

Microbiological and physicochemical quality of groundwater and risk factors for its pollution in Ouagadougou, Burkina Faso

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Table S1: Physicochemical and microbiological parameters of boreholes water

Physicochemical parameters															Microbiological parameters (CFU/100 mL)				
Boreholes codes	Turbity (NTU)	EC (µS/cm)	pH	TH (°f)	Ca ²⁺ (mg/L)	Mg ²⁺ (mg/L)	NO ²⁻ (mg/L)	NO ³⁻ (mg/L)	TA (°f)	PO4 ³⁻ (mg/L)	SO4 ²⁻ (mg/L)	Cl- (mg/L)	F- (mg/L)	Fe ²⁺ (mg/L)	T C	<i>E. coli</i>	E nt	Ps	ASRB
B01	0.82	204	6.7	4.3	11.8	3.3	0	0	101.6	0.13	0	2.1	0	0	89	16	0	0	0
B02	0.48	286	6.7	8.4	15.1	11.3	0	5.7	131.3	0.9	0	2.8	0.1	0.02	>100	0	0	0	0
B03	1.28	163,3	6.2	4	9.6	3.9	0	5.3	75.8	0.6	0	1.4	0.3	0.05	0	0	0	>100	0
B04	0.62	293	6.4	8.4	18.3	9.2	0	15.2	112.1	1.2	0	7.8	0	0	14	0	0	0	0
B05	0.52	50,1	6.8	0.6	0.9	0.9	0	3.3	22.4	0.13	0	2.1	0.4	0	>100	0	0	0	0
B06	0.67	672	7.1	15.1	42.4	10.8	0	0.7	309.8	0.85	22	9.1	3.5	0.04	8	0	0	75	0
B07	0.42	366	6.4	11.4	23.4	13.5	0	10.3	152.1	0.6	11.5	7.1	0.7	0	14	0	0	0	0

B08	6.02	274	6.3	7.4	17.6	7.2	0	2	137. 4	0.3	3	5	0.5	0.39	>100	3	0	0	0
B09	0.48	1179	6.4	43.8	114.2	37.2	0	41.4	434. 1	0.5	23	21.3	0.1	0	10	0	0	0	0
B10	0.48	1161	7.1	41.7	106	37	0	40.5	446. 5	0.7	11	17	0.1	0	9	0	0	0	0
B11	0.7	390	6.6	10.4	20.6	12.8	0.1	3.3	168. 5	0.49	0	1.8	0.3	0.28	0	0	0	0	0
B12	218	1054	6.5	30.4	77	27.2	0.3	469.9	96.9	0.7	17	116.4	0	0.17	0	0	0	0	0
B13	1.67	371	6.5	13.1	25.1	16.7	0	1.3	162	1.1	8.5	2.8	0.4	0	92	33	0	0	0
B14	9.1	145,4	6.3	3.4	6.6	4.3	0.1	7.9	40.1	1.94	0	2.1	0.3	0.07	68	5	0	66	0
B15	0.5	387	6.3	13.4	32.2	13	0	26.2	91.5	0.89	0	32.7	0.4	0.09	0	0	0	0	0
B16	2.8	270	6.4	8	17.8	8.6	0	3.1	113. 5	1.18	0	3.6	0.2	0	0	0	0	0	0
B17	1	399	6.7	14.5	30	16.9	0	3.1	182	0.73	8	3.6	0.2	0.04	66	3	0	56	0
B18	13.2	310	6.9	9.7	22.8	9.8	0.1	5.9	129. 5	1.63	0	1.8	0.4	0.05	88	18	3 8	0	12
B19	2.5	356	6.7	11	29	9.1	0.1	8.8	141. 1	0.63	0	4.6	0.6	0.15	0	0	0	0	0
B20	34.2	330	6.4	8.9	21.9	8	0	2.5	82.9	1.02	7	28.2	0.6	0.15	56	16	0	0	0
B21	1.4	645	6.9	23.2	69.9	13.8	0	7.5	250	0.54	34	5.7	0.8	0.07	57	16	0	0	0
B22	34.4	335	6.4	8.9	22.3	8	0	2.6	84.9	1.03	7	28.4	0.6	0.16	69	16	0	0	0

B23	1.4	645	6.9	23.2	69.9	13.8	0	7.5	250	0.54	34	5.7	0.8	0.07	87	16	0	0	0
B24	41	462	6.8	13.8	38.2	10.2	0	9.7	163. 8	0.46	20	0.7	0.5	0.02	6	0	0	0	0
B25	2.08	345	7.1	9.7	21.6	10.4	0	11.2	106. 1	1.12	2.5	13.5	0.4	0	0	0	0	0	0
B26	0.36	283	7	7.2	16.8	7.3	0	5.1	97.7	0.75	0	3.9	0.2	0.02	69	20	1	0	0
B27	0.34	319	6.8	8.8	20.5	8.8	0	18.3	92.9	1.15	7	7.8	0.2	0.04	0	0	0	0	0
B28	0.26	235	7	7.2	17	7.3	0.1	2.2	103. 2	0.82	0	1.4	0.2	0.2	0	0	0	0	0
B29	0.16	245	6.6	8.7	17.8	10.4	0	7.9	90.8	1.42	0	6.4	0	0.07	0	0	0	0	0
B30	0.27	272	6.7	10.2	21.2	11.8	0	6.8	113. 3	1.49	0	5.7	0	0.03	0	0	0	0	0
B31	0.19	1365	7.2	38	86.8	39.5	0	43.8	223. 3	0.68	27	166.9	1	0.02	0	0	0	0	0
B32	12.2	298	7.1	8.4	19.3	8.8	0	26.2	69.6	0.99	3	3.7	0.4	0.04	0	0	0	0	0
Total of boreholes with non-compliant physicochemical quality								8 (25%)											
Total of boreholes with non-compliant microbiological quality																20 (62%)			
NG/WHO G	≤ 1,5	ND	6.5- 8.5	ND	ND	ND	≤ 50	≤ 50	ND	ND	≤ 50	ND	≤ 1.5	≤ 0.3	0	0	0	0	0

