

A REVIEW :

An overview of water profile in Tamil Nadu

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SUMMARY : The total water resources available in India are 1859 km³, which is roughly 4 per cent of the world's fresh water resources. Tamil Nadu accounts for 4 per cent of the land area and 6 per cent of the population, but only 3 per cent of the water resources of the country. Most of Tamil Nadu is located in the rain shadow region of the Western Ghats and hence receives limited rainfall from the South-west monsoon. The demand for water in Tamil Nadu is increasing at a fast rate both due to increasing population and also due to larger per capita needs triggered by economic growth. The annual per capita water availability in India is about 2200 m³ whereas it is only 750 m³ in Tamil Nadu. As per World standards our State is under water scarcity. Groundwater is the most important water resource on earth. It comprises of the major and the preferred source of drinking water in rural as well as urban areas and caters to 80% of the total drinking water requirement and 50% of the agricultural requirement in rural India. The groundwater is a dynamic and replenishable natural resource, but in hard rock terrains its availability is of limited extent and is essentially confined to the fractured and weathered horizons. In Tamil Nadu, more than 70% of the geological formation is of hard rocks which limit the availability and extraction of ground water unlike other formations. Research studies by various institutions reveal that the percentage of safe blocks has declined from 35.6 per cent to 25.2 per cent while the semi-critical blocks have gone up by a similar percentage. Over-exploitation is occurring in more than a third of the blocks (35.8 %) while eight blocks (2 %) have turned saline over the past five years in Tamil Nadu. Hence adoption of groundwater resource developmental activities are compulsory to handle as well as to meet out the demand in future. And also adoption of improved technologies like micro irrigation, System of Rice Intensification (SRI) and Alternate wetting and drying can greatly reduce the water requirement which also increases the yield.

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BACKGROUND AND OBJECTIVES

Tamil Nadu is located in the Northern hemisphere between 8°05' and 13° 34' north latitude and 76° 10' to 80° 20' east longitude in south-eastern part of India. It covers an area of 1,30,058 km².

The total water available in Tamil Nadu is 35.00 BCM including surface water

(14.9 BCM) and groundwater (20.01 BCM). The total command area of the state is 2048393ha, which is divided as developed and undeveloped area. About 58 per cent is developed and the remaining 42 per cent of command area is under undeveloped category. The total canal command area in the state is 1120504.42 ha. In which, 55 per cent

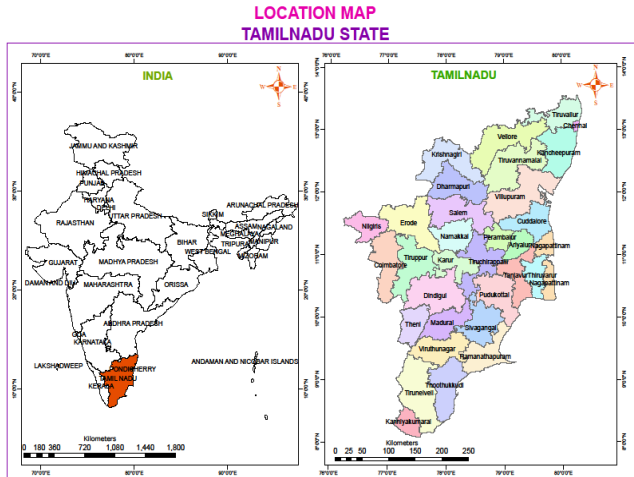


Fig. 1 : Location Map of Tamil Nadu state

of the canal command area (627186 ha) comes under the cauvery delta regions (Thanjavur, Thiruvarur, Nagapattinam, Trichy and Ariyalur). The net area irrigated by different sources during 2014-15 was 2725641 ha. The net area irrigated during 2014-15 constituted 56.56 per cent of the net area sown in the state. The gross area irrigated by all sources of irrigation is 3394295 ha with an irrigation intensity of 125 per cent. Out of the total gross irrigated area, 43 per cent of area was covered by open wells followed by canal (25 %) and tube wells (18 %). Tank irrigation was practiced in 11 per cent of area in the state.

