

Water Supply and Demand for Different Sectors in Bhavani Basin

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ABSTRACT

The irrigated crops Demand based on water requirement is 2.12 m.ha.m (44.72 percent). This Demand-supply gap is 0.48 m.ha.m. (Palanisami 2013). India food grain need is 450 MT by the year 2050. The irrigation sector consumes the majority of water, and more attention is required in this sector. Almost all the utilizable potential will have to be harnessed to meet the demand for agriculture, industry, energy generation, and domestic consumption. The National Water Policy (2002) gives overriding priority to drinking water over other uses. Taking an average of 200 liters per capita per day (liter per consumer demand), the urban demand for water for the population of 1000 million (2012 estimate) would be 73.17 BCM, of which consumptive use should only be 14.63 BCM (20%). A quantity of 14.63 BCM is too tiny compared to the total potential to pose any supply problem. Due to improper wastewater management, the water Demand projected as 60 BCM compared to the actual demand 14.63 BCM. The drinking water Demand is 10 BCM at the present level of 40 liter per consumer and it would be 29 BCM by 2050 d (Ministry of Water Resources, 2018 estimate).

HIGHLIGHTS

- Domestic water demand shall be 820 Million by 2050.
- Industrial uses of water are likely to be about 25 percent in the year 2025 AD.
- The annual food grain requirement works out to be 450 MT by the year 2050.

Keywords: Water demand and supply, agricultural water sector, domestic sector, industries sector

Water Demand

Seventeen river basins are available in Tamil Nadu, with a geographical area of 130069 km². The state average annual rainfall is 945 mm (Agrawal, Yogesh Chandra 2012). 1 Mha area is irrigated by 60 reservoirs. Tank and the well irrigating area is 0.8 M. ha and 1.2 M ha, respectively. The total number of well is 1.6 M. According to NITI; the total groundwater recharge is 2.24 MHM (NITI Aayog 2018). The total surface water availability is 2.50 MHM and groundwater is 2.24 MHM (Himanshu Thakkar (2018). More than 90 percent of accessible water uses for irrigation. The water Demand is increasing for the growing population (Rathore and Singh 2011). Care should be taken

to the agricultural water requirement for current and future needs (Srinivasan and Kulkarni 2014). Tamil Nadu's irrigation potential is 0.08 hectares, and India's irrigation is 0.17 hectares (Season and Crop Report 2017-18). Domestic and industrial demand is 15 percent of the total demand at the present level. And it would be increased to Twenty-five percent in the year 2025 AD.

Oveexploitation of groundwater, insufficient rainfall, and limited groundwater replenishment resulted in groundwater table decline in all parts of the Bhavani basin. Supply is fixed, it has to be

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shared by various users in an optimum way, and this has assumed very significance at present in the state (UN Water 2019). Water is demanded multiple uses like population, urbanization, and industry sectors. Hence, increasing demand from multiple uses leads to water transfers from irrigated agriculture. This water transfer is important issues in Tamil Nadu. Water transfer is more prevalent in the Bhavani Basin. In this basin, demand for water to agricultural, domestic, and industrial is very high, and the significances of water transfer are still thoroughly not studied.

RESULTS AND DISCUSSION

Cropping Pattern in Agricultural Sector in Old Ayacut and New Ayacut

Agricultural demand constitutes the significant sectoral demand in the basin. Two anicuts, namely Kodivery and Kalingarayan, and three canals, namely Arakankottai, Thadapalli, and Kalingarayan canals, are irrigating about 16,000 ha of land. Water is allowed for about 10-½ months in the 1st and 2nd channels and 11 months in the 3rd channel. Continuous supplies help raise a short-duration crop of paddy like IR-50, followed by medium-duration paddy. After the two paddy crops, the land is used to grow a green manure crop like sun hemp or fodder sorghum. The cropping patterns in the Lower Bhavani basin for the study area are given in Table 1.

