

Supplementary Materials

Assessing the Vulnerability of Water Balance to Climate Change at River Basin Scale in Humid Tropics: Implications for a Sustainable Water Future

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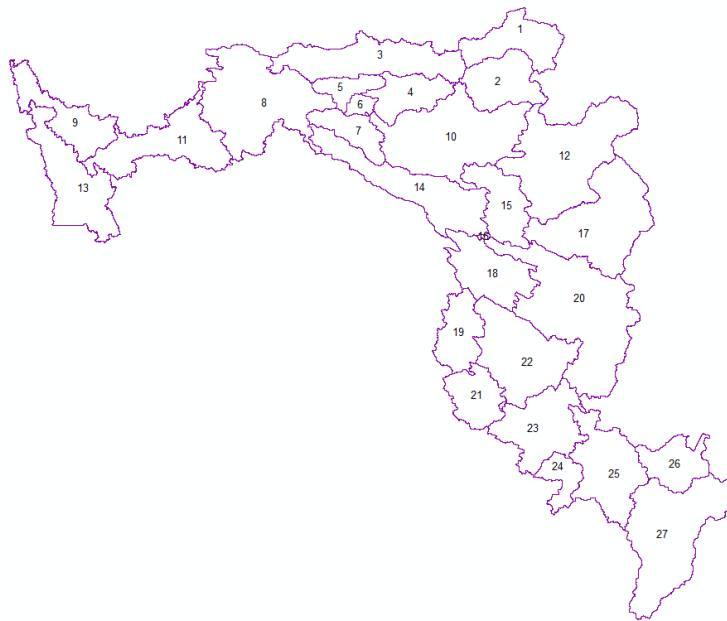


Figure S1: Sub-basin code for Periyar River Basin.

*To identify the sub-basin locations, refer Figure S1.

Table S1: Projected change in annual average precipitation (mm) due to climate change for each sub-basin.

Subbasin	Historical (base)	SSP 245			SSP 585		
		Near	Mid	Far	Near	Mid	Far
1	158.60	196.3(+23.8%)	218.4(+37.7%)	236.4(+49.1%)	153.7(-3.1%)	182.5(+15.1%)	237.7(+49.9%)
2	171.37	212.1(+23.8%)	236(+37.7%)	255.4(+49.1%)	172.2(+0.5%)	197.2(+15.1%)	256.9(+49.9%)
3	257.36	176.6(-31.4%)	217.2(-15.6%)	249.2(-3.2%)	197.3(-23.3%)	195.7(-24%)	245.7(-4.5%)
4	258.05	177.1(-31.4%)	217.7(-15.6%)	249.9(-3.2%)	197.7(-23.4%)	196.2(-24%)	246.4(-4.5%)
5	258.05	177.1(-31.4%)	217.7(-15.6%)	249.9(-3.2%)	197.7(-23.4%)	196.2(-24%)	246.4(-4.5%)
6	258.05	177.1(-31.4%)	217.7(-15.6%)	249.9(-3.2%)	197.7(-23.4%)	196.2(-24%)	246.4(-4.5%)
7	258.05	177.1(-31.4%)	217.7(-15.6%)	249.9(-3.2%)	197.7(-23.4%)	196.2(-24%)	246.4(-4.5%)
8	246.43	167.1(-32.2%)	191.6(-22.3%)	209.1(-15.2%)	191.1(-22.5%)	167.1(-32.2%)	203.7(-17.3%)
9	128.83	112.1(-13%)	148.1(+15%)	167.4(+30%)	83.8(-35%)	130.1(+1%)	162.7(+26.3%)
10	222.14	257.7(+16%)	317.7(+43%)	355.4(+60%)	207.7(-6.5%)	280(+26%)	352.7(+58.8%)