The total area under well irrigation in Tamil Nadu is 2271480 ha. The number of over exploited blocks in the state has increased from 137 to 142 between 1998 to 2009. Sustainability of groundwater resources is the need of hour for alleviate the over exploitation of groundwater. Creation of effective water conservation measures and groundwater recharge structures in over exploited area are the one of the way to improve the groundwater situation in Tamil Nadu.

Surface water resources of Tamil Nadu

There are 17 major river basins in the State with 73 reservoirs and about 41,127 tanks. In the annual water potential of 47125 million cubic metres (MCM), surface flow account for about half. Most of the surface water has already been tapped, primarily for irrigation, which is the largest user. The various sources of irrigation in Tamil Nadu are canals, tanks, tube wells, open wells and bore wells. The number of sources of irrigation in Tamil

Nadu is furnished Table 1.

Table 1 : Number of sources of irrigation

Source	Number
1. Canals	
Govt.	2237
Private	2
Total	2239
2. Reservoirs	73
3. Tanks	41127
4. Wells	
Govt.	716
Private	1861339
Total	1862055

(Planning commission, 2005)

The state has 34 major rivers and 17 river basins. The major reservoirs, location and its capacity are given in the Table 2. Mettur reservoir has the maximum capacity of 2647 MCM followed by Bhavanisagar (929 MCM).

Rivers of Tamil Nadu :

Among the several rivers flowing through the state, Cauvery River, with 760 km of length, is the longest among all the rivers in Tamil Nadu (Fig. 2). Following are the rivers, which flow through this southernmost region of the Indian peninsula.

Bhavani river :

Fed, mostly, by the southwestern monsoon, this is one of the main tributaries of the river Cauvery.

Cheyar river :

This tributary of River Palar is a major seasonal river that flows through the district of Tiruvannamalai.

Chittar river :

The main river originates from the Courtallam Hills of the Shencottah Taluk and Tenkasi Taluk in the district of Tirunelveli. It flows through the state along with its 5 tributaries.

Ponniyar river :

Flowing across the borders in between the taluks of Villupuram and Cuddalore, it finally drains into the Bay of Bengal.

Thamirabarani river :

This river originates from the peaks named Agathimalai, AduppukkalMottai and Cherumunji Mottai in the Tirunelveli district.

Vaigai river :

While flowing towards the Palk Strait, it changes its course towards the south east near Sholavandan and passes through the town of Madurai.

Gundar river :

It mainly flows through the districts of Tirunelveli and Virudhunagar in Tamil Nadu.

Noyyal river:

This tributary of Cauvery flows through Dharapuram taluk and Palladam taluk in Erode district and Coimbatore district, respectively.

Suruli River :

This originates from the Suruli Waterfall, which is among the major tourist attractions in the Theni district.

Vaipar river :

With its origination in the bordering hills of the Kerala state, the river runs through the Virudhunagar district as well as the Theni district.



Fig. 2 : River map of Tamil Nadu

Groundwater resources of Tamil Nadu :

The dependency on ground water has increased many folds during the recent years and the ground water

Table 2 : Capacity of reservoirs in Tamil Nadu					
Sr. No.	Name of reservoir	Full reservoir depth		Capacity at F.R.L	
		meters	Feet	M.Cu.m	M.C.ft.
Irrigation reservoirs					
1.	Mettur	36.58	120	2647	93470
2.	Bhavanisagar	32.00	105	929	32800
3.	Amaravathi	33.53	110	115	4047
4.	Periyar	46.33	152	299	10570
5.	Vaigai	21.64	71	172	6091
6.	Papanasam	43.59	143	156	5500
7.	Manimuthar	35.67	118	156	5511
8.	Pechiparai	14.63	48	126	4450
9.	Perunchani	23.47	77	82	2890
10.	Krishnagiri	15.85	52	47	1666
11.	Sathanur	36.27	119	207	7321
12.	Sholaiyar	48.77	160	143	5052
13.	Parambikulam	21.95	72	380	13408
14.	Aliyar	36.58	120	109	3864
15.	Thirumurthy	18.29	60	49	1744

