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Zoology

WATER LEVEL FLUCTUATION AND INDICATOR BACTERIAL DISTRIBUTION IN QUATERNARY AQUIFERS ALONG PAMPA RIVER BANK, KERALA

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ABSTRACT Pampa, the third longest river in Kerala is one of the most stressed rivers in the state. Water level fluctuation and distribution of indicator bacteria in quaternary aquifers along Pampa river bank in Chengannur- Maramon sector during Southwest and North east monsoons and summer season of 2013-2014 is discussed in this paper. Monthly water level in dug wells is monitored and seasonal analysis of riverine and well waters for indicator bacteria is carried to understand the pollution contribution from the river to the well water and the same from the banks to the river. Water level of dug wells was generally the lowest in SW monsoon which did not show relative influence of their proximity with the river. Water level fluctuation at Maramon did not show seasonal influence probably due to fresh water flow from KIP canal with fractured walls. Higher occurrence of Total and Faecal coliforms in the study area during NE monsoon can also be contributed from the downstream water flow from pilgrimage site at Pampa. During SW Monsoon River water carries coliforms landward but do not infiltrate more than 200-300m off the bank. Contamination of faecal streptococci was ubiquitous in the study area. However, their presence in wells far inland in the absence of faecal coliforms can be of nonhuman in origin. Tracer experiments with marker coliforms can give more specificity to this bacterial movement.

KEYWORDS : Water level, South West Monsoon, North East Monsoon, Faecal coliforms, Streptococci, pollution.

I. INTRODUCTION

River Pampa originates at Pulachimalai hill in the Peerumedu plateau I of the Western Ghats at an altitude of 1650MSL and flows through Ranni, Pathanamthitta, Thiruvalla, Chengannur, Kuttanad and Ambalappuzha taluks. Most part of the river is flowing through Pathanamthitta and Alappuzha District, both are densely populated and the river is depended for various domestic and agricultural purposes.

The water levels in the sandy aquifer, responds readily to the water level fluctuations in the river. Urbanization and unscientific use of water for various activities can cause a river to diminish its quality and transfer its contaminants to the nearby by wells in sandy aquifers (Nair, 1998). Pampa river is known to carry downstream large quantum of contaminants during Sabarimala pilgrimage (Aji, 2005).

While the pollution of river water is monitored by State Pollution Control Board, the same in the dug well water is not estimated by any agency. It is imperative that river water and the water in the wells located along the sediment – filled banks are monitored together in order to understand the pollution contribution from the river to the well water and the same from the banks to the river. This is particularly needed as river bed lowering due to river sand mining has seriously affected the water availability in the phreatic aquifer along the banks of Pampa (Padmalal, 2011). There is no objectively collected data in this regard and the water level need to be continuously monitored to understand the frequency of river bed lowering and its effect on quantity and quality of water.

Under this context the present work examines the monthly water level fluctuation over a period of one year and its impact on indicator bacterial distribution.

1. *Objectives of the study*

1. To monitor the monthly water level fluctuation in wells of Chengannur - Maramon stretch of Pampa where Quaternary sediments constitute the river banks
2. To assess the bacteriological quality of water in Chengannur - Maramon stretch of Pampa river banks
3. Establish the relationship between well water and river water in terms of indicator bacterial contaminants.

II. METHODOLOGY

2.1 *Sample collection*

The study area is a 20km stretch located between latitude 9^0 19' 29.07" N and longitude 76^{0}27' 54.31" E with an elevation of 6 Ft above MSL. Four sites selected were Edanad (E), Arattupuzha (A), Thottappuzhasseri (T) and Maramon (M). The river locations for sample collection these sites were consecutively named R1, R2, R3 and R4. The dug wells in each area was denoted 1, 2, 3 landward from the river spots prefixing the location name (E1, E2... for eg.). These dug wells were monitored for monthly water level. Water samples from the wells and the river were collected during Southwest monsoon {September, 2013}, Northeast monsoon {December 2013} and summer season {March 2014}.

