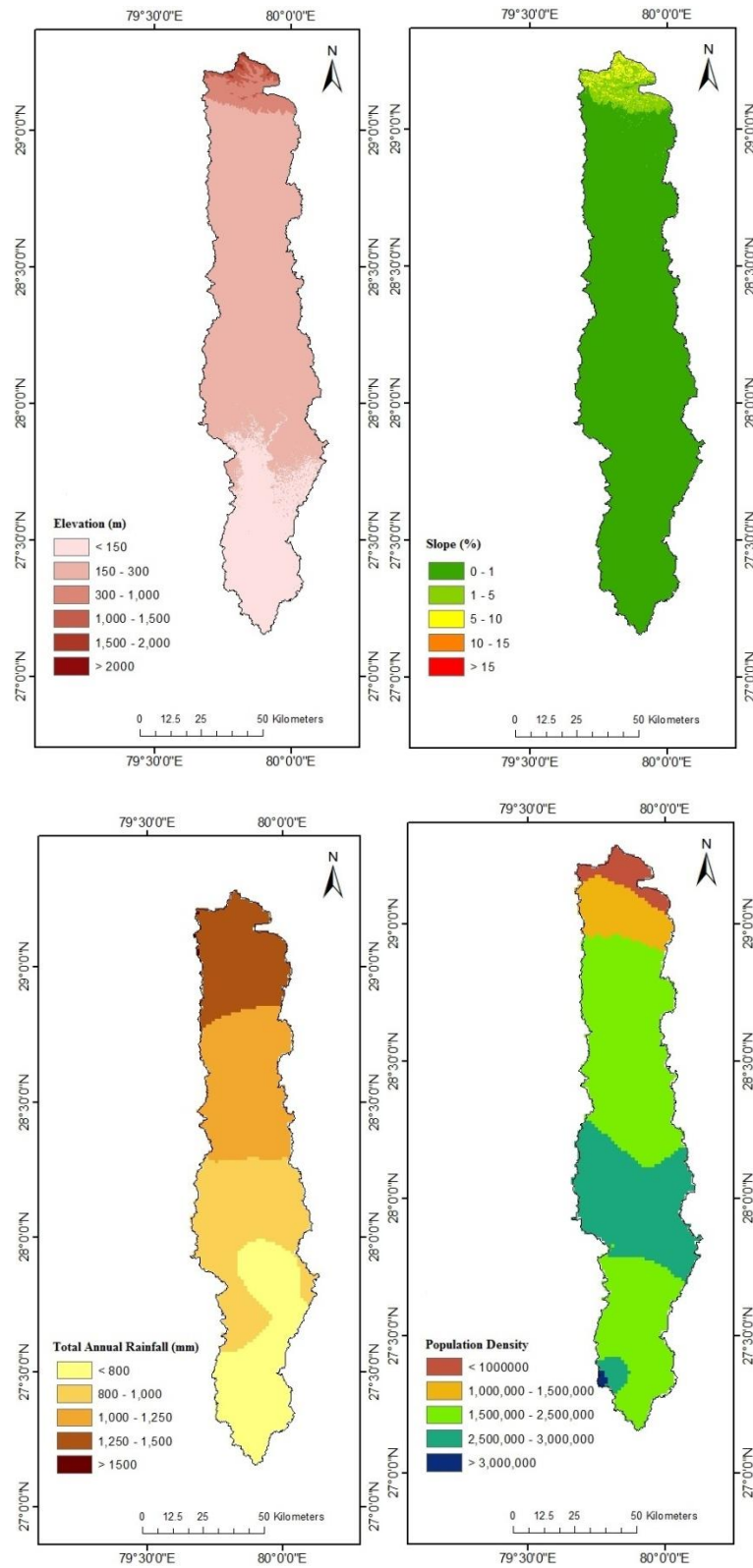
