The Impacts of Water Demand and Its Implications for Future Surface Water Resource Management: The Case of Tanzania's Wami Ruvu Basin (WRB)

Supplementary Material

The WEAP model simulates natural hydrological processes (e.g., evapotranspiration, runoff, and infiltration) and anthropogenic activities such as agriculture and their water allocations between upstream and downstream users [6–9,14]. The model was applied to gain insight on the impacts of water demand and its implications for future surface water resource management at the basin scale. Priority setting between upstream and downstream water users and sectorial water resource allocations using water-centric scenarios which were based on Continuation of existing trend (CT), Economic Growth (EG) and Demand Side Management (DSM). The results were extracted and tabulated, as shown in the Table S1–S5.

In the WEAP model, five categories of water-type years, Very Wet, Wet, Normal, Dry, and Very Dry, are used to represent hydrological patterns. The frequency analysis of an annual inflow record at a representative river point provides a sequence of water-type years. The sequence may then be automatically adjusted to explore alternative assumptions on future hydrological patterns [16]. This method is called the Water Year Method (WYM). The WEAP's WYM results were tabulated as shown below.

Table S1. Accumulated discharges (Units, Million m^3).

Sub Catchments	Dry Year	Normal Year	Wet Year
Kinyasungwe	37.8	312.98	425.65
Mkondoa	443.89	788.83	986.03
Wami	612.33	1118.60	1006.7
Upper Ruvu	774.58	1223.44	1529.3
Ngerengere	73.4	115	143.75
Lower Ruvu	26.96	220.23	198.2
Coast	103.58	209.39	261.74

Several WEAP studies conducted in various basins in Africa, such as, Sokoto Rima River basin in Nigeria [6], Didessa Sub-basin in Ethiopia [7], Ouémé River Basin in Benin [8], Drâa basin in Morocco [9], Niger River Basin in Niger [14], and Zambezi River basin in Zambia [25] were analyzed and annual flow reduction was obtained. The affected riparians were obtained from le Blanc and Perez [26], then results were tabulated as shown below.

Table S2. Annual flow reductions and effected riparians in the Sub Saharan Africa basins (selected countries).

Basins	Annual Flow Reduction (Million m^3)	Affected People by 2025 and Beyond (Million)	Affected People in 2015 (Million)
Sokoto Rima	1700	47	34
Didessa	1101	43	25
Ouémé	1800	32	8
Ngiro North	220	24	12
Zambezi	1300	12	9

The basin's water demand under DSM, EG, and CT scenarios over 2015–2035 period were extracted from the model and the results were tabulated, as shown below.

Table S3. Demand growth projection (Units, Million m^3).

Scenarios	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
DSM	990	1026.29	1062.58	1098.87	1135.16	1171.45	1207.74	1244.03	1280.32	1316.61
CT	1050	1103.645	1157.29	1210.935	1264.58	1318.225	1371.87	1425.515	1479.16	1532.805
EG	1060.1	1105.885	1161.77	1217.655	1273.54	1329.425	1385.31	1441.195	1497.08	1552.965
2025	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
1352.9	1389.19	1425.48	1461.77	1498.06	1534.35	1570.64	1606.93	1643.22	1679.51	1715.8
1586.45	1640.095	1693.74	1747.385	1801.03	1854.675	1908.32	1961.965	2015.61	2069.255	2122.9
1608.85	1664.735	1720.62	1776.505	1832.39	1888.275	1944.16	2000.045	2055.93	2111.815	2167.7

The stream flows data from 2005 to 2015 containing both drier and wetter years was used to calibrate and validate a model and analyzed its performance in replicating the river flows. Similarly, the basin surface runoff was extracted from the model based on DSM, EG, and CT scenarios and results were tabulated, as shown below.

Table S4. Surface runoff trends (Units, Million m^3)

Scenarios	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
DSM	1320.71	934.00	775.62	678.34	716.17	832.99	711.95	3199.76	1383.36	1493.42
EG	1328.51	936.16	779.57	683.84	720.59	844.73	718.79	3199.17	1384.31	1522.18
CT	1338.71	934.62	777.79	681.25	711.24	838.94	718.77	3199.19	1386.80	1526.96
2025	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**
1016.05	1117.84	720.83	3015.06	1141.38	975.30	969.92	871.22	1712.53	763.77	533.68
1025.02	1127.37	743.99	3016.22	1144.97	997.43	994.39	890.57	1812.30	784.67	558.59
1026.68	1128.62	943.72	3016.33	1143.95	995.16	989.41	899.80	1792.01	783.69	559.79

The water resources were allocated in all seven sub-catchments and results were tabulated, as shown below.

Table S5. Spatial and temporal variation in demand and supply (Units, Million m^3)

Sub Catchments	2010		2015		2025		2035	
	Demand	Supply	Demand	Supply	Demand	Supply	Demand	Supply
Kinyasungwe	113.11	44.48	141.83	55.86	170.56	67.25	180.71	60.44
Mkondoa	192.13	94.93	224.39	102.85	256.65	110.78	248.13	104.05
Wami	111.48	75.29	129.49	98.3	147.51	121.31	149.9	92.84
Upper Ruvu	65.2	54.85	75.51	60.71	85.82	66.58	78.07	62.08
Ngerengere	27.48	24.32	36.21	29.58	44.95	34.85	71.42	44.75
Lower Ruvu	37.72	37.26	52.26	48.96	66.8	60.66	55.03	51.83
Coast	169.19	123.61	244	169.1	318.82	214.59	552.64	368.42