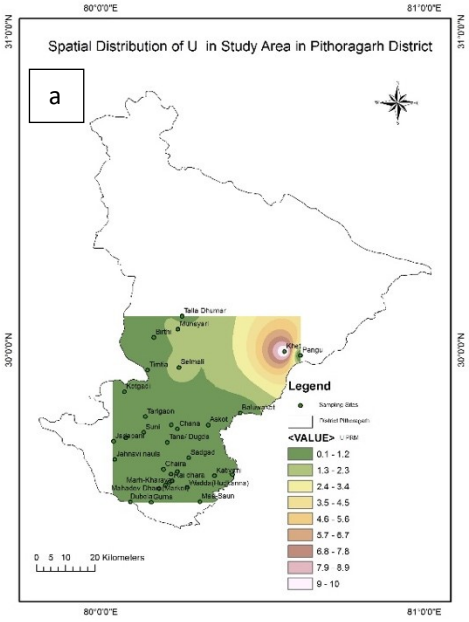
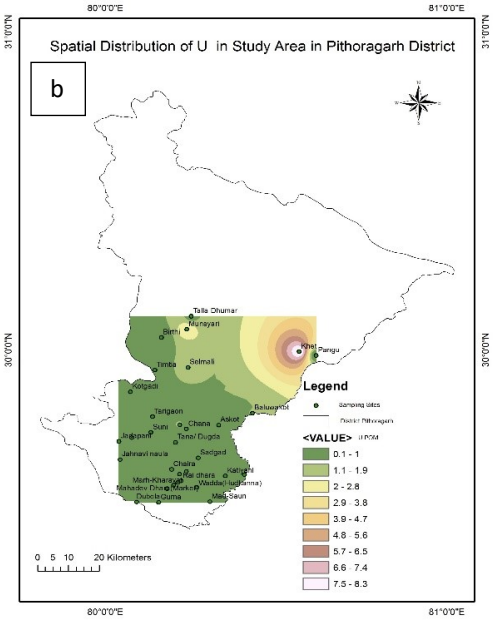
Supporting Information

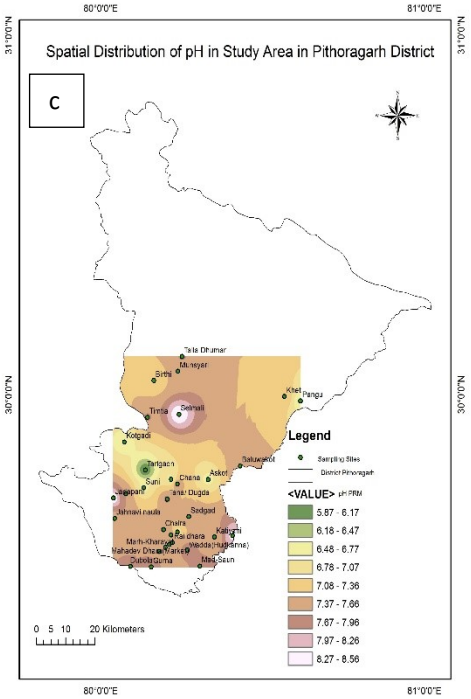
Hydrogeochemical and Statistical Assessment of Groundwater in Pithoragarh, Lesser Himalaya

Kiran Patni[1,2*], Ashutosh Pratap Pande[3], Chitra Pande[4], Kshitindra Kumar Singh[5], Manoj Kumar Jindal[6*],

Sunil Kumar Sahoo[7]






Spatial Distribution of pH in Study Area in Pithoragarh District
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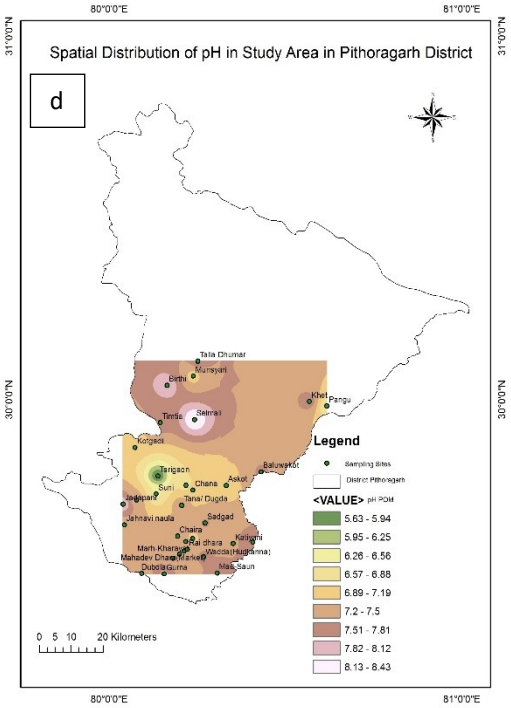
Sampling Sites
District Pithoragarh
<VALUE> pH PRM
5.87 - 6.17
6.18 - 6.47
6.48 - 6.77
6.78 - 7.07
7.08 - 7.36
7.37 - 7.66
7.67 - 7.96
7.97 - 8.26
8.27 - 8.56
0 5 10 20 Kilometers