(CARDS, 2011)

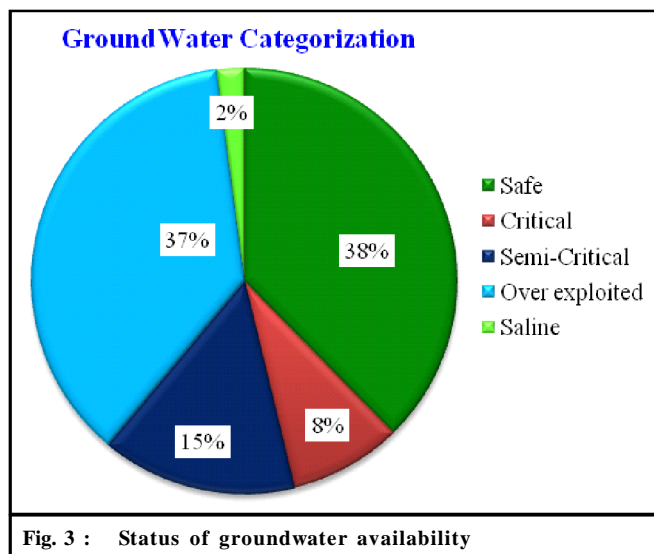
extraction for irrigation, domestic and industries have resulted in lowering of water levels, long-term water level declining trend and even drying up of wells. In order to regulate the groundwater development, Central Ground Water Board in association with State Ground Water Department has computed Dynamic Groundwater Resources and categorized blocks as Over Exploited, Critical, Semi Critical and Safe.

“Over Exploited” blocks having the level of ground water development are more than 100 per cent, with pre or post monsoon water level showing declining. The blocks where ground water resource assessment shows stage of ground water development more than 90 per

cent, but less than 100 per cent, and either pre monsoon or post monsoon ground water level shows a significant long-term decline is called “Critical”. If the level of ground water development is between 70 and 90 per cent and with pre or post water level showing declining trend has been categorized as “Semi Critical”. The level of ground water development is below 70 per cent with both pre and post monsoon water level not showing declining trends are categorized as “Safe”. A total of 385 blocks, 142 blocks have been categorized as “Over Exploited”, 33 are Critical”, 57 are “Semi Critical”, 145 are “Safe” and the remaining 8 blocks are categorized as saline (Fig. 3).

Table 3 : Status of groundwater availability- district wise (CGWB, 2009)

Sr. No	District	Over Exploited	Critical	Semi-Critical	Safe	Saline
1.	Ariyalur	0	0	0	6	0
2.	Coimbatore	10	0	0	2	0
3.	Cuddalore	2	0	3	8	0
4.	Dharmapuri	7	0	1	0	0
5.	Dindigul	11	0	2	1	0
6.	Erode	0	1	5	8	0
7.	Kancheepuram	3	1	4	5	0
8.	Kanyakumari	0	0	0	9	0
9.	Karur	4	1	1	2	0
10.	Krishnagiri	5	1	2	2	0
11.	Madurai	5	1	2	5	0
12.	Nagapattinam	4	1	0	3	3
13.	Namakkal	6	2	4	3	0
14.	Nilgiris	0	0	0	4	0
15.	Perambalur	4	0	0	0	0
16.	Pudukottai	0	0	3	10	0
17.	Ramnathapuram	0	0	0	8	3
18.	Salem	10	3	3	4	0
19.	Sivagangai	0	0	0	12	0
20.	Thanjavur	10	0	2	2	0
21.	Theni	2	6	0	0	0
22.	Tiruvallur	6	0	1	7	0
23.	Thiruvarur	3	0	1	4	2
24.	Tiruppur	2	1	6	4	0
25.	Thoothukudi	3	1	2	6	0
26.	Tirunelveli	4	2	3	10	0
27.	Tiruvannamalai	8	4	5	1	0
28.	Tiruchirappalli	9	0	2	3	0
29.	Vellore	14	3	1	2	0
30.	Villupuram	9	1	3	9	0
31.	Virudunagar	1	4	1	5	0
	Total	142	33	57	145	8



The block wise details in Tamil Nadu falling under various categories and the distribution of over – exploited, critical, semi critical and safe are given in the Table 3.