11	274.84	257(-6.5%)	278.9(+1.5%)	296.5(+7.9%)	253.6(-7.7%)	244.7(-11%)	303.9(+10.6%)
12	215.60	250.1(+16%)	308.3(+43%)	344.9(+60%)	198.8(-7.8%)	271.7(+26%)	342.3(+58.8%)
13	249.07	247.3(-0.7%)	264.8(+6.3%)	272.7(+9.5%)	193.5(-22.3%)	227.1(-8.8%)	285.2(+14.5%)
14	279.21	247.3(-11.4%)	295.3(+5.8%)	328.5(+17.7%)	207.3(-25.8%)	255(-8.7%)	325.9(+16.7%)
15	222.14	257.7(+16%)	317.7(+43%)	355.4(+60%)	211.1(-5%)	280(+26%)	352.7(+58.8%)
16	222.14	257.7(+16%)	317.7(+43%)	355.4(+60%)	211.1(-5%)	280(+26%)	352.7(+58.8%)
17	76.99	263.7(+242.5%)	309.1(+301.4%)	335(+335.2%)	211.9(+175.3%)	279.5(+263%)	330.2(+328.9%)
18	221.80	257.3(+16%)	317.2(+43%)	354.8(+60%)	190.8(-14%)	279.5(+26%)	352.1(+58.8%)
19	155.33	107.7(-30.7%)	112.6(-27.5%)	119.3(-23.2%)	88.3(-43.2%)	105.6(-32%)	120.7(-22.3%)
20	76.96	111.8(+45.3%)	89.7(+16.5%)	85.7(+11.3%)	106.3(+38.1%)	88.2(+14.6%)	92.7(+20.5%)
21	155.54	107.8(-30.7%)	112.8(-27.5%)	119.5(-23.2%)	88.4(-43.2%)	105.8(-32%)	120.9(-22.3%)
22	155.98	108.1(-30.7%)	113.1(-27.5%)	119.8(-23.2%)	88.7(-43.2%)	106.1(-32%)	121.2(-22.3%)
23	216.38	306(+41.4%)	360.6(+66.7%)	389.8(+80.2%)	228.1(+5.4%)	320.1(+47.9%)	389.6(+80.1%)
24	215.56	304.9(+41.4%)	359.3(+66.7%)	388.3(+80.2%)	227.3(+5.4%)	318.9(+47.9%)	388.2(+80.1%)
25	79.41	275.6(+247%)	348.9(+339.4%)	387.6(+388%)	188.8(+137.7%)	299.3(+276.9%)	378(+376%)
26	78.48	272.4(+247%)	344.8(+339.4%)	383(+388%)	193.2(+146.2%)	295.8(+276.9%)	373.6(+376%)
27	69.00	239.5(+247%)	303.1(+339.4%)	336.7(+388%)	197.3(+186%)	260(+276.9%)	328.4(+376%)