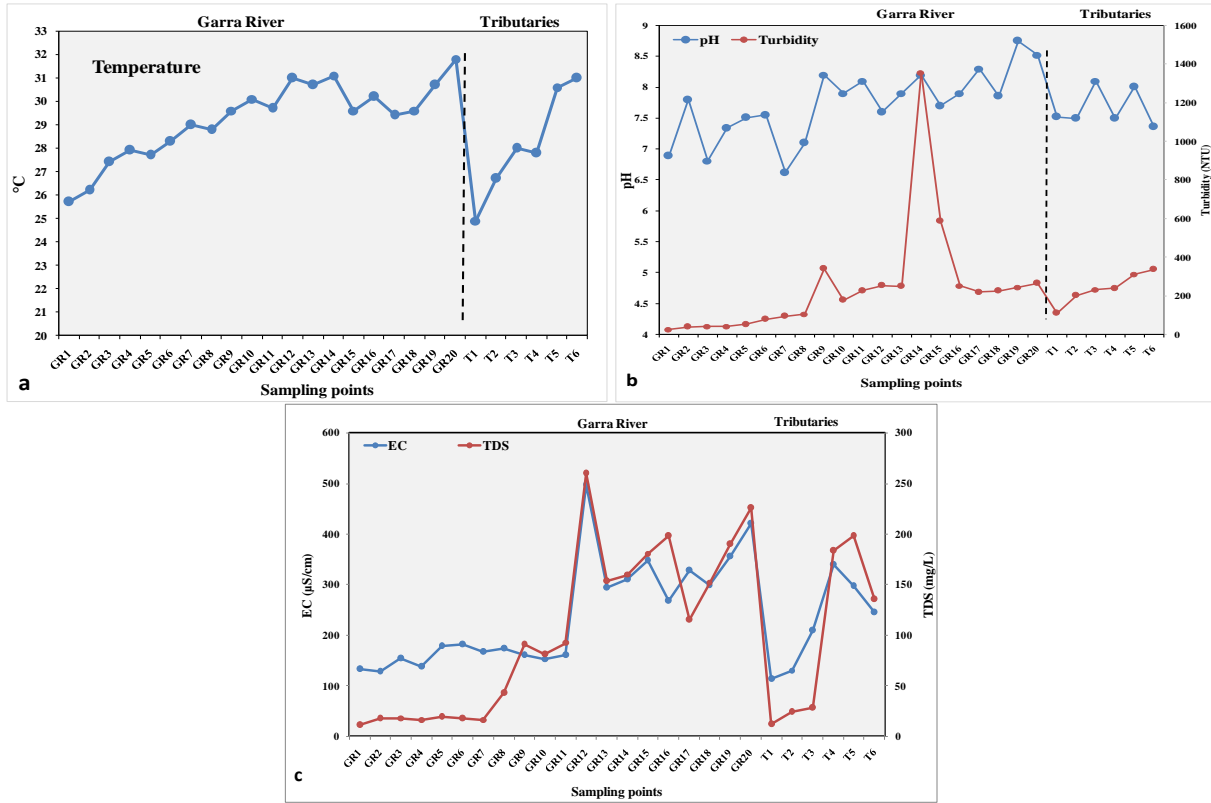