Table 1: Cropping Pattern in Lower Bhavani Basin (Ayacut)

Sl. No	Crop	Area (ha)	Percentage to Ayacut Area
1	Paddy	25188	24.79
2	Sugar cane	6300	6.20
3	Banana	933	0.92
4	Turmeric	3331	3.28
5	Groundnut	10304	10.14
6	Cotton	3360	3.31
7	Pulse	1702	1.68
8	Gingelly	3000	2.95
9	Tapioca	2205	2.17
10	Maize	2496	2.46
11	Cholam	3000	2.95
12	Coconut	5150	5.07
13	Others	34620	34.08
Gross Cropped Area		101589	100.00

Source: Joint Director of Agriculture Erode.

Based on the cropping pattern in the ayacut area of the basin, the relative percentage of area under significant crops in the ayacut was calculated and given in Table 2. It was seen from the information of the table that paddy occupied a major area (24.13%) among significant crops and was followed by groundnut (10.14%) and sugarcane (6.20%) in the ayacut area. In total ayacut and non-ayacut area, paddy occupied 15.20 % and followed by groundnut 10.61%.

Demand for Water in Agricultural Sector

Water need was calculated based on crop water necessities. One could calculate the total irrigation water need of the agriculture sector by multiplying individual crop areas by the unit crop water requirement.

The demand for water in the agricultural sector at the gross water requirements level is given in Table 2. Water requirement calculated at 40 percent efficiency of water recommendation of each crop (Cauvery Basin Report by PWD, 2000). It was seen from the information table that the gross water requirement is about 3283.56 MCM.

Supply-Demand Gap for Water in Agricultural Sector

The details of total Supply and Demand for the water of the agricultural sector were calculated and presented in Table 3. It was seen from the details of the table that the total supply of surface water and groundwater was 1516.12 MCM and 490.85 MCM, respectively. So, the total basin supply of water is 2006.97 MCM. Water demand was 3283.56 MCM in the basin. The quantity of Supply and Demand gap was 1487.49 MCM.

Supply of and Demand for Water in Domestic Sector

Supply of Water

The domestic requirements of the Bhavani river basin as also the adjacent Noyyal basin are met partly by surface water in the Bhavani river. The river provides water to several municipalities, town panchayats, and village panchayats for domestic consumption. The municipalities pump water for domestic requirements directly from the river.

Table 2: Demand for Water in Agricultural Sector in Lower Bhavani Basin

Crops	Lower Bhavani Basin						Total Water Requirement MCM Column 6+7
	Ayacut Area*	Non Ayacut Area*	Water Requirement**/ha		Water Demand*** (MCM)		
			Ayacut	Non Ayacut	Ayacut Column 2*4	Non Ayacut Column 3*5	
1	2	3	4	5	6	7	8
Paddy	25188	0	3000	0	755.64	0.00	755.64
Cumbu	752	2603	1125	675	8.46	17.57	26.03
Cholam	3000	5713	1625	975	48.75	55.70	104.45
Maize	2496	900	1500	900	37.44	8.10	45.54
Ragi	7208	6883	1125	675	81.09	46.46	127.55
O.Small Millets	2221	247	1125	1000	24.99	2.47	27.46
Red Gram	255	1699	1250	750	3.19	12.74	15.93
B.Gram	768	1423	1250	750	9.60	10.67	20.27
G.Gram	531	1300	1250	750	6.64	9.75	16.39
Other pulses	148	4005	1250	750	1.85	30.04	31.89
Groundnut	10304	7288	1750	1050	180.32	76.52	256.84
Gingelly	3000	1018	625	375	18.75	3.82	22.57
Coconut	5150	0	3750	3750	193.13	0.00	193.13
Caster	347	1649	1000	600	3.47	9.89	13.36
Sunflower	304	10	1125	675	3.42	0.07	3.49
Other oil seeds	1620	470	1125	675	18.23	3.17	21.40
Cotton	3360	2778	3250	1950	109.20	54.17	163.37
Sugercane	6300	3128	6250	6250	393.75	195.50	589.25
Chillies	617	0	1250	1125	7.71	0.00	7.71
Turmeric	3331	2295	3750	3750	124.91	86.06	210.98
Arecanut	571	0	1125	1000	6.42	0.00	6.42
Tobacco	3426	0	1500	1500	51.39	0.00	51.39
Banana	933	1000	5000	5000	46.65	50.00	96.65
Tapioca	2205	1323	1750	1250	38.59	16.54	55.13
Other Crops	12879	23088	1250	1125	160.99	259.74	420.73
Total					2334.56	948.99	3283.56

*Source: Joint Director of Agriculture Erode Note: **Water requirement at 40 per cent efficiency level. *** Effective Rainfall is not included.