Total water availability in Tamil Nadu :

The total water available in Tamil Nadu is 35.00 BCM including surface water (14.9 BCM) and groundwater (20.01 BCM). The district wise surface water and groundwater availability is furnished below (Table 4).

Command area in Tamil Nadu:

Command area is the agriculture or cultivable area, which receives assured irrigation through canals, waters, courses and field channels up to farmer's field. The total command area of the state is 2048393 ha, which is divided as developed and undeveloped area. About 58 per cent is developed and the remaining 42 per cent of command area is under undeveloped category. The total command area is categorized into two types based on the source of irrigation *i.e.* canal command and other command areas (Tank irrigated area). The total canal command area in the state is 1120504.42 ha. In which, 55 per cent of the canal command area (627186 ha) comes under the cauvery delta regions (Thanjavur, Thiruvarur, Nagapattinam, Trichy and Ariyalur)

Area irrigated by different sources of irrigation :

The net area irrigated by different sources during 2014-15 was 2725641 ha. The net area irrigated during

2014-15 constituted 56.56 per cent of the net area sown in the state. The Gross area irrigated by all sources of irrigation is 3394295 ha with an irrigation intensity of 125 per cent. Out of the total gross irrigated area, 43 per cent of area was covered by open wells followed by canal (25 %) and tube wells (18 %). Tank irrigation was practiced in 11 per cent of area in the state (Fig. 5). The following table shows the net area irrigated by various sources during 2014-15.

Area irrigated by canals :

The gross irrigated area under canal irrigation is

Sr. No.	District	Surface water (BCM)	Groundwater (BCM)	Total availability (BCM)
1.	Ariyalur	0.22	0.05	0.27
2.	Coimbatore	0.88	0.79	1.68
3.	Cuddalore	NA	1.56	1.56
4.	Dharmapuri	0.12	0.50	0.62
5.	Dindigul	0.30	0.63	0.93
6.	Erode	2.00	0.99	2.99
7.	Kancheepuram	0.60	1.24	1.84
8.	Kanyakumari	0.54	0.26	0.80
9.	Karur	0.04	0.32	0.36
10.	Krishnagiri	0.20	0.38	0.58
11.	Madurai	1.51	0.68	2.19
12.	Namakkal	0.42	0.49	0.92
13.	Nilgiris	0.17	0.12	0.28
14.	Nagapattinam	0.02	0.18	0.21
15.	Perambalur	0.02	0.69	0.71
16.	Pudukottai	0.02	0.87	0.88
17.	Ramanathapuram	0.05	0.34	0.39
18.	Salem	0.35	0.86	1.21
19.	Sivagangai	0.64	0.81	1.45
20.	Thanjavur	1.26	0.74	1.99
21.	Thiruvarur	2.23	0.32	2.55
22.	Tiruppur*	NA	NA	NA
23.	Theni	0.09	0.44	0.53
24.	Thoothukudi	0.08	0.23	0.30
25.	Tiruchirappalli	1.16	0.71	1.87
26.	Tirunelveli	0.28	0.90	1.18
27.	Tiruvallur	0.28	1.11	1.39
28.	Tiruvannamalai	0.48	0.74	1.21
29.	Vellore	0.07	0.98	1.06
30.	Villupuram	0.67	1.70	2.37
31.	Virudunagar	0.21	0.47	0.68
	Total	14.90	20.11	35.00

(* data not available)