Samples for bacteriological parameters such as Total coliforms (TC), faecal coliforms (FC) and faecal streptococci (FS) were collected in sterilized glass containers. Bacteriological analysis was carried out in situ on readymade media plates brought to the field. The method employed were membrane filtration and pour plating. Incubation and enumeration of respective bacterial species were done in the laboratory following standard methods (APHA, 2005). Mean and standard deviation for each parameters were determined from the three samples using Microsoft excel software.

III. RESULTS

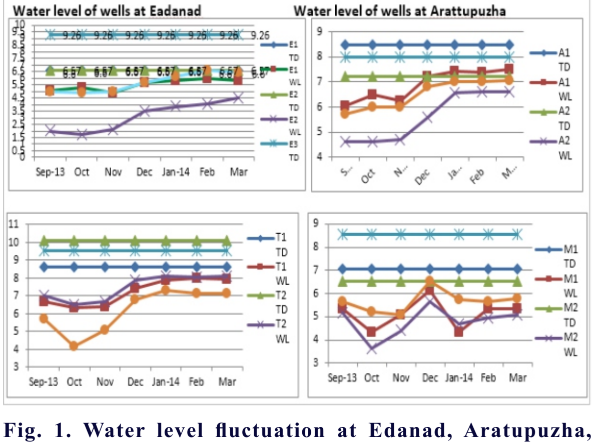

Fig. 1. Water level fluctuation at Edanad, Aratupuzha, Thotappuzhasserry and Maramon.

At Edanad was 5.01m during SW monsoon, 5.3-5.7m during NE monsoon and 5.8-6.0m during summer at E1, 2.0m, 1.7-3.5m and 3.85-4.5m at E2, 4.96, 4.86-5.7m and 6.4- 6.56m at E3 respectively during SW monsoon, NE monsoon and summer seasons. At Arattupuzha it varied from 6.02, 6.23-7.23m and 7.38-7.48m at A1, 4.6, 4.6-5.6m and 6.55-6.6m at A2 and 5.7, 6.0-6.8m and7.0-7.05m at A3 respectively.

At Thottappuzhassery water level varied from 6.69, 6. 32-7.42m and 7.87-8.0m at T1, 7.0, 6.5-7.9m and 8.05-8.1m at T2 and 5.7, 4.1-6.8m and7.15-7.28m at T3 respectively during SW monsoon, NE monsoon and summer seasons. At Maramon, the values were 5.35m during SW monsoon, 4.35 -6.15m during NE monsoon and 4.35-5.35m during summer at M1. It varied from 5.15, 3.15-5.65m and 4.7-5.1m at M2 and 5.66, 5.1-6.55 and 5.65-5.8m at M3 respectively during SW monsoon, NE monsoon and summer seasons.

TABLE 1.Total coliform distribution in Edanad– Maramon stretch

Stations	SW monsoon$(x10^2)$/ml	NE Monsoon $(x10^2)$/ml	Summer $(x10^2)$/ml
R1	3.4± 0.3	4.86 ± 0.3	3.12± 0.2
E1	1.35 ± 0.1	1. 95 ± 0.3	1.14 ± 0.2
E2	0.55± 0.2	1.35± 0.2	1.12 ± 0.3
E3	0.80± 0.1	0.65± 0.1	0.86 ± 0.1
R2	3.12± 0.2	9.5± 0.2	1.45± 0.3
A1	1.14 ± 0.2	1.55± 0.1	1.00± 0.2
A2	1.00± 0.2	0.45± 0.1	1.12 ± 0.3
A3	0.86 ± 0.1	0.20± 0.03	0.35± 0.1
R3	4.14± 0.4	6.12± 0.2	1.60± 0.2
T1	1.60± 0.2	2.0± 0.8	1.14 ± 0.2
T2	0.90± 0.2	0.60± 0.2	1.12 ± 0.3
T3	0.40± 0.2	0.25± 0.1	0.86 ± 0.1
R4	4.0± 0.2	6.5± 0.6	2.36± 0.2
M1	2.5± 0.2	0.60± 0.2	1.14 ± 0.1
M2	1.26± 0.1	0.43± 0.1	1.12 ± 0.3
M3	0.40± 0.03	0.75± 0.2	0.86 ± 0.1