Table 3: Supply-Demand Gap for Water in Agriculture

Sl. No.	Particulars	MCM
	Supply:	
1	Surface water	1516.12
	Groundwater*	490.85
	Total	2006.97
2	Demand	3283.56
3	Supply -Demand Gap	-1276.59 9

Source: * Calculated based on figures furnished by Central Ground Water Board.

The annual drawl from the river for the existing schemes and the schemes proposed in the future by the TWAD Board is of the order of 174 MCM. There are two water supply circles for household water requirements in Lower Bhavani Basin i.e. (1) Coimbatore circle and (2) Erode Circle; The details of the various schemes and their water supply are given in Table 4 and 5.

The table indicates that nine schemes are running to provide drinking water supply to Coimbatore Circle. The total drawl from the Bhavaniriver for this Circle is 378.50 million liter per day (0.38 MCM) and a yearly 138.5 MCM. Among the nine schemes, five schemes running to give 335.86 million liter per day (0.34 MCM) and yearly (122.58 MCM) of water to Noyyal Basin. There are 32 schemes running to

Table 4: Drinking Water Supply Schemes in Coimbatore Circle

Sl. No.	Scheme	Quantity of drawl (millions of liter per day)
1	Coimbatore corporation 20 town panchayats and 523 rural habitations	131.25
2	Tiruppur municipality and 412 wayside habitations	82.49
3	Karamadai T.P.I	2.95
4	Thekkampatty CWSS	0.72
5	Siruvani WSS	101.4
6	Mettupalayam municipality	20.94
7	Sirumugai	3.64
8	CWSS to Annur – Avanashi	15.11
9	CWSS to Koundampalayam and Vadavalli T.PTS	20.00
Sub Total -1		378.50

Source: Government of Tamil Nadu Water Supply and Drainage Board, Erode .mld: million liters per day.

Table 5: Drinking Water Supply Schemes in Erode Circle

Sl. No.	Scheme	Source	Quantity drawl (mld)
1	WSIS to Sathyamangalam Municipality	Thalakarai	20.40
2	WSS to Gobichettipalayam Municipality	Sengalakarai	9.50
3	WSS to Bhavani Sagar	Bhavani Sagar Canal	0.80
4	WSS to Kothamangalam and four other village panchayats in Bhavani & Sathy Union	Kothamangalam	2.86
5	WSS to Kembanaickanpalayam RTP	Periyakoduveri	0.88
6	CWSS to Kasipalayam and 12 other habitation in T.N Palayam	Makkinam Kompai	1.07
7.	CWSS to Periyapuliur and ten other habitations in Bhavani Union	Siraimeetanpalayan	0.30
8	CWSS to Kadayampatti and 4 other habitations in Bhavani Union	Thalavaipettai	0.48
9	WSS to Jambei RTP in Bhavani Union	Thalavaipettai	1.59
10	CWSS to Vellalpalayam, Vellankoil and 54 other Habitations in Gobi Union	Nanjayagoun-danpalayam	1.66
11	CWSS to Doddampalayam and 116 wayside Habitations in Erode district	Bagadu Durai	3.23
12	CWSS to Periya Kodiveri and seven other village panchayats in T.N. Palayam Union	Kodiveri	4.10
13	CWSS to Kugalur and Athani T.P.	Kuppandampalayam	2.88
14	WSS to Nambiyur and five other Village Panchayat	Makkinam Kompai	1.75
15	CWSS to Mahalipudur and 7 other habitations in Nambiyur in Sathy union	Makkinam Kompai	1.06
16	CWSS to Goundampalayam and seven other habitations in Gobi and Bhavani Unions	Perunthalaiyur	1.10
17	CWSS to Olagadam RTP and 4 VPRTs in Ammapet and Bhavani Union	Thalavaipettai	1.16
18	WSS to Appakudal RTP in Erode district	Kotham Poondi	1.00
19	CWSS to Kavunapadi, P. Mettupalayam and Salangapalayam town panchayat	Perunthalaiyur	2.21