Table S2: Projected change in annual average ET (mm) due to climate change for each sub-basin.

Subbasin		SSP 245					
	Historical (base)	Near	Mid	Far	Near	Mid	Far
1	70.54	53(-24.9%)	54.1(-23.3%)	54.9(-22.2%)	51.2(-27.5%)	52.3(-25.9%)	56.4(-20.1%)
2	76.60	57.9(-24.4%)	59.2(-22.8%)	60(-21.7%)	56(-26.9%)	57.2(-25.3%)	61.6(-19.6%)
3	90.02	58.9(-34.6%)	59.5(-33.9%)	60.8(-32.5%)	57.7(-35.9%)	58.8(-34.7%)	62.3(-30.8%)
4	74.75	52.3(-30%)	52.6(-29.7%)	54(-27.8%)	51.1(-31.7%)	51.2(-31.5%)	55.4(-25.9%)
5	76.67	52.9(-31%)	53.2(-30.6%)	54.7(-28.7%)	51.8(-32.4%)	52.1(-32.1%)	56.3(-26.5%)
6	76.53	52.9(-30.9%)	53.2(-30.5%)	54.6(-28.6%)	52.1(-31.9%)	52(-32.1%)	56.2(-26.5%)
7	73.91	50.7(-31.4%)	50.9(-31.1%)	52.5(-29%)	50.3(-32%)	49.8(-32.6%)	54.2(-26.7%)
8	74.46	50.8(-31.7%)	51.1(-31.3%)	52.6(-29.4%)	50.4(-32.4%)	50.1(-32.7%)	54.6(-26.7%)
9	36.84	26(-29.5%)	26.4(-28.4%)	27.2(-26%)	24.9(-32.5%)	25.8(-30.1%)	28.3(-23.3%)
10	79.05	55.1(-30.3%)	56.2(-28.9%)	58(-26.6%)	54.2(-31.5%)	56.3(-28.8%)	60.1(-24%)
11	79.48	55.4(-30.3%)	56.2(-29.3%)	58(-27%)	53.2(-33%)	54.6(-31.3%)	59.5(-25.1%)
12	73.52	52.2(-29.1%)	53(-27.9%)	54.8(-25.4%)	51.1(-30.5%)	53(-27.9%)	56.9(-22.6%)
13	101.18	66.6(-34.2%)	67.1(-33.7%)	67.5(-33.3%)	65.4(-35.4%)	66.1(-34.7%)	69.1(-31.7%)
14	81.38	54.8(-32.6%)	54.9(-32.5%)	56(-31.2%)	53.1(-34.8%)	54.6(-32.9%)	58.8(-27.8%)
15	77.03	54.3(-29.5%)	55.4(-28.1%)	57.2(-25.8%)	53.3(-30.8%)	55.4(-28.1%)	59.3(-23%)
16	80.56	55(-31.7%)	56(-30.5%)	58(-28%)	54.2(-32.7%)	56.3(-30.1%)	60.3(-25.1%)
17	45.46	51.8(+13.9%)	52.2(+14.8%)	53.4(+17.5%)	50.3(+10.5%)	50.9(+12%)	55.3(+21.7%)
18	75.07	53(-29.4%)	53.9(-28.3%)	55.8(-25.7%)	52.2(-30.4%)	53.9(-28.2%)	58(-22.7%)
19	90.00	58.9(-34.6%)	58.7(-34.8%)	58.5(-35%)	57.8(-35.7%)	57.4(-36.2%)	60(-33.3%)
20	47.30	44.8(-5.4%)	43.9(-7.2%)	45.2(-4.4%)	43.2(-8.6%)	42.8(-9.5%)	46.8(-1.1%)
21	69.13	47.1(-31.9%)	46.9(-32.2%)	47.3(-31.6%)	45.3(-34.4%)	45(-34.9%)	48.7(-29.5%)
22	80.24	53.8(-33%)	53.6(-33.2%)	53.7(-33.1%)	52(-35.3%)	51.9(-35.3%)	55.2(-31.3%)
23	77.72	54.2(-30.3%)	55.1(-29.1%)	56.5(-27.3%)	52.1(-32.9%)	53.5(-31.2%)	58.6(-24.6%)
24	76.00	52.6(-30.8%)	53.5(-29.6%)	55(-27.6%)	50.6(-33.5%)	51.9(-31.8%)	57.1(-24.9%)
25	57.89	53.8(-7.1%)	55.9(-3.4%)	58.1(+0.4%)	53.4(-7.8%)	54.9(-5.2%)	59.9(+3.4%)
26	53.46	52.6(-1.6%)	55(+2.9%)	57.3(+7.1%)	51.7(-3.2%)	53.6(+0.3%)	59(+10.4%)
27	44.57	45.7(+2.6%)	47.8(+7.2%)	49.8(+11.7%)	44.8(+0.6%)	46.6(+4.5%)	51.3(+15%)

Table S3: Projected change in annual average runoff (mm) due to climate change for each sub-basin.