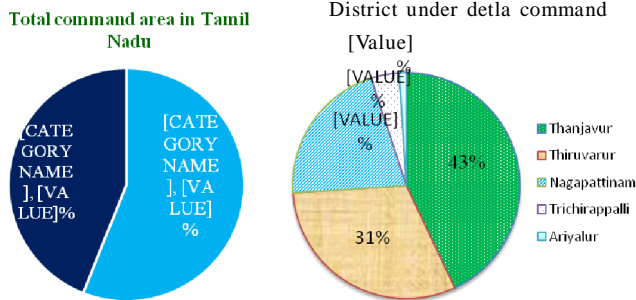


Fig. 4: Total command and delta command area in Tamil Nadu

851158 ha with an irrigation intensity of 127 per cent. About, 24.5 per cent of the irrigation is done by canal water in the state. In canal command areas paddy is the major crop followed by pulses. The Cauvery delta regions viz., Tiruvarur, Thanjavur and Nagapattinam districts consists of maximum canal irrigated areas in the state (545317 ha) but 255686.33 ha of canal command area is still under undeveloped condition. The district viz., Sivangagai, Erode, Madurai, Vellore, Villupuram district has more area of undeveloped canal command.

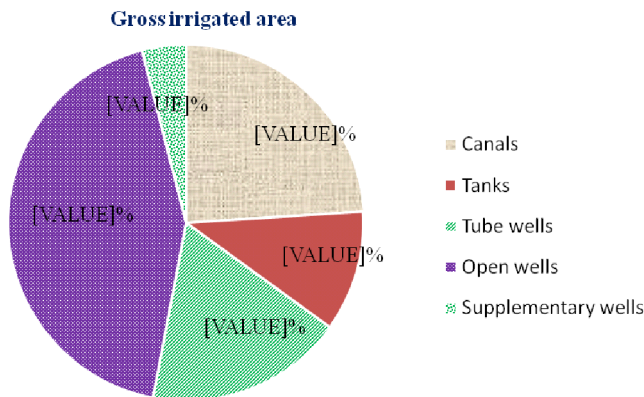


Fig. 5 : Gross irrigated area under sources of irrigation

Area irrigated by Tanks :

The area under tank irrigation is 398359 ha which 11per cent of the total irrigation by sources in Tamil Nadu. Sivangagai, Ramanathapuram and Kancheepuram districts followed tank irrigation and the remaining districts utilized both surface and groundwater simultaneously. In Sivangagai district, the total developed area under tank irrigation is 14237 ha. But the undeveloped area which has the possibility of getting irrigation through tank command (117154 ha). The same criteria is seen in Tiruvannamalai, Tirunelveli, Kancheepuram and many other districts.

Area irrigated by wells (Open and Tube wells) :

Nearly 61per cent of area is irrigated through groundwater resources in Tamil Nadu. Dug well is the predominant sources of groundwater irrigation. Ground water potential is high in Villupuram district, where major irrigated area is (248099 ha) used groundwater. The Cuddalore district has more tube wells for irrigation (135405 ha).

Number of irrigation sources :

The total number of canals , tanks and wells in Tamil Nadu are 2239, 41948 and 1862055, respectively (Fig. 6). The numbers of canals were high in Vellore district (604) where the total canal command area is 13748.45 ha. Vellore district lies in Palar river basin and the entire command is undeveloped. Hence implementing the command area development will add additional area for irrigated cropping.

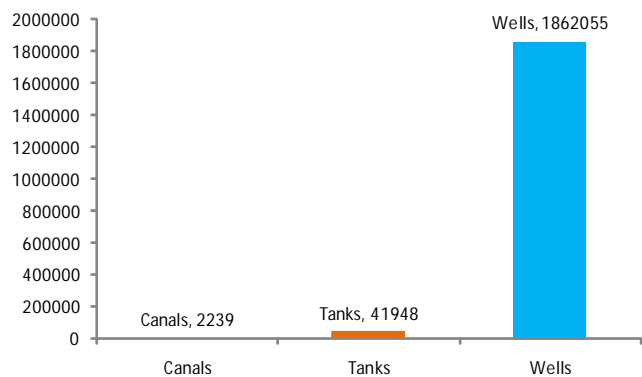


Fig. 6 : Number of irrigation sources in Tami Nadu

Pudukottai district consists of more tanks (5451 Nos.) followed by Sivagangai (4966 Nos) and Dindigul (3104 Nos). The major irrigation sources in these districts are tank irrigation. Sivagangai has highest area of tank command in the state (54745 ha) followed by Pudukottai (50900 ha).

