

Pambar and Kottakaraiyar Basin

Introduction

There are 34 river basins in Tamilnadu including one west flowing river. The 34 river basins are grouped into 17 major river basins. Pambar and Kottakaraiyar river basin is one among them. The water demand for domestic, irrigation, industries, livestock, power generation and other uses is governed by socio-economic and agricultural factors, including the present and future population size, income level, urbanization, market facilities, remunerative prices, cropping patterns, etc. An analysis of the water balance, water utilisation and allocation plan for different competing water users form the core of a river basin plan.

Water resources planning which is people oriented and resource based requires extensive data on Rainfall, Geology, Soil, Geomorphology, Hydrogeology, Hydrology, Climatology, Water quality, Environment, Socio-economic, Health, Agricultural, Population, Livestock, Industries, etc. Data availability on the above accounts is discussed below:

Location and extent of Pambar and Kottakaraiyar Basin

Pambar and Kottakaraiyar basin is one among the 17 river basin of Tamilnadu. It is located in the South Central Portion of Tamilnadu. In the northwestern portion of the study area is covered by discontinuous hillocks of Eastern Ghats mountain ranges. They are 'relict' mountains. The important hillocks are Alagar hills (829m), Karandamalai (913m), Ayyalur hills (9578m), Sirumalai hills (eastern part only) (835m) and Kodangikkuttu hills (642m). The remaining part of the basin area is gently slopping topography. The study area is slopping towards south east direction.

This is an elongated basin in the East-West direction. The basin area is bounded north by Agniyar basin, northwest by Cauvery basin, south by Vaigai basin and east by Palk Bay. The basin is located in the geographical co-ordinates of $9^{\circ} 30' 00''$ N to $10^{\circ} 25' 00''$ N Latitudes and $78^{\circ} 10' 00''$ E to $79^{\circ} 00' 00''$ E longitudes and an aerial extent of 5910.87 km.

The index map of the Pambar and Kottakaraiyar River Basin is shown in Fig.1.