Spatial Distribution of pH in Study Area in Pithoragarh District
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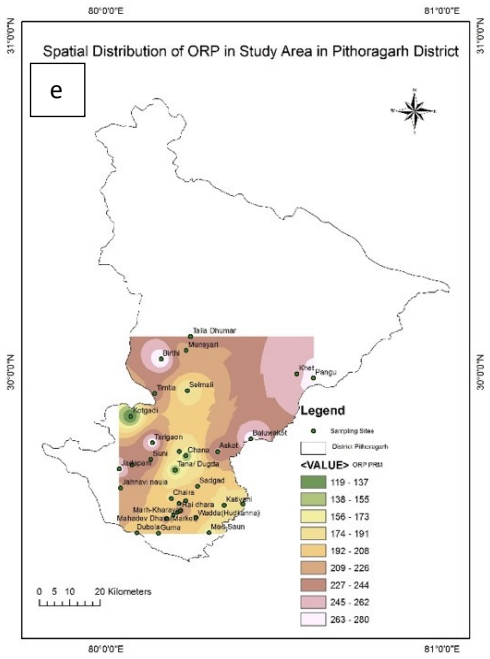
Sampling Sites
District Pithoragarh
<VALUE> pH POM
5.63 - 5.94
5.95 - 6.25
6.26 - 6.56
6.57 - 6.88
6.89 - 7.19
7.2 - 7.5
7.51 - 7.81
7.82 - 8.12
8.13 - 8.43
0 5 10 20 Kilometers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Legend
Sampling Sites
District Pithoragarh
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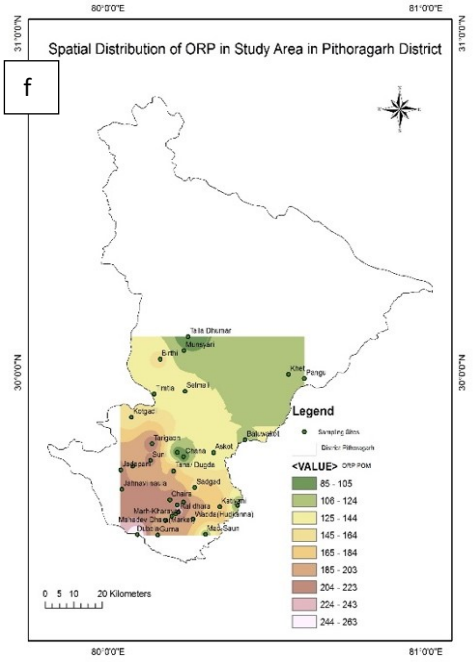
119 - 137
138 - 155
156 - 173
174 - 191
192 - 208
209 - 226
227 - 244
245 - 262
263 - 280
0 5 10 20 Kilometers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Legend
Sampling Sites
District Pithoragarh
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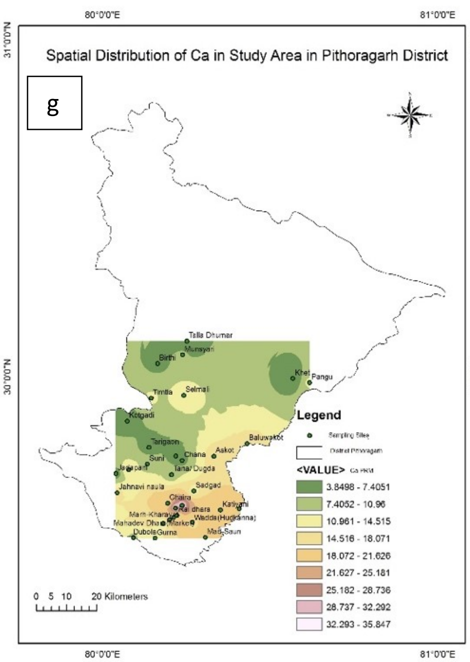
106 - 124
125 - 144
145 - 164
165 - 184
185 - 203
204 - 223
224 - 243
244 - 263
0 5 10 20 Kilometers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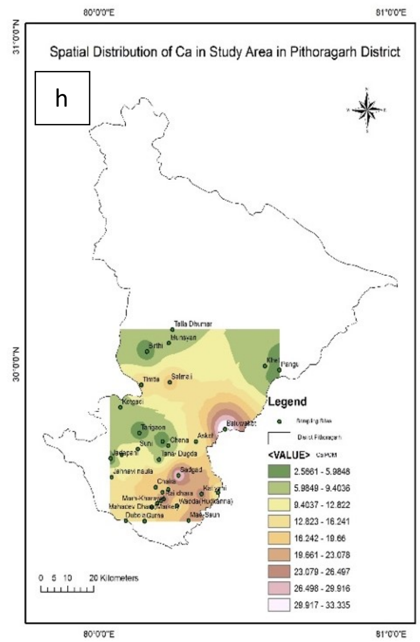
Spatial Distribution of Ca in Study Area in Pithoragarh District
g
Talla Dhumar
Munsyari
Birthi
Khet
Pangu
Timtia
Selmali
Kotgadi
Tarigaon
Baluwakot
Chana
Askot
Suni
Tanai Dugda
Jajarpani
Jahnavi naula
Sadgad
Chaira
Rai dhara
Katyani
Marh-Kharayat
Mahadev Dhar
Wadda(Hudkanna)
Dubola Guma
Mad-Saun
Legend
Sampling Sites
District Pithoragarh
<VALUE> Ca PCM
3.8498 - 7.4051
7.4052 - 10.96
10.961 - 14.515
14.516 - 18.071
18.072 - 21.626
21.627 - 25.181
25.182 - 28.736
28.737 - 32.292
32.293 - 35.847
0 5 10 20 Kilometers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31°0'0"N
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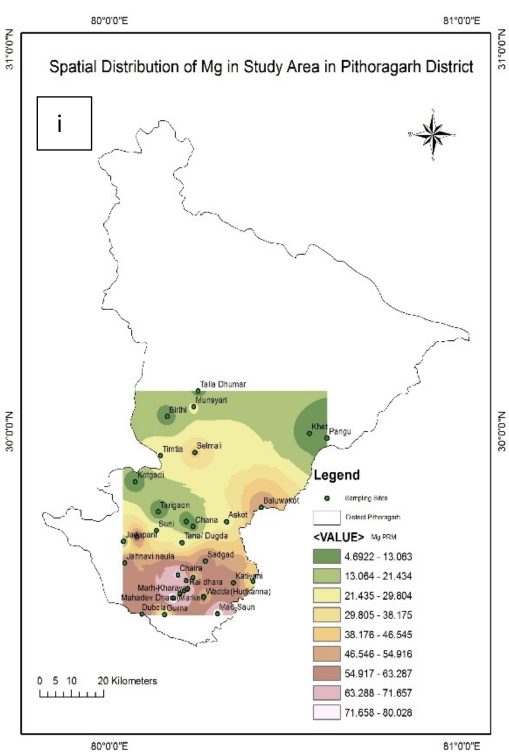
Spatial Distribution of Ca in Study Area in Pithoragarh District
h
Talla Dhumar
Munsyari
Birthi
Khet
Pangu
Timtia
Selmali
Tarigaon
Chana
Askot
Suni
Tanai Dugda
Jahnavi naula
Sadgad
Chaira
Rai dhara
Katyani
Wadda(Hudkanna)
Mad-Saun
Legend
Sampling Sites
District Pithoragarh
<VALUE> Ca PCM
2.5661 - 5.9848
5.9849 - 9.4036
9.4037 - 12.822
12.823 - 16.241
16.242 - 19.66
19.661 - 23.078
23.079 - 26.497
26.498 - 29.916
29.917 - 33.335
0 5 10 20 Kilometers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Spatial Distribution of Mg in Study Area in Pithoragarh District
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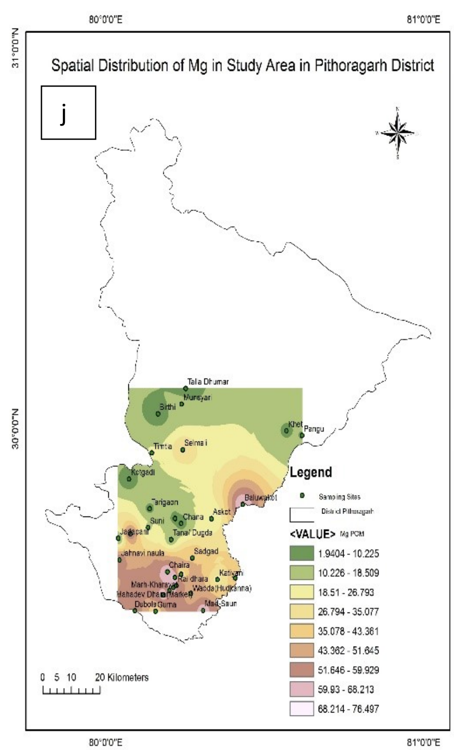
Munsyari
Birthi
Khet
Pangu
Timtia
Selmali
Kotgadi
Tarigaon
Baluwakot
Chana
Askot
Suni
Tanai Dugda
Jajarpani
Jahnavi naula
Sadgad
Chaira
Rai dhara
Katyani
Marh-Kharayat
Mahadev Dhar
Wadda(Hudkanna)
Dubola Guma
Mad-Saun
Legend
Sampling Sites
District Pithoragarh
<VALUE> Mg PPM
4.6922 - 13.063
13.064 - 21.434
21.435 - 29.804
29.805 - 38.175
38.176 - 46.545
46.546 - 54.916
54.917 - 63.287
63.288 - 71.657
71.658 - 80.028
0 5 10 20 Kilometers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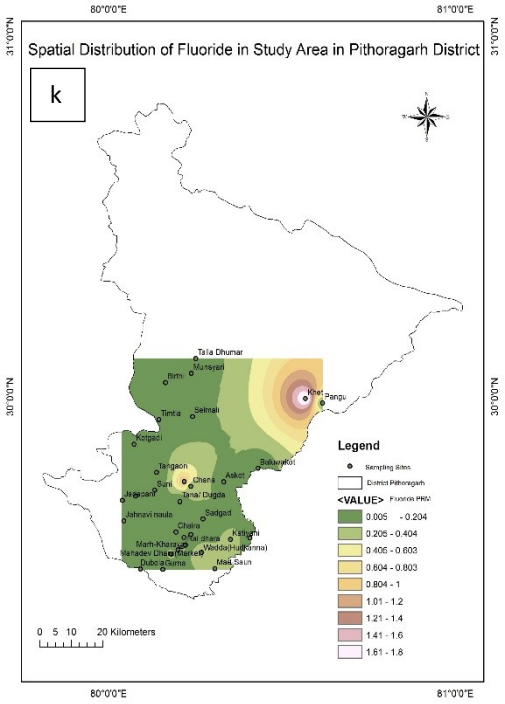
Spatial Distribution of Mg in Study Area in Pithoragarh District
j
Talla Dhumar
Munsyari
Birthi
Khet
Pangu
Timtia
Selmali
Kotgadi
Tarigaon
Baluwakot
Chana
Askot
Suni
Tanai Dugda
Jahnavi naula
Sadgad
Chaira
Rai dhara
Katyani
Marh-Kharayat
Wadda(Hudkanna)
Dubola Guma
Mad-Saun
Legend
Sampling Sites
District Pithoragarh
<VALUE> Mg PCM
1.9404 - 10.225
10.226 - 18.509
18.51 - 26.793
26.794 - 35.077
35.078 - 43.361
43.362 - 51.645
51.646 - 59.929
59.93 - 68.213
68.214 - 76.497
0 5 10 20 Kilometers