River basin wise water potential :

The river basins in Tamil Nadu are grouped into 17 major river basins as furnished in Table 5. The river basin wise total water potential and its drainage area were given in the following table.

Drainage area :

The Cauvery River has a highest drainage area of 44016 km² out of the 17 river basins in Tamil Nadu. The

total length of the river from the origin to its outfall into the sea is 800 km of which 320 km is in Karnataka, 416 km in Tamil Nadu and 64 km in Pondicherry. The Cauvery basin is leaf shaped in Tamil Nadu. The run-off does not drain off quickly because of its shape and therefore no fast raising floods occur in the basin. The basin in Tamil Nadu receives good flows from the North-East Monsoon.

Distributaries of cauvery delta :

There are mainly 7 distributaries from the river Cauvery in delta region that contribute the flow for the Karaikal area which are as follows:

1. Nandalar, 2. Nattar, 3. Vanjiyar, 4. Noolar, 5. Arasalar, 6. Thirumalairajanarand 7. Puravadaiyanar

All the distributaries in the region are non-perennial

Table 5 : Area under major river basin

Sr. No	Name of the major river basin group	Drainage area in Tamil Nadu km ²	Normal annual rainfall (mm)	Normal rain volume (Km ³)	System tanks	Non system tanks
1.	Chennai Basin Group	5542	1130	6.26	1304	215
2.	Palar	10674	940	10.03	661	
3.	Varahanadhi	3637	1250	4.55	131	1290
4.	Ponnaiyar	12141	920	11.17	1133	
5.	Vellar	8558	980		386	71
6.	Paravanar	760		8.39	2	9
7.	Cauvery	44016	930	45.32		
8.	Agniyar	4463	910	4.06	346	3629
9.	Pambar and Kottakaraiyar	5302	880	3.07	160	1161
10.	Vaigai	7741	900	6.97	521	976
11.	Gundar	4838	770	3.73	526	123
12.	Vaippar	6255	800	5	151	711
13.	Kallar	1739	600	1.04	15	184
14.	Tamirabarani	5482	1110	6.09		1300
15.	Nambiyar	1561	950	1.48	559	38
16.	Kodaiyar	1533	1720	2.64	2	1460
17.	PAP	2174	610	1.33		

Table 6 : Water potential of major river basin

Sr. No.	Name of the Major River Basin Group	Surface water potential	Groundwater potential	Other sources	Total water potential
1.	Chennai Basin Group	906	1120.22		2026.22
2.	Palar	1758	2610.32		4368.32
3.	Varahanadhi	412.09	1482.07	4	1898.16
4.	Ponnaiyaar	1310.43	1560		2870.43
5.	Vellar	1065	1344	6	2415
6.	Paravanar	104.3	225.5	39.7	370
7.	Cauvery	5962	2869		8831
8.	Agniyar	585	920	499	2004
9.	Pambar and Kottakaraiyar	653	976		1629
10.	Vaigai	1579	993		2572
11.	Gundar	567.52	766		1334
12.	Vaippar	611	1167	4.82	1782.82
13.	Kallar	124.56	69.58	17.37	211.51
14.	Tamirabarani	1375	744		2119
15.	Nambiyar	203.87	274.74		478.61
16.	Kodaiyar	925	342.1		1267.1
17.	PAP	416	751.001		1167

(CARD, 2011)

and flow is mainly due to Cauvery release during June to January. No considerable flow occurs due to south west monsoon. For most of the months in the year, the flows available are the releases/regulated flows from upper regulators maintained by Tamil Nadu. Central Water Commission has set up Hydrological Observation stations on all these distributaries and Gauge and Discharge observations are being taken regularly (Source: India-WRIS).