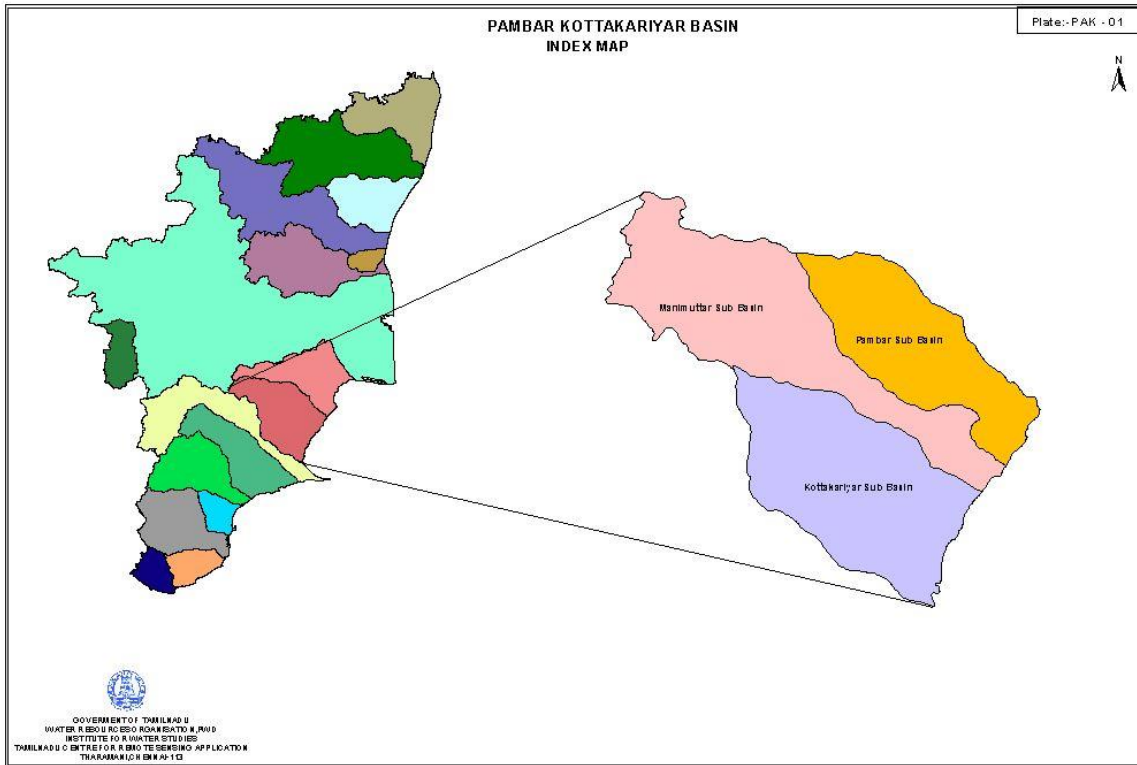


Fig 1. Index map of Pambar and Kottakaraiyar Basin

The basin area spread over six districts and major portion is covered by Sivagangai district. Nearly 50% of the basin area occupied by Sivagangai District. The other districts are Ramanathapuram, Pudukottai, Dindigul, Madurai and Trichy.

The administrative setup of the Pambar and Kottakaraiyar basin is given in Table 1 and the administrative map is shown in Fig.2.

Table 1 – Administrative setup of Pambar and Kottakaraiyar basin

Sl.No	District	Taluk	Blocks	Area in sq.km
1	Sivagangai	1.Sivagangai	1.Sivagangai	213.291
			2.Kalayarkoil	590.880
		2.Manamadurai	3.Manamadurai	28.565
			3.Ilyankudi	4.Ilyankudi
		4.Devakottai	5.Devakottai	273.776
			6.Kannankudi	188.771
		5.Karaikudi	7.Sakkotai	350.838
		6.Thiruppathur	8. Thiruppathur	355.988
			9.Singampunari	228.252
			10.S.Pudur (Semmanthattipudur)	103.777

			11.Kallal	393.035
2.	Ramanathapuram	7.Ramanathapuram	12.Ramanathapuram	55.247
		8.Thiruvadanai	13. Thiruvadanai	448.008
			14. R.S. Mangalam	520.926
		9.Paramakudi	15.Nainarkoil	89.272
3	Dindigul	10.Dindigul	16.Sanarpatti	40.079
		11.Natham	17.Natham	483.302
		12.Vedasendur	18.Vadamadurai	12.413
4	Pudukottai	13.Thirumayam	19.Thirumayam	222.728
			20.Ponamaravathy	130.294
			21.Arimalam	160.333
		14.Aranthangi	22.Aranthangi	14.508
		15.Avudaiyarkoil	23.Avudayarkoil	311.179
		16.Manamelkudi	24.Manamelkudi	22.035
5	Madurai	17.Melur	25.Melur	72.093
			26.Kottampatti	281.344
6	Trichy	18.Manapparai	27.Marungapuri	46.247
TOTAL AREA				5910.877



Fig.2 Administrative map of Pambar and Kottakaraiyar basin
The base map of Pambar and Kottakaraiyar basin is shown in Fig.3.