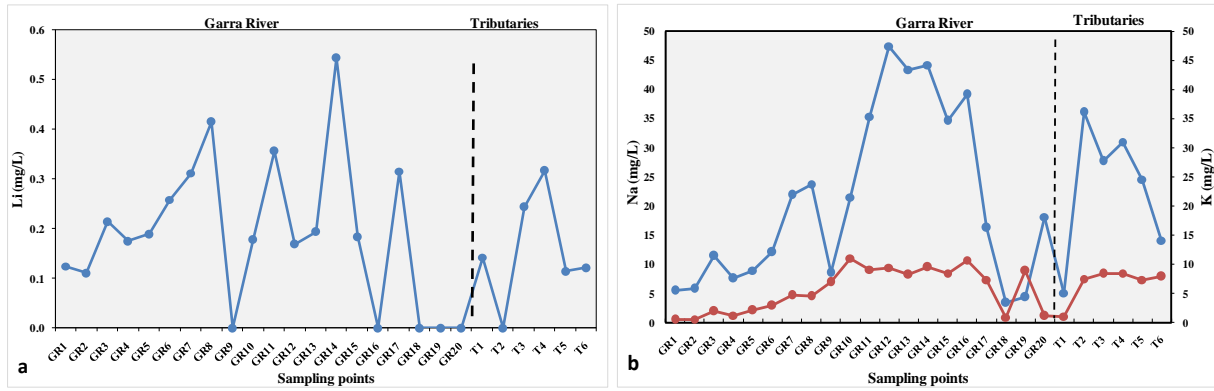
## Supplementary Materials



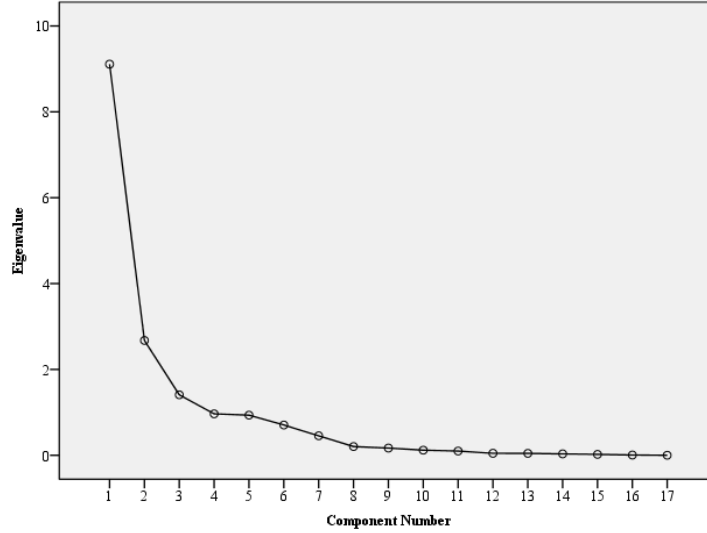
**Fig. S1.** Characteristics of the study area: (a) Ground elevation; (b) Ground slope; (c) Annual rainfall (d) Population density.



**Fig. S2** (a)–(c) Spatial variations in temperature, pH, turbidity, EC and TDS in water of Garra River and its tributaries.



**Fig. S3.** Spatial variations in Li<sup>+</sup>, Na<sup>+</sup> and K<sup>+</sup> in water of Garra River and its tributaries.



**Fig. S4.** Scree plot of the characteristic roots (eigenvalues) of principal components.

**Table S1.** Descriptive Statistics of Water Quality Parameters of the Garra River and Its Tributaries

Parameter	Tributaries	Garra River	BIS (1989)	WHO (2008)
Temperature (°C)	28.2 ± 2.3	29.2 ± 1.6	-	25
pH	7.67 ± 0.2	7.73 ± 0.5	6.5-8.5	6.5-8.5
Turbidity (NTU)	238.68 ± 73.4	243.87 ± 286.3	1	5
EC (µS/cm)	222.54 ± 82.4	242.6 ± 105.6	-	-
TDS (mg/L)	97.28 ± 77.9	103.04 ± 79.80	500	500
COD (mg/L)	24.25 ± 5.5	26.65 ± 12.01	-	-
BOD (mg/L)	15.23 ± 2.9	14.28 ± 5.9	-	-
NO <sub>3</sub> <sup>-</sup> (mg/L)	2.92 ± 0.9	1.31 ± 1.1	45	50
PO <sub>4</sub> <sup>3-</sup> (mg/L)	0.37 ± 0.07	0.29 ± 0.1	-	-
SO <sub>4</sub> <sup>2-</sup> (mg/L)	11.83 ± 6.5	8.23 ± 6.9	200	250
F <sup>-</sup> (mg/L)	0.27 ± 0.05	0.27 ± 0.1	1	1.5
Cl <sup>-</sup> (mg/L)	4.44 ± 2.1	3.12 ± 1.9	250	250
Li <sup>+</sup> (mg/L)	0.19 ± 0.1	0.15 ± 0.1	-	-
Na <sup>+</sup> (mg/L)	22.67 ± 5.6	18.49 ± 8.3	-	200
K <sup>+</sup> (mg/L)	2.12 ± 0.7	2.45 ± 0.8	-	-
Ca <sup>2+</sup> (mg/L)	21.29 ± 4.0	28.24 ± 5.4	75	250
Mg <sup>2+</sup> (mg/L)	13.33 ± 1.9	10.23 ± 3.3	30	200
HCO <sub>3</sub> <sup>-</sup> (mg/L)	148.96 ± 16.4	151.16 ± 36.7	200	-
Zn (mg/L)	0.10 ± 0.05	0.14 ± 0.2	5	3-5
Fe (mg/L)	16.94 ± 23.4	17.30 ± 17.9	0.3	0.3
Mn (mg/L)	0.24 ± 0.3	0.25 ± 0.2	0.1	0.1