20	CWSS to Pudukothukadu and 4 other habitations in Sathy and Bhavanisagar	Ariyappampalayam	0.72
21	CWSS to Kalingayam, and Siruvallur RTP	Sengalakarai	5.18
22	CWSS to Vemmandampalayam and seven other village PTS in Nambiyur Union	Pudukothukadu	2.35
23	WSS to Ariyapampalayam RTP and Konamoor village panchayat	Pudukothukadu	2.95
24	CWSS to Nallampatty, Pethampalayam, Kanjikoil and Pallapalayam RTPs	Siraimetan -Palayam	6.65
25	CWSS to Elathur, Nambiyur RTP and Kosanam, Thalkuni VPTs in Erode	Arasur	8.633
26	CWSS to Nagalur and two other panchayats in Anthiyur Union	Near Athani	1.89
27	CWSS to 17 habitations in Chinnapuliyur	Vairamangalam	0.44
28	WSS to Punjaipuliyampatti UTP	Bagadu Durai	2.94
29	WSIS to Anthiyur UTP	Athani	2.62
30	CWSS to Kavundapadi, V.P.	Kuttipalayam	3.30
31	CWSS to Moongilpatti, Kilvani, Vempanthi	Moongilpatti	0.80
32	WSIS to Siruvalur VP	Kavundapadi	0.50
Sub Total-II			97.13
Total			475.63 mld
			174 MCM/year

Source: Tamil Nadu Water Supply and Drainage (TWAD) Board, Erode 2017-18.

Note: CWSS: Combined Water Supply Scheme; WSS: Water Supply Scheme; WSIS: Water Supply Improvement Scheme.

give drinking water to Erode Circle. The total drawl from the Bhavani river in this Circle is 97.126 mld (0.09 MCM) and yearly 35.45 MCM. Hence, the total drinking water drawl from the Bhavani river is both for Coimbatore and Erode circles, which is 475.626 mld (0.48 MCM), and yearly it is 173.60 million cubic meters

Demand for Water in Domestic Sector

The requirement of water in the domestic sector has been estimated based on per day water recommended level by the TWAD board. The total water Demand of the domestic sector was estimated by multiplying the population of the basin by the per day water allocation norms of the TWAD board. Tamil Nadu Water Supply and Drainage Board recommendation level per day for rural areas was 90 liters per capita per day, and urban, municipalities, corporation areas were 110 liters per capita per day. The water requirement for the domestic sector is given in Table 6. It was seen from the details of the table that the need is about 93.68 MCM per year (256.66 MLD), and supply is 51.01 per year (139.76

MLD) in the basin. The gap is 42.66 MCM/year (116.9 MLD)

Demand for Water and Supply in Noyyal Basin from Bhavani River

The details of the Supply and Demand for water in the Noyyal basin to be met out from the Bhavaniriver are given in Table 7. From the table, it is found that 335.86 MLD (133.25 MCM yearly) of water supplied from the Bhavani river to the Noyyaland 253.56 MLD (92.54 MCM) demanded in the Noyyal basin. The excess water supply was 82.3 MLD (30.03 MCM).

Industrial Water Supply and Demand

The Water Resource Organization (WRO) has permitted 20 industries to draw a total quantity of 39.152 MCM (1,383 Mcft)/year. Out of 20 industries, seven industries sectors are on the upstream side of Bhavanisagar, and the remaining 13 industries sectors are downstream.