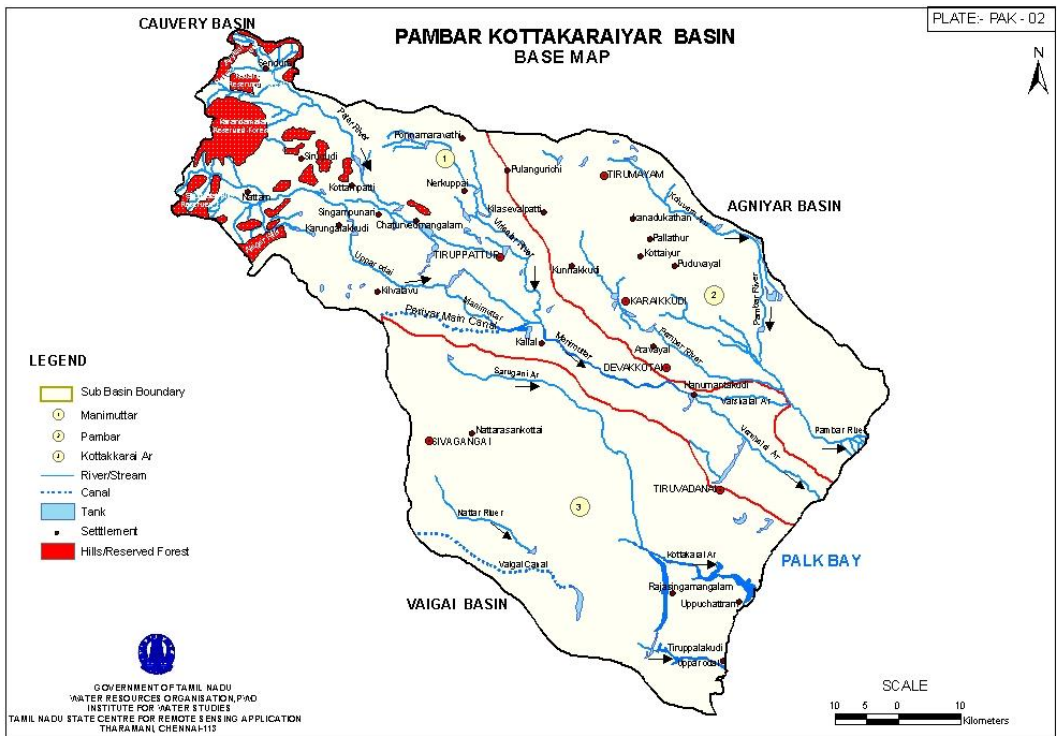


Fig.3 Base map of Pambar and Kottakaraiyar Basin

Mostly the hills and reserved forest are located at the North western boundary of this basin. Rest of the area is generally plain. Most of the rivers are originating from North Western part of the basin and drains towards Northeast.

A tributary of Varshali river merges with this river at Mekkavayal. It attains the name of Koluvanaru near Valanoor and after travelling a long distance it falls into Palk Bay at Mimisal. A tributary called Palar originates and drains through Kodangikuthur, Karandamalai, Southern flank of Mudimalai Reserved forest, Northwestern flank of Motaimalai Reserved forest located at the Western part of this basin, it is called as Manimuthar and after feeding all the tanks through its way, it passes through North of Kallal and Devakottai and finally it confluent with Palk Bay at Sundara pandiyanpattnam.

The stream Kottakaraiyar is a wide and rapid stream formed by the junction of two rivulets 'Natharu' and 'Saruganiyar'. Natharu drains through the high lands of Nattarasankottai, Kalayarkoil, Manamadurai and Ilayankudi. The river Saruganiyar appears to have its origin near Pungudi and then part of Paganeri acquires the name of Manimuthar. The two rivulets join at Rajakamangalam Tank, Sarugani river at Sarugani. The surplus course of this tank takes the name of Kottakaraiyar, which falls into Palk Bay near Tondi.

Geology with lineament map of Pambar and Kottakaraiyar basin is shown in Fig.4.