Spatial Distribution of Fluoride in Study Area in Pithoragarh District
k
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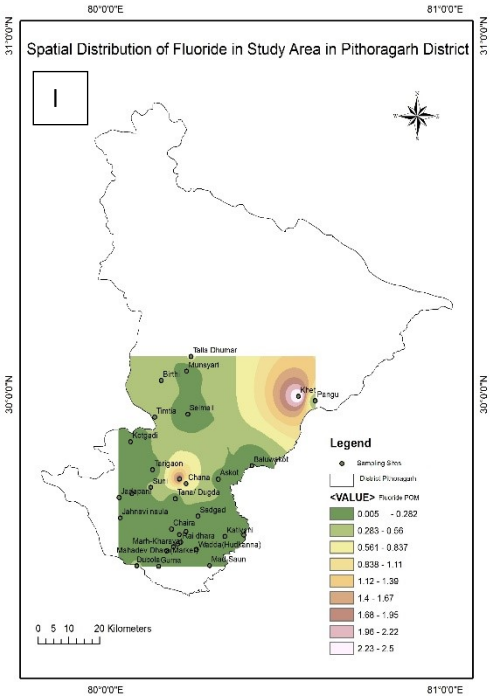
31°0'0"N
30°0'0"N
Legend
Sampling Sites
District Pithoragarh
<VALUE> Fluoride PRE
0.005 - 0.204
0.205 - 0.404
0.405 - 0.603
0.604 - 0.803
0.804 - 1
1.01 - 1.2
1.21 - 1.4
1.41 - 1.6
1.61 - 1.8
0 5 10 20 Kilometers