Table 6: Domestic Demand for and Supply of water in Lower Bhavani Basin for 2018-19

Sl. No.	Population	Old Ayacut	New Ayacut	Total Population	Recommend water supply** Liters per capita per day	Total million liters per day
I	Demand:					
1	Rural	1053090	972084	2025174	90	182.26
2	Urban	351738	324682	676420	110	74.40
	Total	1404829	1296765	2701594		256.66
II	Actual drawl:					
A	Coimbatore Circle					42.64
B	Erode Circle					97.12
	Total				139.76	
III	Demand-Supply Gap				-116.9	
					42.66 MCM/year	

Source: *Population statistics 2011, Assistant Director of Statistics Erode and Coimbatore; ** Tamil Nadu Water Supply and Drainage Board, Government of Tamil Nadu.

Table 7: Domestic Demand for Water in Noyyal Basin and Supply from Bhavani River for 2018-19

Sl. No	Population	Total Population	Recommend water supply** (LPCD)	Total MLD
I	Demand:			
1	Rural	1085682	90	97.71
2	Urban Population	1416822	110	139.66
	Total	2502504		253.56
II	Supply Coimbatore Circle			335.86
III	Demand-Supply Gap			+ 82.3
			30.03 MCM/year	

Source: * Population Statistics 2011, Assistant Director of Statistics, Coimbatore; ** Tamil Nadu Water Supply and Drainage Board recommendation level; **Note:** LPCD: Liters per capita per day and MLD: Million liters per day.

Table 8: Industries Permitted by the Government to Draw Water from Bhavani River

Sl. No.	Name of Industry	Quantity (M ³ / year)
1	M/s Eence Aromatics, Mettupalayam	30,405
2	M/s Indo Swiss Synthetic Gem Manufacturing CO, MTP	5,67,341
3	M/s Nanjiah Lingammal Polytechnic, Mettupalayam	16,593
4	M/s Sudarasan Paper Mills Mothepalayam, Sirumugai	5,97,213
5	M/s Sri Vishnedevi Mills Pvt. Ltd., Jedayampalayam	2,19,000
6	M/s Siruvani Textile (P) Ltd., Jedayampalayam	41,482
7	M/s Micro Tex India Limited Tiruppur	1,82,500
8	M/s South India Viscose Ltd., Sirumugai	2,15,55,060
9	M/s T T Maps Pungar Bhavani Sagar, Sathy Taluk	16,60,750
10	M/s Sam Turbo Industry Bhavani Sagar	7,30,000
11	M/s Sri Karthikega Paper and Board Limited, Rajanagar	1,83,000
12	M/s Talent Paper Board (P) Ltd., Rajanagar	14,60,000
13	M/s Bannariamman Sugars Ltd., Sathy Taluk	16,32,645
14	M/s Bannariamman Sugars (Granite Division) Sathy Taluk	7,87,991,54,750
15	M/s Bannariamman Educational Trust, Alathukombai	54,750
16	M/s KPR Mills (P) Ltd., Indiampalayam, Sathy Taluk	54,750
17	Sri Bhavani Textiles (P) Ltd., Akkaraikodivery, Erode	1,36,875
18	M/s Sathy Sugars Ltd., Appakudal, Bhavani Taluk	39,81,420
19	Tamil Nadu Newsprint & Paper Ltd., Kagithapuram, Karur	88,635
20	M/s Coimbatore Alcohol & Chemicals Ltd., Bhavani	51,76,153
	Total	3,91,52,563 (or) 39.15MCM



Three Sectors Demand and Supply of Water in Bhavani Basin

The three sectors, water Demand, and Supply, are presented in Table 9. It was seen from the details of the table that in all the sectors, water demand is more than the Supply excluding in inter-basin need of domestic water supply (82.3 MCM).