E–Edanad, A– Arattupuzha, T– Thottappuzhassery and M– Maramon

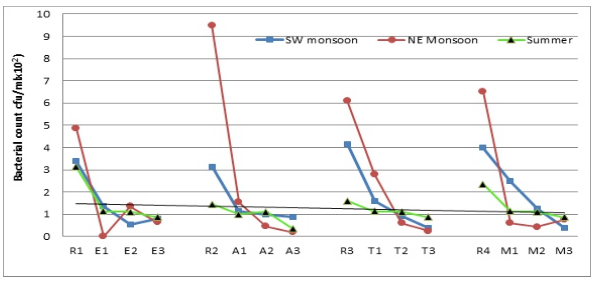

Fig. 2.Total coliform distribution in Edanad– Maramon stretch

TABLE 2. Faecal coliform distribution in Edanad– Maramon stretch

Station	SW monsoon$(x10^2)$/ml	NE Monsoon $(x10^2)$/ml	Summer $(x10^2)$/ml
R1	0.30 ± 0.1	0.40± 0.2	0.21± 0.1
E1	0.15± 0.1	0.2± 0.1	0.08± 0.01
E2	ND	ND	ND
E3	ND	ND	ND
R2	0.35± 0.1	0.65± 0.3	0.14± 0.1
A1	ND	0.5± 0.2	0.02± 0.01
A2	0.1± 0.01	0.5± 0.2	ND
A3	ND	ND	ND
R3	0.5± 0.2	1.0± 0.1	0.24± 0.1
T1	ND	ND	ND
T2	ND	ND	ND
T3	0.3± 0.1	0.15± 0.01	ND
R4	1.0± 0.2	1.0± 0.2	0.61± 0.3
M1	ND	ND	ND
M2	ND	ND	ND
M3	ND	ND	ND

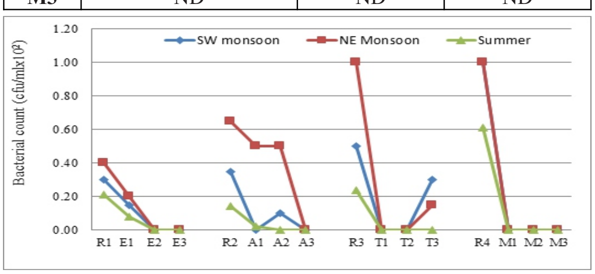

Fig.3.Faecal coliform distribution in Edanad– Maramon stretch

TABLE 3. Faecal streptococci distribution in Edanad– Maramon stretch

Stations	SW monsoon $(x10^2)$cfu/ml	NE Monsoon $(x10^2)$cfu/ml	Summer $(x10^2)$cfu/ml
R1	1.65± 0.2	2.35± 0.4	0.68± 0.1
E1	0.75± 0.1	1.75± 0.2	0.36± 0.1
E2	0.85± 0.2	1.02± 0.2	0.21± 0.1
E3	0.55± 0.1	0.90± 0.2	0.15± 0.01
R2	2.0± 0.4	3.5± 0.8	0.83± 0.3
A1	ND	0.25± 0.1	0.01± 0.01
A2	0.5± 0.2	1.5± 0.3	ND
A3	ND	0.1± 0.01	ND
R3	1.75± 0.3	2.30± 0.6	1.24± 0.4
T1	0.45± 0.2	1.65± 0.3	ND
T2	1.85± 0.1	1.35± 0.2	ND
T3	0.9± 0.2	0.45± 0.1	ND
R4	1.90± 0.2	2.35± 0.3	1.83± 0.3
M1	0.5± 0.3	0.5± 0.1	0.01± 0.1
M2	0.5± 0.2	0.25± 0.1	ND
M3	ND	0.1± 0.01	ND