The river basins like Ponnaiyar (12141km²) and Palar (10674km²) has drainage area of more than 10,000 km². The more number of system tanks were found in Chennai basin (1304), which is mainly used for drinking water purpose (Table 5). The numbers of non system tanks were high in Agniyar river basin (3629). The district falls under Agniyar river basin area is Pudukottai where the main source of irrigation in tank.

Total water availability-river basin wise in Tamil Nadu :

The highest water potential were recorded in the Cauvery river basin (8831 MCM) followed by Palar river basin (4368 MCM). Here, the groundwater potential is high while comparing with surface water potential. Vellore, Tiruvannamalai and Kancheepuram districts were covered under Palar river basin and these district higher groundwater potential than surface water potential. The surface water potential is higher in Cauvery river basin where there is no system or non-systems tanks (Table 6).

Status of water resources in Tamil Nadu :

Surface water

The overall efficiency in surface irrigation like canals and tanks is only 40 per cent (when compared to 75 % in Israel) whereas in well irrigation it is 70 percent. Researchers opine that this level of overall efficiency can be increased to 50 to 60 per cent in surface irrigation and to 85 per cent in well irrigation. If the overall efficiency were increased in phases from 40 per cent to 50 per cent and 60 percent, this would annually save about 3,000 MCM for every 10 per cent increase in efficiency. Many major reservoirs in Tamil Nadu are filled up with

sediments and polluted. In Bhavanisagar and Vaigai reservoirs the rate of sedimentation is 0.246 and 0.1989 (Th.Cu.m/sq.km/yr) during the period of 1986-1996. The actual storage capacity of reservoirs in Tamil Nadu was also reduced due to silt deposition. Desilting and canal rehabilitation in the command area will make a way for increase in storage as well as reduction of seepage losses through canal. Modernization of irrigation system like canal automation will reduce the water losses and increase the distribution efficiency. Hence, the excess water will use to feed up the remaining undeveloped command area of the state.

In total command area of 2048393 ha in Tamil Nadu, 855724 ha is still under undeveloped condition. Vellore is the main district, which has 604 canals, but entire command area is under undeveloped category. Additional storage structures should be created in order to conserve the rainfall and excess runoff from the upstream. Hence, creating irrigation potential, additional storage structures and regulating the water distribution will give a way for changing the undeveloped into developed command area.

The command area development works include execution of on farm development works and regulation of water resulting in considerable saving of water for successfully raising the crops. The improvement in application efficiency of water does not affect economy in water use but else serves improving the crop production. The water saved there from, can be fed to additional area for irrigated cropping. Dependability of water supply has played an equitable distribution of water amounting the farmers to play a prominent part in the system of operation in eliminating and reducing the time.

Groundwater :

About 61per cent of irrigated area is depending on groundwater for irrigation. The total area under well irrigation in Tamil Nadu is 2271480 ha. The number of over exploited blocks in the state has increased from 137 to 142 between 1998 to 2009 (Table 7).

It indicates that, there is a wide gap between groundwater draft and recharge. To alleviate these problems and to sustain the groundwater resources, watershed development activities should be implemented

Table 7 : Status of groundwater development during 1998 and 2009

Assessment year	Over Exploited	Critical	Semi-Critical	Safe	Saline	Total
1998	137	70	35	135	8	385
2009	142	33	57	145	8	385

in the ground water intensive districts.

Water budget :

Watersupply at present in Tamil Nadu is 35.00 BCM and water demand for all sectors is around 61.26 BCM and it would be increased upto 70.83 BCM by 2023. As for as water gap for all sectors at present it is 26.26 BCM and 35.83 BCM for 2023.

Conclusion :

To sustain the water resources, adoption of groundwater resource developmental activities like creation of effective water conservation measures, groundwater recharge structures in over exploited area, artificial recharge structures, desilting of existing tanks, new storage tanks, construction of new field channels are compulsory to handle as well as to meet out the demand in future. And also implementation of existing schemes and earnest extension activities are important. With respect to crop production, implementation of improved technologies like micro irrigation, System of Rice Intensification (SRI) and Alternate wetting and drying (AWD) can greatly reduce the water requirement which also increases the yield.

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