Spatial Distribution of Fluoride in Study Area in Pithoragarh District
l
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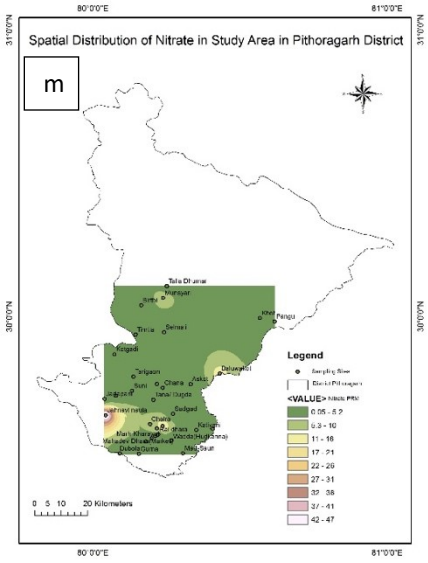
30°0'0"N
Legend
Sampling Sites
District Pithoragarh
<VALUE> Fluoride POM
0.005 - 0.282
0.283 - 0.56
0.561 - 0.837
0.838 - 1.11
1.12 - 1.39
1.4 - 1.67
1.68 - 1.95
1.96 - 2.22
2.23 - 2.5
0 5 10 20 Kilometers