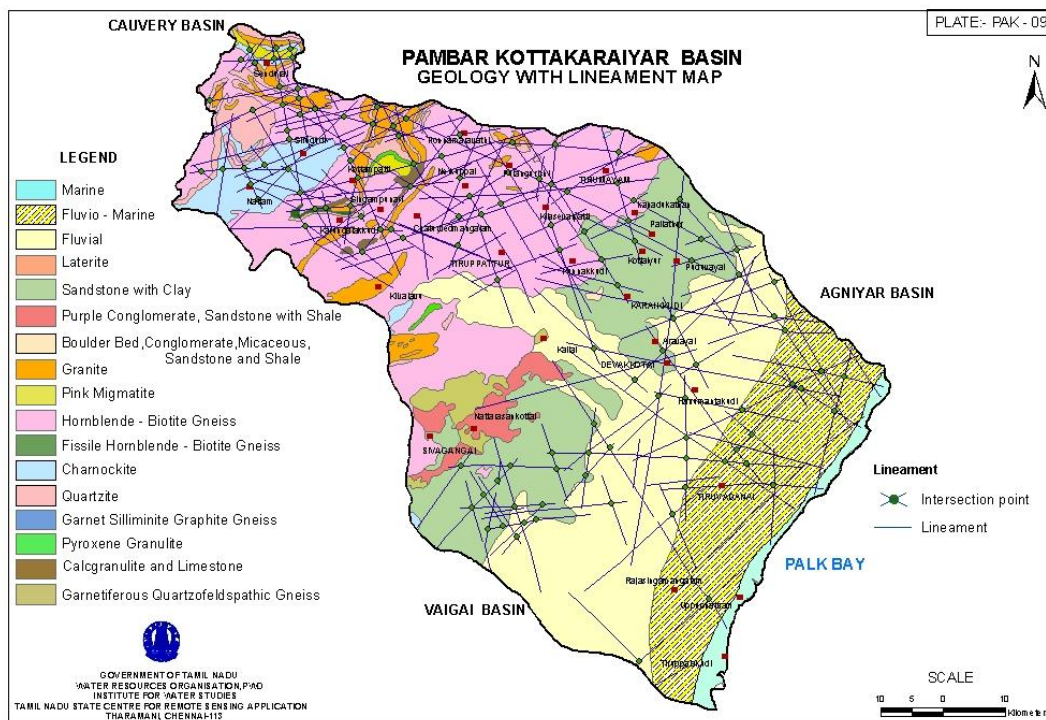


Fig.4 Geology with lineament map of Pambar and Kottakaraiyar basin

Geologically the study comprised of Archaean complex suit of rocks on the north and northwest and overlain by Upper Gondwana, Tertiary and Recent to sub recent formations on the east. Overlying the Archaean, Upper Gondwana formation known as 'Sivaganga beds' of Upper Jurassic age crop out east of 'Sivaganga Town'. The formation consists of sand stones, grits and variegated shales. Recent to sub recent formations are represented by Alluvium, Laterite and soils. Laterite occurs in parts of Sivaganga, Thirupathur, Karaikudi & Devakottai areas. Alluvium is developed along the river courses and the thickness ranges between 6m and 40 m.

The depth to bedrock is grouped into three general categories viz. 1. depth to bedrock at shallow depth (15-41 m bgl), 2. at intermediate depth (41-70 m bgl) and 3. at deeper depth (70-750 m bgl) with the increase of depth from west to east comprising of weathered rock aquifer in the west, fractured rock aquifer in the central and sedimentary region in the east. Generally the depth to bottom of aquifer (depth to bedrock) of this basin extends to deeper depth, however augmenting groundwater is possible in the region where dewatering or over exploitation is not a concern. The depth to bedrock map of Pambar and Kottakaraiyar Basin is shown in Fig.5.