NG = National guidelines, WHOG=World Health Organization Guidelines, ND= Not determined, TC= Total coliforms Ps =Pseudomonas aerigunosa, Ent= Entrecoccus, ASRB= Anaerobic sulphite reducing bacteria

NB: values in bold are those that do not meet national guidelines

Table S2. Extraction Method, Principal Component Analysis

Component	Total variance Explained					
	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,984	42,747	42,747	5,984	42,747	42,747
2	3,053	21,809	64,556	3,053	21,809	64,556
3	1,279	9,139	73,695			
4	1,120	8,003	81,698			
5	7,798	5,570	87,268			
6	6,590	4,707	91,975			
7	5,982	4,273	96,248			
8	2,978	2,128	98,376			
9	1,455	1,039	99,415			
10	3,545	0,253	99,668			
11	3,048	0,218	99,886			
12	1,255	0,090	99,976			
13	3,012	0,022	99,998			
14	3,003	0,002	100			

Table S3. Contribution of physicochemical parameters in the main components

Variables	F1	F2	F3	F4
%	42,7%	21,8%	9,1%	8%
Turbidity	2.48	23.47	0.54	1.49
EC	16.33	0.08	0.20	0.01
pH	1.59	4.68	0.63	31.23
TH	15.68	0.43	1.64	1.68
Ca ²⁺	15.46	0.61	0.39	1.68
Mg ²⁺	14.10	0.13	5.92	1.50
NO ₂ ⁻	0.89	23.4	0.55	1.59
NO ₃ ⁻	4.51	20.86	0.02	1.00
TA	9.46	8.25	0.07	3.96
PO ₄ ³⁻	1.31	0.53	25.96	16.92
SO ₄ ²⁻	9.79	2.17	6.53	0.97
Cl ⁻	7.60	4.52	0.20	4.17
F ⁻	0.64	4.21	30.31	22.23
Fe ²⁺	0.13	6.62	27.03	11.57

Table S4. Correlation matrix between the microbiological and physicochemical parameters

	Turbidity	EC	pH	TH	Ca ²⁺	Mg ²⁺	NO ²⁻	NO ³⁻	TA	PO ₄ ³⁻	SO ₄ ²⁻	Cl ⁻	F ⁻	Fe ²⁺	TC	<i>E. coli</i>	Ent	Ps	ASRB
Turbity	1																		
EC	0.31	1																	
pH	-0.15	0.30	1																
TH	0.24	0.97	0.25	1															
Ca ²⁺	0.24	0.96	0.26	0.99	1														
Mg ²⁺	0.22	0.95	0.22	0.96	0.9	1													
NO ²⁻	0.77	0.17	-0.09	0.12	0.11	0.12	1												
NO ³⁻	0.94	0.45	-0.08	0.39	0.38	0.39	0.78	1											
TA	-0.15	0.77	0.29	0.83	0.84	0.74	-0.17	-0.02	1										
PO ₄ ³⁻	-0.04	-0.23	-0.09	-0.22	-0.26	-0.14	0.10	-0.07	-0.28	1									
SO ₄ ²⁻	0.18	0.72	0.30	0.70	0.76	0.55	-0.05	0.21	0.64	-0.32	1								
Cl ⁻	0.51	0.70	0.14	0.57	0.51	0.64	0.35	0.60	0.11	-0.08	0.39	1							
F ⁻	-0.11	0.20	0.31	0.08	0.12	-0.01	-0.15	-0.15	0.30	-0.10	0.45	0.08	1						
Fe ²⁺	0.24	-0.10	-0.27	-0.14	-0.12	-0.16	0.40	0.16	-0.16	-0.17	-0.12	0.05	0.01	1					
TC	-0.12	-0.29	-0.09	-0.26	-0.23	-0.29	-0.16	-0.22	-0.14	-0.12	-0.02	-0.25	-0.05	0.06	1				
<i>E.Coli</i>	-0.04	-0.12	-0.01	-0.09	-0.06	-0.14	-0.10	-0.16	-0.04	0.07	0.14	-0.14	0.01	-0.04	0.65	1			
Ent	0,00	-0.08	0.14	-0.07	-0.07	-0.06	0.22	-0.04	-0.04	0.34	-0.14	-0.08	-0.01	-0.04	0.25	0.28	1		
Ps	-0.09	-0.13	-0.18	-0.17	-0.16	-0.18	-0.02	-0.1	-0.01	0.12	-0.02	-0.13	0.39	-0.08	-0.05	-0.15	-0.07	1	
ASRB	0,00	-0.08	0.14	-0.07	-0.07	-0.06	0.22	-0.04	-0.04	0.34	-0.13	-0.08	-0.01	-0.04	0.25	0.27	0,99	-0.07	1

TC, Total coliforms; Ent, Enterococcus; Ps, Pseudomonas aeriginosa, ASRB, anaerobic sulphite reducing bacteria