Spatial Distribution of Nitrate in Study Area in Pithoragarh District
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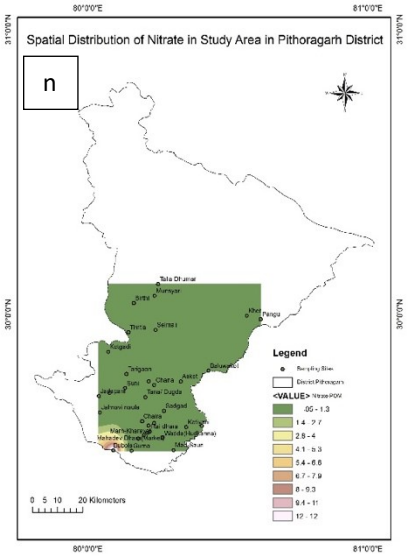
31°0'0"N
30°0'0"N
Legend
Sampling Sites
District Pithoragarh
<VALUE> Nitrate PRE
0.05 - 5.2
5.3 - 10
11 - 16
17 - 21
22 - 26
27 - 31
32 - 36
37 - 41
42 - 47
0 5 10 20 Kilometers


Spatial Distribution of Nitrate in Study Area in Pithoragarh District
n
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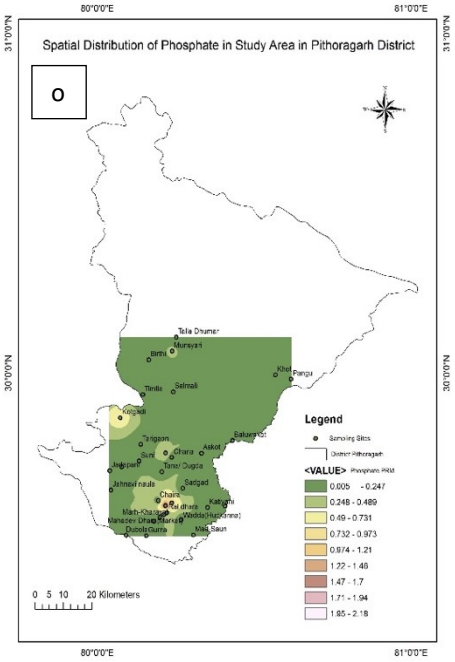
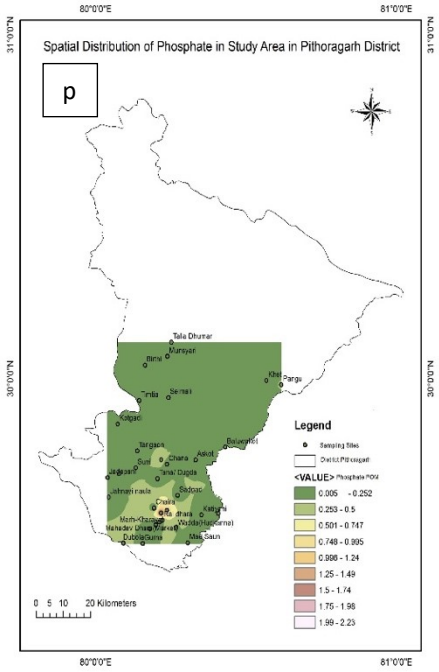
31°0'0"N
30°0'0"N
Legend
Sampling Sites
District Pithoragarh
<VALUE> Nitrate POM
0.05 - 1.3
1.4 - 2.7
2.8 - 4
4.1 - 5.3
5.4 - 6.6
6.7 - 7.9
8 - 9.3
9.4 - 11
12 - 12
0 5 10 20 Kilometers


Spatial Distribution of Phosphate in Study Area in Pithoragarh District
o
80°0'0"E
81°0'0"E
31°0'0"N
30°0'0"N
Legend
Sampling Sites
District Pithoragarh
<VALUE> Phosphate PO4
0.005 - 0.247
0.248 - 0.489
0.49 - 0.731
0.732 - 0.973
0.974 - 1.21
1.22 - 1.46
1.47 - 1.7
1.71 - 1.94
1.95 - 2.18
0 5 10 20 Kilometers