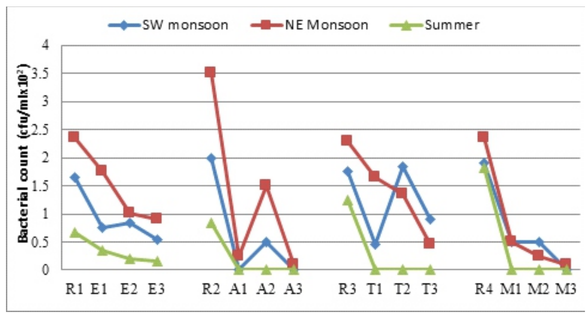

Fig.4. Faecal streptococci distribution in Edanad– Maramon stretch

Total coliforms in river water varied from 3.4±0.3 in SW monsoon, 4.86±0.3 in NE monsoon and 3.12±0.2 during summer. It fluctuated between 1.14±0.2 in summer to 1.95±0.3 at E1, 0.55±0.2 in SW monsoon to 1.35±0.2 NE monsoon at E2 and 0.65±0.1 in NE monsoon to 6.86±0.1 in summer at E3.

At Arattupuzha TC in river water varied between 1.4±0.3 in summer to 9. 5±0.2 in NE monsoon, 1.00±0.2 in summer to 1.55±0.2 in NE monsoon at A1, 0.45±0.1 in NE monsoon to 1.12±0.3 in summer at A2 and 0.20± 0.03 to 0.86± 0.1 in SW monsoon at A3.

At Thottappuzhassery TC count varied from 1.60±0.2 in summer to 6.12±0.2 in NE monsoon in river water, 1.14±0.2 n summer to 2.0±0.8 in NE monsoon at T1, 0.6±0.2 in NE monsoon to 1.12±0.3 in summer at T2 and 0.2±0.1 in NE monsoon to 0.86±0.1 in summer at T3. In Maramon the values fluctuated between 2.36±0.2 to 6.5±0.2 in NE monsoon in river water, 0.6±0.2 in NE monsoon to 2.5±0.2 in SW monsoon at M1, 0.43±0.1 in NE monsoon to 2. 0.2 in SW monsoon at M1, 0.43±0.1 in NE monsoon to 1.26±0.1 in SW monsoon at M2 and 0.4±0.03 in SW monsoon to 0.86± 0.3 in summer at M3.

FC varied between 0.21±0.1in summer to 0.40±0.2 during NE monsoon in river water, 0.08±0.01 during summer to 0.2±0.1 during NE monsoon at E1 and Not Detected (ND) at other well stations. At Arattupuzha, the count varied from 0.14±0.1 in summer to 0.65± 0.3 during NE monsoon at river station, ND during SW monsoon to 0.5±0.2 during NE monsoon at A1, ND during summer to 0.5±0.2 during NE monsoon at A2 and ND at A3.

At Thottappuzhassery the count fluctuated between 0.240.5±0.2 during NE monsoon at A10.1 in summer to 1.00.5±0.2 during NE monsoon in river sample, ND during all seasons at T1 and T2 and ND during summer to 0.3± 0.1 during SW monsoon at T3. At Maramon only riverine sample enumerated FC which fluctuated between 0.61±0.3 during summer to 1.02±0.2 during both SW and NE monsoon.

Discussion

Water level of dug wells was the minimum in SW monsoon at Edanad and Arattupuzha. At Thottappuzhassery the minimum water level was recorded during NE monsoon. Obviously during summer the water level increased in these three clusters. Water level in wells did not show relative influence of their proximity with river. At Ednadu and Aratupuzha, wells E2 and A2 (almost 200away from river), not E1 and A2, showed the minimum water level while T3 showed the same at Thoappuzhaerry (Fig.1).

However, the water level fluctuation at Maramon did not show seasonal influence. It showed the minimum (4.35) and the maximum (6.15) at well M1 during NE monsoon. This indicated the influence of KIP (Kerala Irrigation Project) canal which has numerous perforations allowing water to reach nearby dug wells whenever it carries water.