Subbasin		SSP 245					
	Historical (base)	Near	Mid	Far	Near	Mid	Far
1	29.81	53.9(+80.7%)	60.4(+102.5%)	64.1(+115.1%)	33.1(+10.9%)	46(+54.3%)	66.8(+124.1%)
2	28.38	51.5(+81.5%)	57.6(+103%)	61.1(+115.4%)	31.4(+10.6%)	43.8(+54.3%)	63.8(+124.7%)
3	78.18	40.9(-47.7%)	62(-20.7%)	78.1(-0.1%)	40.5(-48.2%)	54.9(-29.8%)	74.1(-5.3%)
4	61.17	30.8(-49.6%)	48.1(-21.3%)	61.5(+0.6%)	26.3(-56.9%)	42.5(-30.5%)	57.7(-5.6%)
5	84.31	44.3(-47.5%)	66.9(-20.7%)	84(-0.4%)	44.9(-46.7%)	59.2(-29.8%)	79.9(-5.2%)
6	75.51	39.4(-47.9%)	59.8(-20.8%)	75.3(-0.3%)	42(-44.4%)	53.1(-29.6%)	71.2(-5.6%)
7	82.49	43.3(-47.5%)	65.7(-20.3%)	82.7(+0.2%)	41.2(-50.1%)	57.9(-29.8%)	78.7(-4.6%)
8	73.79	39.4(-46.6%)	52.4(-29%)	59(-20%)	45.7(-38.1%)	43.5(-41.1%)	52.9(-28.4%)
9	70.20	66.8(-4.8%)	99.9(+42.3%)	114.1(+62.5%)	61.5(-12.3%)	84.6(+20.5%)	108.5(+54.5%)
10	43.97	68.9(+56.6%)	102.4(+132.9%)	117.9(+168.1%)	33.6(-23.7%)	83.6(+90.1%)	112.5(+155.9%)
11	78.14	84(+7.4%)	91.3(+16.8%)	94.6(+21%)	61.9(-20.8%)	76.7(-1.9%)	100.5(+28.6%)
12	34.71	58.8(+69.4%)	88.7(+155.5%)	102.2(+194.3%)	26.6(-23.3%)	71.4(+105.8%)	97.2(+180%)
13	84.00	98.6(+17.3%)	105.8(+25.9%)	104.8(+24.8%)	70.2(-16.4%)	86.2(+2.6%)	113.6(+35.3%)
14	95.22	79.3(-16.7%)	112.2(+17.9%)	130.3(+36.8%)	40.2(-57.8%)	87.8(-7.8%)	127.1(+33.4%)
15	39.31	63.7(+62%)	95.3(+142.3%)	109.7(+179.1%)	30(-23.7%)	77.2(+96.5%)	104.6(+166%)
16	66.69	98.5(+47.6%)	143.4(+115%)	166.4(+149.5%)	75.6(+13.4%)	118.4(+77.5%)	160.4(+140.5%)
17	2.53	61.6(+2331%)	75(+2860.1%)	81.2(+3104%)	42.9(+1593%)	66(+2503.6%)	78.2(+2983%)
18	37.11	61.5(+65.7%)	92.3(+148.7%)	106.2(+186%)	38.6(+3.9%)	74.7(+101%)	101.1(+172%)
19	18.80	11(-41.3%)	11.9(-36.8%)	13.3(-29.2%)	6.5(-65.2%)	10.9(-42%)	13.4(-28.6%)
20	2.67	11.6(+332.8%)	6.7(+151%)	6(+125.6%)	10.9(+309%)	6.8(+155.8%)	6.5(+142.9%)
21	15.07	8.4(-44.1%)	9.1(-39.6%)	10.4(-31.2%)	4.6(-69.3%)	8.2(-45.5%)	10.5(-30.4%)
22	14.85	8.1(-45.3%)	8.8(-40.8%)	10(-32.5%)	4.4(-70.5%)	7.9(-46.7%)	10.2(-31.3%)
23	32.58	78.8(+141.7%)	102.2(+213%)	107.4(+229%)	46.8(+43.7%)	87.6(+169%)	106.7(+227%)
24	34.24	81.1(+136.9%)	104.9(+206%)	110.2(+221%)	48.8(+42.6%)	90.2(+163%)	109.4(+219%)
25	3.38	64.3(+1800%)	91(+2590%)	98.7(+2818%)	30(+787.1%)	72.5(+2043%)	94.2(+2686%)
26	6.27	84.6(+1249%)	118.5(+1789%)	129.4(+1963%)	41.9(+567.9%)	95.7(+1426%)	124(+1877.3%)
27	4.67	75.1(+1508%)	105.8(+2167%)	115.5(+2374%)	36.1(+673.9%)	84.9(+1718%)	110.5(+2267%)

Table S4: Projected change in annual average groundwater discharge (mm) due to climate change for each sub-basin.