Spatial Distribution of Phosphate in Study Area in Pithoragarh District
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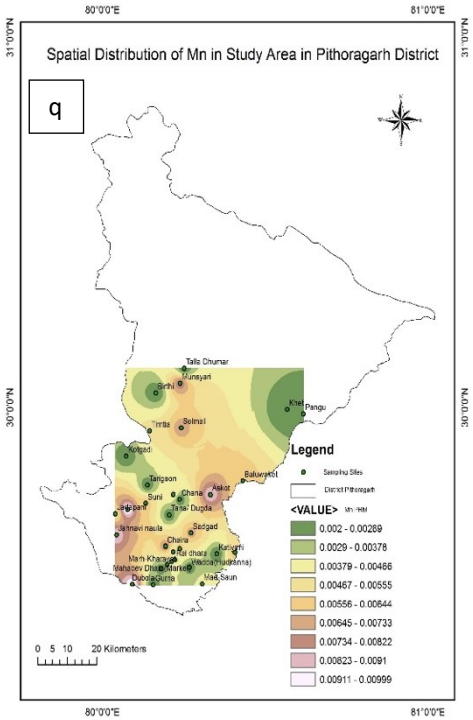
31°0'0"N
30°0'0"N
Legend
Sampling Sites
District Pithoragarh
<VALUE> Phosphate PO4
0.005 - 0.252
0.253 - 0.5
0.501 - 0.747
0.748 - 0.995
0.996 - 1.24
1.25 - 1.49
1.5 - 1.74
1.75 - 1.98
1.99 - 2.23
0 5 10 20 Kilometers


Spatial Distribution of Mn in Study Area in Pithoragarh District
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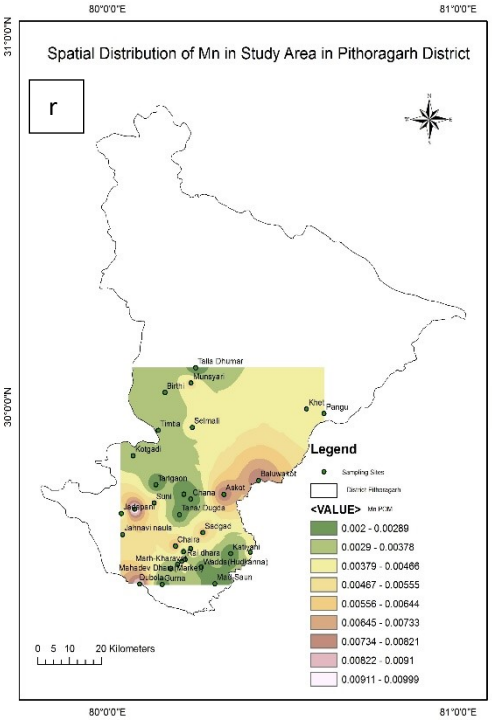
81°0'0"E
31°0'0"N
30°0'0"N
Legend
Sampling Sites
District Pithoragarh
<VALUE> Mn Rel
0.002 - 0.00289
0.0029 - 0.00378
0.00379 - 0.00466
0.00467 - 0.00555
0.00556 - 0.00644
0.00645 - 0.00733
0.00734 - 0.00822
0.00823 - 0.0091
0.00911 - 0.00999
0 5 10 20 Kilometers


Spatial Distribution of Mn in Study Area in Pithoragarh District
r
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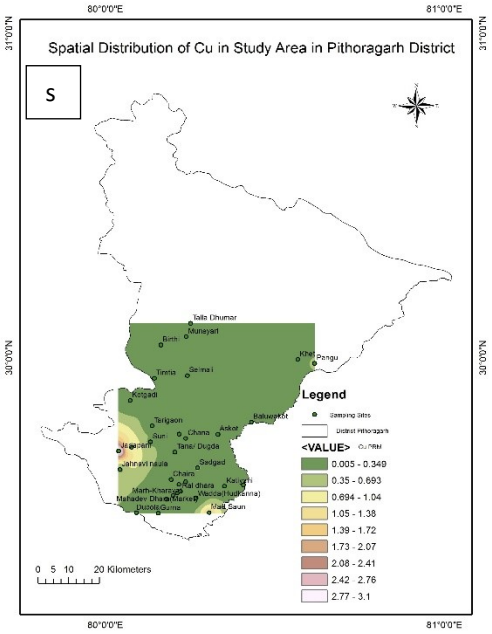
31°0'0"N
30°0'0"N
Legend
Sampling Sites
District Pithoragarh
<VALUE> Mn PO4
0.002 - 0.00289
0.0029 - 0.00378
0.00379 - 0.00466
0.00467 - 0.00555
0.00556 - 0.00644
0.00645 - 0.00733
0.00734 - 0.00821
0.00822 - 0.0091
0.00911 - 0.00999
0 5 10 20 Kilometers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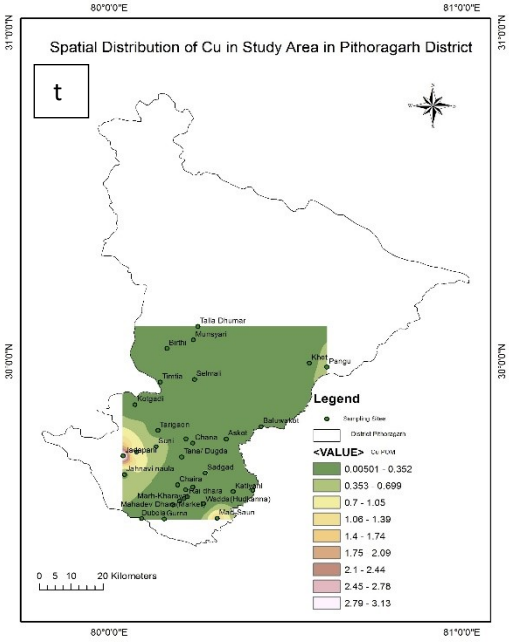
30°0'0"N
Legend
<VALUE>
0.005 - 0.349
0.35 - 0.693
0.694 - 1.04
1.05 - 1.38
1.39 - 1.72
1.73 - 2.07
2.08 - 2.41
2.42 - 2.76
2.77 - 3.1
0 5 10 20 Kilometers