Total coliforms have showed their presence in river water in all seasons. Higher occurrence recorded during NE monsoon may be due to pilgrimage. Distribution of faecal coliforms and faecal streptococci also showed similar pattern (figs.2 & 3). Firozia and Kumar (2013) reported total coliform as high as $5.98 \pm 0.1 \times 10^3$ cfu/ml at Triveni before pilgrimage, $8.36 \pm 0.1 \times 10^3$ cfu/ml during pilgrimage season and $6.31 \pm 0.1 \times 10^3$ cfu/ml in summer season. An earlier study reported faecal contamination in the drinking water supplied by Govt. agency in Pampa at the range 1600 to 3003 per 100ml of water whereas the permitted level is maximum 10 bacteria (Baby, 2003). The study however, showed coliform bacteria in 100ml water was more than 1.5 lakhs, much above the permissible level in Pampa river water.

Sharma et al (2003) while studying the occurrence of different microbial contamination in surface-, ground- and drinking water in Delhi found that the Yamuna River had a 100 to 1000 fold increase in all indicator parameters near Delhi in comparison to the upstream sites of the city and the majority of groundwater samples (shallow and deep) were contaminated by coliforms. In the current study area the proximity of highly permeable fluvio-glacial gravels to rivers creates a particular contamination risk for sources in such groundwater settings. Pollution level as per official data available with the Kerala Pollution Control Board (PCB) office at Pampa, the total coliform count in the river had gone up occasionally to 3.55 lakh per100 ml (PCB Report, 2013). In SW monsoon high TC counts were recorded from wells closest to the river and there was consecutive decrease in TC landward indicating rise in river water level and its immediate influence. During NE monsoon also similar influence was seen in Arattupuzha and Thottappuzhasserry. During summer high TC counts in river water indicates the possible flow of bacterial contaminants from dug wells to river. Tracer experiments with marker coliform can give more specific to this bacterial movement.

Distribution of faecal coliforms was more clearly indicated the flow of faecal contaminants downstream of pilgrimage site. River stations and close dug wells showed maximum occurrence. In summer, contamination of faecal streptococci was limited to river at Maramon, This reveals that influence of river borne contaminants do not reach well waters due to the intermittent flow of freshwater from KIP canal (fig.3). Contamination from faecal streptococci was complete in the study area. The maximum population recorded during NE monsoon season confirms the downstream flow of contaminants from pilgrimage site. However, presence of FS in wells far inland in the absence of faecal coliforms can of nonhuman in origin.

IV CONCLUSION

Water level of dug wells was generally the lowest in SW monsoon which did not show relative influence of their proximity with the river. Water level fluctuation at Maramon did not show seasonal influence probably due to fresh water flow from KIP canal with fractured wall. Higher occurrence of Total and faecal coliforms in study area recorded during NE monsoon can also be contributed from the downstream water flow from pilgrimage site. During SW Monsoon River water carries coliforms landward but do not infiltrate more than 200-300m off the bank. Contamination of faecal streptococci was ubiquitous in the study area. However, their presence in wells far inland in the absence of faecal coliforms can of nonhuman in origin.

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References

1. N. J. Firozia and S. M. G. Kumar. “Water Quality Assessment of Pamba River of Kerala, India in Relation to Pilgrimage Season”. Int. J. Res. Chem. Environ. Vol. 3, no.1.pp. 341-347, 2013.
2. PCB Report. Report of water quality of Pampa River at Pilgrimage site, Kerala State Pollution Control Board, 2013.
3. APHA. Standard methods for the examination of water and waste water. American public Health Association. 21st ed. Washington DC p. 948, 2005.
4. K. M. Nair. “Quaternary aquifers and Kerala's drinking water problems”. Paper#11 in Proceedings of Workshop on Ground water Regime monitoring, Central Ground Water Board, Trivandrum, 1998.
5. D. Padmalal and S. Sreebha. “Environmental Impact Asessment of Sand Mining From Small Catchment Rivers In The Southern Coast Of India: A case study” vol.47, no 1, pp. 130-140, 2011.
6. S. Sharma, I. Singh and J. S. Virdi. Microbial contamination of various water sources in Delhi, Current Science Vol. 84, p. 11, 2003.
7. M. D. Baby. 'Economics of Sabari Pilgrimage With Special Reference to the Households in Erumely Grama Panchayat', Final Project Report (Ref. No. 31/99), Kerala Reserch Programme on Local Level Development (KRPLLD), Centre for Development Studies, Thiruvananthapuram, December 2003.