.
- Contamination of chemical species i.e. Na^+, K^+, Mg^{2+}, Ca^{2+}, Fe, Mn, F^-, Cl^-, SO_4^{2-}, HCO_3^-, etc. and study their seasonal variations.
- The sources of Na^+, K^+, Mg^{2+}, Ca^{2+}, Fe, Mn, F^-, Cl^-, NO_3^-, SO_4^{2-}, HCO_3^-, etc.
- Development of water quality indexes.

5. Noteworthy contribution in the field of proposed work

Our research group is engaged in the investigated of groundwater quality of the regions. The groundwater of this region is contaminates with As and F^- at elevated leaches [25 - 30].

6. Proposed methodology

The water samples will be collected by using standard procedures [31]. The samples will be preserved by keeping the samples in the freezer. The following analytical techniques may be used for measurements of water constituents. The models i.e., cluster and factor analysis can be used to differentiate the water contaminants on the basis of their composition and origin [32 - 35].

Table 1. Analysis of water constituents

S. No.	Species	Techniques
1	pH/conductivity/TDS/DO/RP	Hana meter
2	Alkalinity/Hardness	Titration method
3	F^-	Ion selective electrode
4	Cl^-, NO_3^-, SO_4^{2-}	IC/Spectrometry/Titration method
5	Na^+, K^+, Mg^{2+}, Ca^{2+}, Fe, Mn	AAS/Flame photometer/IC
6	Bacteria	Test Kit

7. Expected outcomes of the proposed work

- Understanding of groundwater quality depletion.
- Sources of unwanted species in groundwater of Raipur area.
- Causes of water borne diseases in this regions.

8. Bibliography

1 Howard, K. W. F. and Israfilov, R. G., Current problems of hydrogeology in urban areas, urban agglomerates, and industrial centres, Springer, 2002.

2 Lerner, D. N., Urban groundwater pollution, A. A. Balkema, 2004.

3 Tellam, J. H., Rivett, M. O. and Israfilov, R. G., Urban groundwater management and sustainability, Springer, 2006.

4 Burke, J. J., Land and water systems: managing the hydrologic risk, Natural Resources Forum, 2000.

5 Burke, J. J., Groundwater for irrigation: productivity gains and the need to manage hydro - environmental risk, in Llamas, R. & Custodio, E., eds. Intensive use of groundwater challenges and opportunities, Abingdon, U. K., Balkema, 2002.

6 Custodio, E., Aquifer overexploitation - what does it mean?, Hydrogeology Journal, 2002.

7 Sampal, P. and Trouble, D., The hidden threat of groundwater pollution, World Watch Paper, 2000.

8 Roy, A. D. and Shah, T., Socio - ecology of groundwater irrigation in India, intensive use of groundwater: challenges and opportunities, Llamas, R. and Custodio, E., Lisse, A.A. Balkema**,** 2002.

9 Takizawa, Satoshi (Ed.) groundwater management in Asian cities, Technology and policy for sustainability series: cSUR - UT series: Library for Sustainable Urban Regeneration, 2008.

10 Shah, T., Roy, A. D., Qureshi, A. S. and Wang, J., Sustaining Asia's groundwater boom: an overview of issues and evidence, Natural Resources Forum, 2003.

11 Shankar, P. S. V., Kulkarni, H. and Krishnan, S., India's groundwater challenge and the way Forward, Economic & Political Weekly EPW January 8, 2011.

12 Shah, T., Taming the anarchy: groundwater governance in South Asia, Washington, DC: resources for the future, Colombo, International Water Management Institute, 2009.

13 Bryson, C., The fluoride deception, Seven Stories Press, 2004.

14 CGWB, Groundwater quality in shallow tube well, Ministry of water resources, Faridabad, 2010.

15 Dagar, J. C., Salinity research in India: an overview, Bulletin of the National Institute of Ecology, 2005.

16 Rahman, M. M., Mandal, B. K., Chowdhury, T. R., Sengupta, M. K., Chowdhury, U. K., Lodh, D., Chanda, C. R., Basu, G. K., Mukherjee, S. C., Saha, K. C. and Chakraborti, D., Arsenic groundwater contamination and sufferings of people in North 24 - Parganas, one of the nine arsenic affected districts of West Bengal, India: The seven years study report, Environmental Science & Health, 2003.

17 Chakraborti, D., Mukherjee, S. C., Pati, S., Sengupta, M. K., Rahman, M. M., Chowdhury, U. K., Lodh, D., Chanda, C. R., Chakraborti, A. K. and Basu, G. K., Arsenic groundwater contamination in middle Ganga Plain, Bihar, India: A Future Danger, Environmental Health Perspectives, 2003.