Spatial Distribution of Cu in Study Area in Pithoragarh District
t
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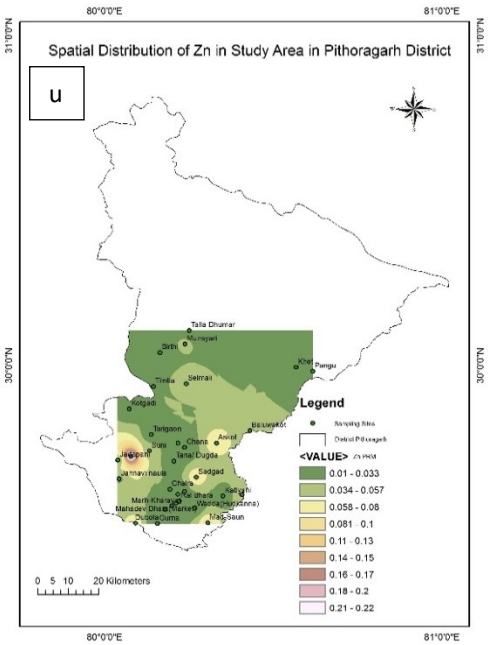
31°0'0"N
30°0'0"N
Legend
<VALUE>
0.00501 - 0.352
0.353 - 0.699
0.7 - 1.05
1.06 - 1.39
1.4 - 1.74
1.75 - 2.09
2.1 - 2.44
2.45 - 2.78
2.79 - 3.13
0 5 10 20 Kilometers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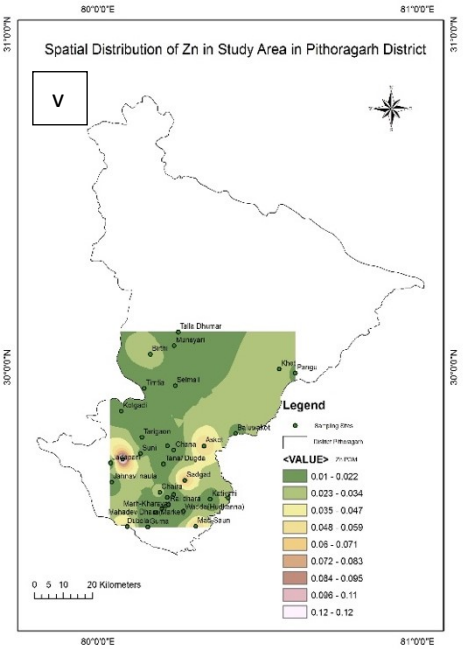
31°0'0"N
30°0'0"N
Legend
<VALUE>
0.01 - 0.033
0.034 - 0.057
0.058 - 0.08
0.081 - 0.1
0.11 - 0.13
0.14 - 0.15
0.16 - 0.17
0.18 - 0.2
0.21 - 0.22
0 5 10 20 Kilometers