Subbasin		SSP 245					
	Historical (base)	Near	Mid	Far	Near	Mid	Far
1	27.24	56.9(+108.7%)	67.3(+147%)	77.1(+182.9%)	36(+32%)	51.5(+89%)	73.9(+171.4%)
2	27.96	58(+107.4%)	68.7(+145.6%)	78.6(+181.2%)	36.5(+30.6%)	52.5(+87.8%)	75.5(+170%)
3	54.23	47(-13.4%)	59.3(+9.3%)	68.6(+26.6%)	40.8(-24.8%)	49.6(-8.5%)	67.5(+24.4%)
4	40.09	33.2(-17.1%)	43.5(+8.6%)	51.4(+28.1%)	37.7(-5.9%)	35.9(-10.6%)	50.3(+25.5%)
5	55.91	49.5(-11.5%)	61.5(+10%)	70.7(+26.5%)	39.2(-29.9%)	51.7(-7.6%)	69.5(+24.2%)
6	60.69	51.5(-15.1%)	64.9(+7%)	75.2(+23.9%)	39.1(-35.6%)	54.6(-10.1%)	74(+21.9%)
7	40.94	38.3(-6.5%)	47.2(+15.2%)	54(+31.8%)	26.4(-35.5%)	39.3(-4%)	52.8(+28.9%)
8	64.69	53.7(-17%)	61.6(-4.8%)	68.8(+6.3%)	40.5(-37.4%)	49.8(-23%)	67.4(+4.2%)
9	85.82	83.8(-2.4%)	116(+35.2%)	135.1(+57.5%)	75.5(-12%)	98.4(+14.7%)	129.3(+50.7%)
10	36.41	63.4(+74.2%)	76.4(+110%)	87.2(+139.6%)	53.4(+46.7%)	65.3(+79.4%)	87.3(+139.9%)
11	86.48	91.5(+5.8%)	103.3(+19.5%)	113.3(+31.1%)	69.6(-19.5%)	87.1(+0.8%)	112.4(+30%)
12	16.88	36(+113.2%)	44.7(+165%)	51.7(+206.4%)	38(+125.4%)	37.3(+121%)	51.6(+205.7%)
13	73.21	80.6(+10.1%)	89.5(+22.3%)	96.5(+31.8%)	59.1(-19.2%)	74.1(+1.2%)	98(+33.8%)
14	52.76	66.6(+26.2%)	75.1(+42.3%)	83.8(+58.8%)	56.1(+6.4%)	64.7(+22.6%)	81.3(+54.2%)
15	26.59	49.6(+86.5%)	60.3(+126.9%)	69.2(+160.1%)	42.3(+59.2%)	51.1(+92.1%)	69.1(+160%)
16	41.21	69.5(+68.6%)	78.7(+90.9%)	87.4(+112.1%)	57.4(+39.2%)	68.8(+66.9%)	87.9(+113.4%)
17	1.18	37.1(+3038%)	47.3(+3893.6%)	53.5(+4417.6%)	30(+2438.8%)	40.1(+3284%)	51.4(+4239%)
18	20.46	40.8(+99.6%)	50(+144.3%)	57.3(+180.3%)	28.9(+41.4%)	42(+105.6%)	57.2(+179.8%)
19	12.83	10.8(-15.7%)	12.4(-3.1%)	14.1(+10.1%)	6.5(-49.5%)	10.6(-17.2%)	13.9(+8.3%)
20	0.96	9.2(+866.6%)	4.8(+403.5%)	3.7(+290.9%)	8.6(+802.9%)	4.6(+385%)	4.8(+398.5%)
21	7.70	6.1(-21%)	7(-9.7%)	7.9(+2.9%)	3.9(-49.7%)	6(-22.1%)	7.9(+2.4%)
22	9.27	7.5(-19.2%)	8.6(-7.4%)	9.8(+5.2%)	4.6(-50.6%)	7.4(-20.2%)	9.6(+3.9%)
23	20.87	54.8(+162.7%)	65.8(+215.3%)	74.6(+257.7%)	37.6(+80.1%)	55.5(+166%)	73.2(+250.9%)
24	18.64	50.9(+172.9%)	61.1(+227.9%)	69.3(+272%)	34.7(+86%)	51.5(+176.1%)	68(+264.8%)
25	1.11	50.9(+4462%)	67.9(+5987%)	79(+6983.3%)	30.5(+2631%)	55.4(+4866%)	75.6(+6682.6%)
26	1.34	80.1(+5874%)	104.1(+7662%)	120.5(+8889%)	51.7(+3757%)	86.5(+6349.2%)	116.1(+8556%)
27	1.09	64.4(+5801%)	84.7(+7653%)	98.3(+8905%)	40.4(+3599%)	69.8(+6292.6%)	94.5(+8551.6%)