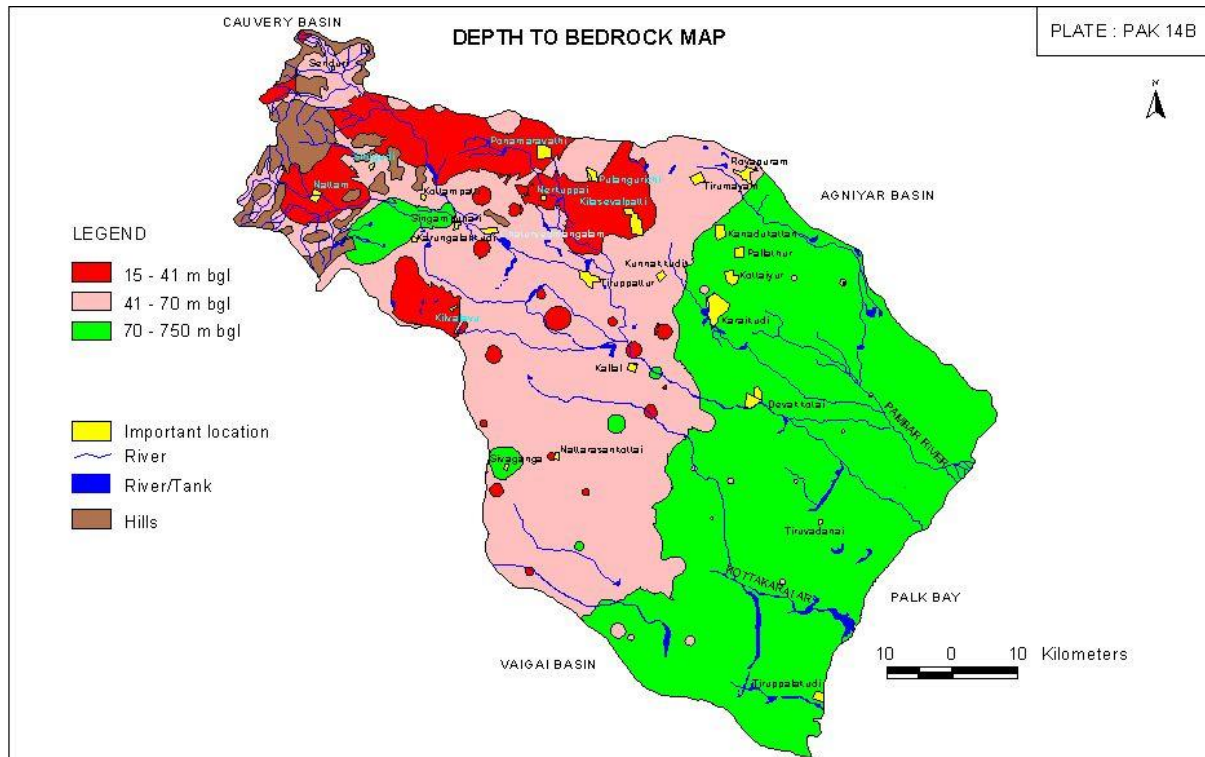


Fig.5 Depth to Bedrock map of Pambar and Kottakaraiyar Basin

The land use map of Pambar and Kottakaraiyar Basin is given in Fig.6 and the land use and the land cover category is given in Table 2.

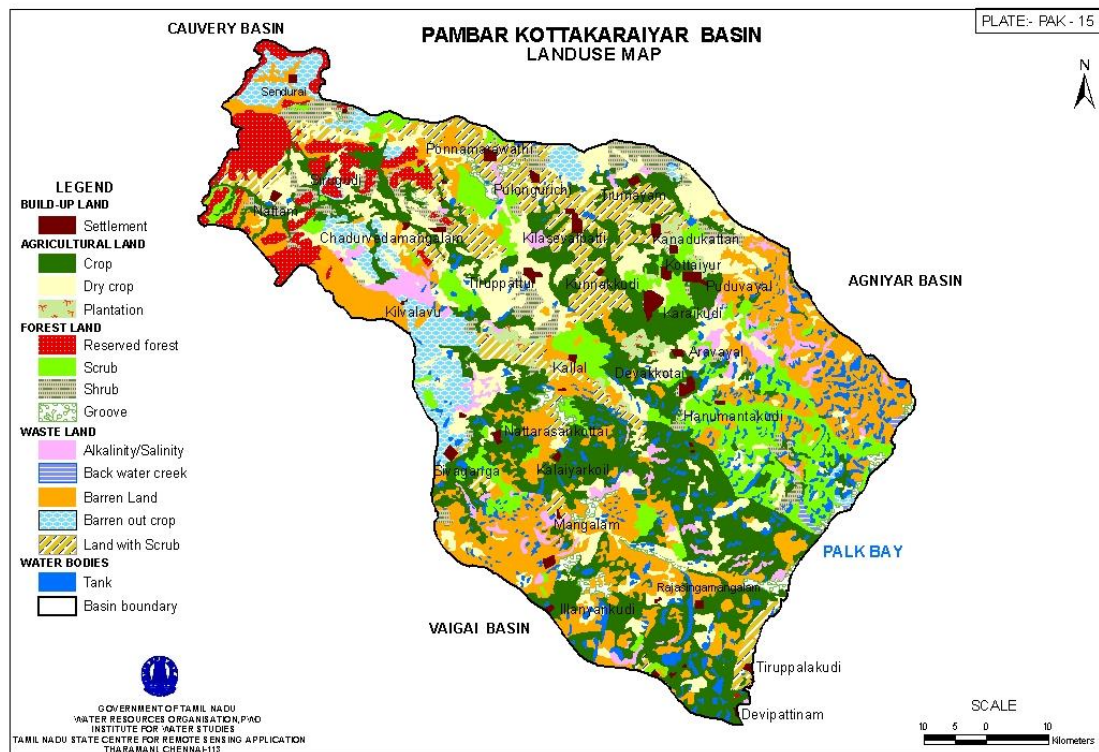


Fig.6 Landuse map of Pambar and Kottakaraiyar basin
Table 2- Aerial extent of various land use categories

Features	Area in Sq.km	Percentage (%)
Settlement	72.75	1.23
Crop land	1572.49	26.60
Dry crop	753.16	12.74
Plantation	71.82	1.21
Reserved forest	196.61	3.33
Scrub	578.56	9.79
Shrub	303.08	5.13
Groove	102.02	1.73
Alkalinity/Salinity	172.33	2.91
Back water creek	7.55	0.13
Barren land	1122.97	18.99
Barren out crop	244.75	4.14
Land with crop	530.91	8.98
Tank	183.01	3.10

Total	5912.00	100.00
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The soil map shown in Fig.7 gives the details about the types of soil spread in the Pambar and Kottakaraiyar basin.