Projection of water Demand in Domestic and Industrial sector

With projections of the population to be served by the basin water, the actual requirement for the future population was worked out (the population needs 90 liters/person/day in rural areas and 110 liters/person/day in urban areas). Thus demand for water for domestic sector requirement for any time period in MCM (for the year 2011 and 2031) was calculated by the following method and presented in Table 10.

$$r_i = [(p_{2001}/p_{1991})^{1/10}] - 1$$

$$r_i = [(2025174/1746993)^{0.1}] - 1$$

$$r_i = 0.01$$

$$p_{r2011} = p_{r2001}(1 + r_i)^{10}$$

$$p_{r2011} = 17.47 \times 1.01^{10} = 20.25 \text{ lakhs};$$

Where, p_r = rural population.

It was seen from the information of the table that domestic sector demand for water based on existing supply norms projected as varied from about 66.53 MCM in 2001 to about 81.04 MCM in 2031 in rural areas. Similarly, in urban areas with the present supply norms, the projections varied from about 27.16 MCM in 2001 to approximately 33.08 MCM in 2031. The projected total demand thus ranges from 93.69 MCM in 2001 to about 114.12 MCM in 2031.

Table 9: Different Sectors Water Demand and Supply in Bhavani Basin

Sl. No.	Sectors	Demand	Supply	Gap
1	Agriculture (MCM)	3283.56	2006.97	-1276.59
2	Domestic			
	(a) Intra basin	(MLD) 256.66	139.76	-116.90
		(MCM) 93.68	51.01	-42.67
	(b) Interbasin	(MLD) 253.56	335.86	+82.3
		(MCM) 92.54	133.25	+30.03
3	Industry (MCM)	39.15	39.15	0.00

Table 10: Projection of Demand for Water in Domestic Sector

Sl.No	Population	Population (lakhs)			Growth Rate	2001 Water requirement / MCM	2011 Water requirement / MCM	2031 Water requirement / MCM
		2001	2011	2031				
1	Rural	17.47	20.25	22.35	10.1	66.53	73.42	81.04
2	Urban	5.73	6.76	7.47	10.2	27.16	29.97	33.08
	Total	23.20	27.02	29.82	10.15	93.69	103.40	114.12

Table 11: Compound Growth Rate of each Category of Industries

Sl. No.	Category of Industry	GCR	t value	Demand for water (MCM)		
				Present	2011	2031
1	Sugar (N=2)	13.30	1.73 (0.445)	5.61	6.35	7.20
2	Paper (N=6)	9.23	14.57 (0.006)	4.72	5.15	5.66
3	Rayon (N=1)	12.48	2.821 (0.041)	21.56	24.25	27.16
4	Distillery (N=2)	13.71	5.57 (0.023)	5.18	5.89	6.69



Considering industrial demand for water, the existing level as estimated based on quantities drawn by the licensed industries is about 39.15 MCM representing about 1.92 percent of the basin resources. The Water Resource Organization (WRO) has permitted 20 industries. The compound growth rate was worked out for industries sectors and is given in Table 11. It was seen from the table that rayon industries water requirement is high (24.25 MCM) in next decade followed by sugar (6.35 MCM), distillery (5.89 MCM) and Paper (5.15 MCM).

The other minor industry water requirement for the last ten years was not available. Take the average compound growth rate of significant industries and assume this compound growth rate (12.18 %) for minor industries sectors. So, the total industrial water requirement increases from the present demands of 39.15 MCM 2001-01 to 47.37 MCM in 2031. It is important to analyze why this gap between demand for and water Supply occurs among different sectors.

CONCLUSION

The urban demand will be expanding due to government priority for drinking water; it is necessary to protect the future needs. Projections of the population made at existing norms of 90 liters/person/day in rural areas and 110 liters/ person/day in urban areas. Domestic sector demand for water based on existing supply norms has varied from 66.53 MCM in 2001 to 81.04 MCM in 2021 in rural areas. Similarly, in urban areas with the present supply norms, the projections changed from about 27.16 MCM in 2001 to about 33.08 MCM in 2025. The projected total demand thus ranges from 93.69 MCM in 2001 to about 114.12 MCM in 2021. The whole industrial water requirement increase from present needs of 39.15 MCM 2001-01 to 47.37 MCM in 2021.

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