**Table S2.** Paired *t*-test of the Water Quality Parameters in the Garra River

<b>Parameter</b>	<b>t- statistic</b>	<b>Probability &gt; t-test</b>
COD	2.12,764	0.08,666
BOD <sub>5</sub>	-1.7,145	0.1,471
NO <sub>3</sub> <sup>-</sup>	0.49,675	0.64,043
PO <sub>4</sub> <sup>2--</sup> P	-0.26,198	0.80,378
SO <sub>4</sub> <sup>2-</sup>	0.16,085	0.87,851
F <sup>-</sup>	-1.16,417	0.29,688
Cl <sup>-</sup>	-0.33,424	0.75,176
Li	0.15,993	0.8,792
Na	0.04,874	0.96,301
K	-1.53,994	0.1,842
Ca	-8.37,364	3.98E-04
Mg	0.6,689	0.5332
HCO <sub>3</sub> <sup>-</sup>	-3.80,255	0.0,126

**Table S3.** Matrix of Correlation for the Garra River Water Samples

	pH	EC	TDS	COD	BOD	DO	NO <sub>3</sub> <sup>-</sup>	PO <sub>4</sub> <sup>2-</sup>	Li <sup>-</sup>	Na	K	Ca	Mg	HCO <sub>3</sub> <sup>-</sup>	SO <sub>4</sub> <sup>2-</sup>	F <sup>-</sup>	Cl <sup>-</sup>
pH	1																
EC	0.511	1															
TDS	0.642	<b>0.915</b>	1														
COD	0.432	0.573	0.49	1													
BOD	0.473	0.641	0.565	<b>0.88</b>	1												
DO	-0.45	-0.226	-0.145	-0.208	-0.24	1											
NO <sub>3</sub> <sup>-</sup>	0.672	0.639	0.666	0.247	0.31	-0.64	1										
PO <sub>4</sub> <sup>2-</sup>	0.45	0.614	0.601	0.321	0.454	-0.51	<b>0.715</b>	1									
Li <sup>-</sup>	-0.26	-0.166	-0.277	0.384	0.355	0.038	-0.39	0.002	1								
Na	0.104	0.461	0.555	0.57	0.542	0.324	0.012	0.274	0.44	1							
K	0.428	0.362	0.554	0.635	0.552	0.061	0.145	0.347	0.218	<b>0.709</b>	1						
Ca	0.479	0.676	<b>0.74</b>	0.455	0.592	-0.21	0.472	<b>0.825</b>	0.125	0.59	0.66	1					
Mg	<b>0.722</b>	0.591	0.668	0.507	0.596	-0.63	<b>0.79</b>	<b>0.8</b>	0.014	0.302	0.474	<b>0.733</b>	1				
HCO <sub>3</sub> <sup>-</sup>	0.588	0.573	<b>0.732</b>	0.443	0.579	-0.32	0.563	<b>0.778</b>	-0.04	0.512	0.687	<b>0.894</b>	<b>0.824</b>	1			
SO <sub>4</sub> <sup>2-</sup>	0.546	0.526	0.591	0.437	0.55	-0.3	0.399	0.446	0.28	0.476	0.425	0.601	0.693	0.55	1		
F <sup>-</sup>	0.581	0.588	0.589	0.237	0.465	-0.49	0.601	0.555	-0.04	0.125	0.148	0.532	<b>0.722</b>	0.517	<b>0.843</b>	1	
Cl <sup>-</sup>	0.59	0.671	<b>0.771</b>	0.471	0.459	-0.4	0.682	0.635	-0.01	0.529	0.498	0.696	<b>0.822</b>	0.691	<b>0.741</b>	0.649	1