Spatial Distribution of Zn in Study Area in Pithoragarh District
v
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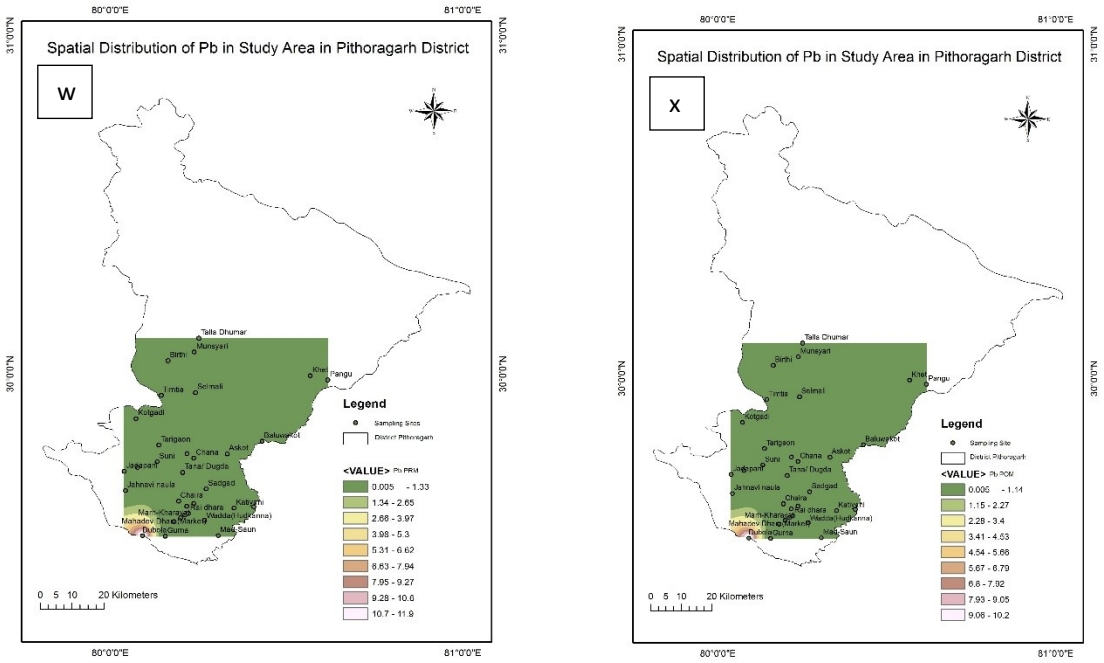
81°0'0"E
31°0'0"N
30°0'0"N
Legend
<VALUE>
0.01 - 0.022
0.023 - 0.034
0.035 - 0.047
0.048 - 0.059
0.06 - 0.071
0.072 - 0.083
0.084 - 0.095
0.096 - 0.11
0.12 - 0.12
0 5 10 20 Kilometers



S. Fig. 1: Spatial distribution of water quality parameters in Pithoragarh district during pre- and post-monsoon seasons: (a) Uranium Pre-monsoon, (b) Uranium Post-monsoon, (c) pH Pre-monsoon, (d) pH Post-monsoon, (e) ORP Pre-monsoon, (f) ORP Post-monsoon, (g) Calcium Pre-monsoon, (h) Calcium Post-monsoon, (i) Magnesium Pre-monsoon, (j) Magnesium Post-monsoon, (k) Fluoride Pre-monsoon, (l) Fluoride Post-monsoon, (m) Nitrate Pre-monsoon, (n) Nitrate Post-monsoon, (o) Phosphate Pre-monsoon, (p) Phosphate Post-monsoon, (q) Mn Pre-monsoon, (r) Mn Post-monsoon, (s) Cu Pre-monsoon, (t) Cu Post-monsoon, (u) Zn Pre-monsoon, (v) Zn Post-monsoon, (w) Pb Pre-monsoon, (x) Pb Post-monsoon.

Table S1. Comparison of hydrogeochemical facies and water quality characteristics of the present study with earlier national (Himalayan) and international spring-water studies.

Region / Study	Hydrochemical Facies
Upper Indus Basin, (UIB) western Himalaya	Na-HCO_3, Ca-Na-HCO_3 and Ca-Mg-HCO_3 water facies [1]
Basantar watershed of Jammu Himalaya	Ca–Mg– HCO_3 and Ca–Mg– HCO_3– SO4 type [2]
South Kashmir, Himalayan springs	Dominance of Ca–Mg–HCO_3 facies [3]
Western Himalaya	Ca–Mg–HCO_3 in ~86% of samples [4]
Apuseni Mountains, Romania	Mostly Ca–HCO_3; Na–HCO_3 toward Pannonian Basin [5]
Genova Province, Italy	Mg–HCO_3 and high-pH Ca–OH [6]
Present study	Ca–Mg–HCO_3, Ca–Mg–SO_4, Na–K–Cl

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3. S. A. Lone, S. U. Bhat, A. Hamid, F. A. Bhat and A. Kumar, Quality Assessment of Springs for Drinking Water in the Himalaya of South Kashmir, India, *Environ. Sci. Pollut. Res.*, 2021, **28**, 2279–2300.
4. S. Rajan, J. R. Nandimandalam and P. Ram, Hydrogeochemical Evolution of Spring Water in the Western Lower Himalayas: Seasonal Changes, Quality Assessment, and Health Risks, *Groundw. Sustain. Dev.*, 2025, **29**, 101411.

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