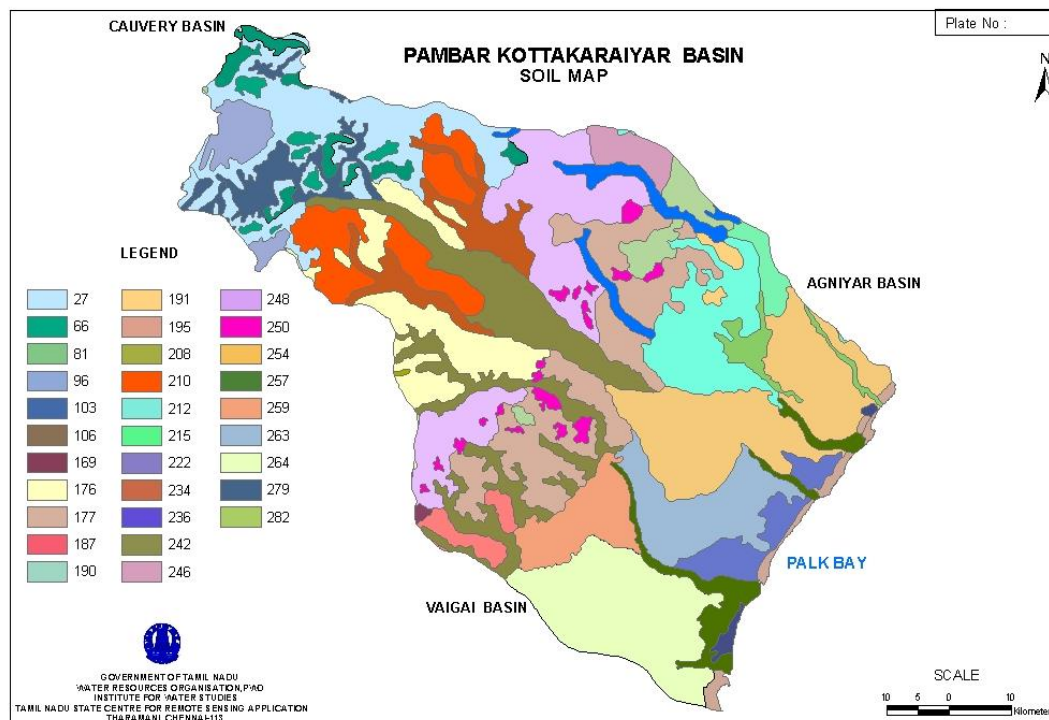


Fig.7 Soil map of Pambar and Kottakaraiyar basin

Demographic Details

The sub basin wise population of Pambar and Kottakaraiyar basin is given in Table- 3

Table- 3 Sub Basin wise Urban and Rural Population as per census 2001 (in Million)

Sl. No.	Name of the Sub basin	Urban Population	Rural Population	Total Population
1	Pambar	0.097	0.342	0.439
2	Manimuthar	0.308	0.517	0.825
3	Kottakaraiyar	0.168	0.438	0.606
TOTAL		0.573	1.297	1.870

Industrial Employment and Water Utilization

There are about 34 large and medium industries and about 12377 small scale industries available in this basin at present.

There are 16 rain gauge stations having long term records in and around the basin are considered for the detailed analysis. These rain gauge stations are maintained by Public Works Department, Revenue department, IMD and Salt department. Climate data for analysis are taken from Parthibanur maintained by PWD (GW).

The annual dependable rainfall recorded in 16 raingauge stations of Pambar and Kottakaraiyar basin is given in Table- 4.