18 Chakraborti, D., Ahamed, S., Rahman, M. M., Sengupta, M. K., Lodh, D., Das, B., Hossain, Md. A., Mukherjee, S. C., Pati, S. and Niloy K. De., Risk of arsenic contamination in groundwater, Environmental Health Perspectives, 2004.

19 Sankararamakrishnan, N., Sharma, A. K. and Iyengar, L., Contamination of nitrate and fluoride in ground water along the Ganges Alluvial Plain of Kanpur district, Uttar Pradesh, India, Environmental Monitoring and Assessment, 2008.

20 Jha, S. K., Nayak, A. K. and Sharma, Y. K., Potential fluoride contamination in

the drinking water of Marks Nagar, Unnao district, Uttar Pradesh, India, Environmetal Geochemistry and Health, 2010.

21 Yadav, J. P., Lata, S., Kataria, S. K. and Kumar, S., Fluoride distribution in groundwater and survey of dental fluorosis among school children in the villages of the Jhajjar District of Haryana, India, Environmetal Geochemistry and Health, 2009.

22 Kundu, M. C. and Mandal, B., Assessment of potential hazards of fluoride contamination in drinking groundwater of an intensively cultivated district in West Bengal, India, Environmental Monitoring and Assessment, 2009.

23 Singh, B., Gaur S. and Garg, V. K., Fluoride in drinking water and human urine in southern Haryan, India, Journal of Hazardous Material, 2007.

24 Reddy, D. V., Nagabhushanam, P., Sukhij, B. S., Reddy A. G. S. and Smedley, P. L., Fluoride dynamics in the granitic aquifer of the Wailapally watershed, Nalgonda District, India, Chemical Geology, 2010.

25 Patel, K. S., Ambade, B., Yubero, E. and Lautent, M. Urban runoff water quality in central India, Proceedings, 7th EUREGEO International Conference, Bologna, 2012.

26 Patel, K. S., Rajak, M., Dahariya, N. S., Mukerjee, A., Blazhev, B., Nicolas, J., Yubero, E., Hoinkis, J. and Lautent, M., Potential groundwater pollution in central India, Proceedings, 7th EUREGEO Internatuional Conference, Bologna,

2012.

27 Patel, K. S., Sharma, R., Patel, R. K. and Lautent M., Groundwater quality of Rajnangaon city, Proceedings, Workshop on Groundwater Pollution Around Industrial Clusters: Mitigation & Management, Raipur, 2011.

28 Patel, K. S., Bhatia, A. P., Patel, R. K. and Lautent, M. Source apportionment of arsenic and other elements in groundwater of Ambagarh Chouki, Raipur, Proceedings, Workshop on Groundwater Pollution Around Industrial Clusters: Mitigation & Management, Raipur, 2011.

29 Dahariya, N. S., Patel, K. S., Dewangan, R. K., Patel, R. K. and Lautent, M., Groundwater quality in Raipur city, Accepted, IGWQ Conference 2012.

30 Banjare, G. R., Patel, K. S., Dewangan, R. K., Patel, R. K. and Laurent, M., Fluoride pollution in groundwater of Dongergaon, Chhattisgarh, Accepted, IGWQ Conference 2012.

31 Nielsen, D. M., The essential handbook of ground-water sampling, CRC Press, 2006

32 Liu, C. W., Lin, K. H. and Kuo, Y. M., Application of factor analysis in the assessment of groundwater quality in a blackfoot disease area in Taiwan, Science of Total Environment, 2003.

33 Jalali, M., Hydrochemical identification of groundwater resources and their changes under the impacts of human activity in the Chah basin in western Iran,

Environmental Monitoring & Assessment, 2007.

34 Singh, K. P., Malik, A., Singh, V. K., Mohan, D. and Sinha, S., Chemometric analysis of ground water quality data of alluvial aquifer of Gangetic plain, North India, Analytica Chimica Acta, 2005.

35 Venugopal, T., Giridharan, L. and Jayaprakash, M., Application of chemometric analysis for identifying pollution sources: a case study on the River Adyar, India, Marine and Freshwater Research, 2009.

9. List of published papers of the candidate

(1) Dahariya, N. S., Patel, K. S., Dewangan, R. K., Patel, R. K., and Lautent, M., Groundwater quality in Raipur city, IGWQ Conference, Accepted, 2012,

(2) Patel, K. S., Rajak, M., Dahariya, N. S., Mukherjee, A., Blazhev, B., Nicolas, J., Yubero, E., Hoinkis, J. and Lautent, M., Potential groundwater pollution in central India, Proceedings, 7th EUREGEO International Conference, Bologna, 2012.

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