Table 4- Annual Dependable Rainfall

Sl. No.	Sub basin	25%	50%	75%	90%
1	Pambar	326.96	254.72	214.27	151.79
2	Manimuthar	397.88	337.29	275.44	191.20
3	Kottakaraiyar	424.71	338.31	271.13	212.79

Climate

The climatological values of this river basin at Raya Raghunatha Samudiram and Kundrakudi are given in Table- 5

Table-5 Climatological Parameters

S. No	Climatological Parameter	Raya Raghunatha Samudiram	Kundrakudi
1	Average monthly temperature Maximum. in. ⁰ Celsius	35.12	34.47
2	Average monthly temperature Minimum. in. ⁰ Celsius	26.20	20.83
3	Average mean temperature in ⁰ Celsius	30.66	27.65
4	Average relative humidity in %	70.80	70.86
5	Average wind velocity in km/hour	4.56	3.21
6	Average Sunshine hours / day	6.70	6.18
7	Pan Evaporation in mm	149.30	197.53

The monthly average ETo in mm for Parthibanur station is estimated using Penman Montieth Method. The estimated ETo values for the station from 1993 to 2004 are given in Table- 6.

Table- 6 Monthly average ETO in mm from 1993 to 2004

MONTH	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
AVERAGE (Daily)	4.23	5.23	5.98	5.94	5.79	5.78	5.49	5.65	5.50	4.32	3.63	3.69
ETO (Monthly)	131.26	146.51	185.40	178.30	179.46	173.44	170.32	175.28	165.09	133.81	108.96	114.27

River System

This basin is drained by two main Rivers namely Pambar and Kottakaraiyar. Manimuthar is a tributary of Pambar. The entire basin is divided into three sub basins. They are Pambar sub basin, Manimuthar sub basin and Kottakaraiyar sub basin.

PAMBAR SUB BASIN

Pambar

Ponpethiar is the tributary of Pambar. Koluvan Ar and Papan Ar are two individual rivers in Pambar sub basin. Pambar originates at the surplus of Thamarai kanmoi tank in Thirumayam taluk. Thamarai Kanmoi group is a group of 137 tanks.. The last tank, the Thamarai Kanmoi, of the group is situated in Thirumayam taluk and the surplus course of this tank is the origin of the Pambar River. Pambar then feeds Mudukkuvayal periya kanmoi. At the 40th Km point of Pambar river, Irumbanadu dividing dam is located. The left arm from this dam is called Ponpethiar. The right arm is the Pambar river and it falls into Irumbanadu big tank in Avudayarkoil taluk. Again this river takes its course from the right side surplus of Irumbanadu big tank and passes through Sananvayal. Then at the 50th Km point of Pambar river, the tributary, Kottakudiar joins with it. Pambar then passes through Pulangudi, Tevarendal and Iluppakkudi villages. At 1 Km south east of Iluppakkudi, at the 55th Km point of Pambar, its tributary, Thenar joins with it. At the 58th Km point of Pambar, its tributary, Manimuthar joins with it. Then Pambar passes through Tirukalyanapuram, Mudukkuvayal, Pullangakottai, Thiruppunavasal and Sundarapandianpattanam. It confluences with Palk bay in between Puttukkidapatnam and Sundarapandianpattanam. There are ten anicuts in the River Pambar with 16 supply channels and feeds an ayacut of 3250.75 hectares. In addition, there are 9 open off takes for feeding the tanks. There are many non-system tanks in the basin which are all rain fed.

Kottakudiar

The surplus of Sakkaivayal big tank is the origin of Kottakudiar and from this origin point it forms into a regular river course. It passes through Nenmeni, Kalathur, Pappakudi and Perunganur and finally confluences with Pambar at 1Km east of Valaiyanvayal village ie., at a point 400m upstream of Kalabam Anicut. There are no anicuts across this river. However there are two open off takes and one bed dam in the river for feeding 22 tanks. The command area is 686.80 Ha. The total length of Kottakudiar is 24Km.

Thenar

. The total length of Thenar is 31.7 Km. There are 3 Anicuts and 19 Open off-takes having 63 tanks feeding the ayacut of 3639.85 Ha in Sivagangai and Pudukottai Districts.

Ponpethiar

At the 40th Km point of Pambar river, Irumbanadu dividing dam is located. The left arm from this dam is the origin of Ponpethiar and empties into Bay of Bengal. There is only one anicut in Ponpethiar and 15 open off-takes feeding 19 non-system tanks and 2 nos of rainfed tanks. The area irrigated by Ponpethiar is 1474.32 Ha.

Koluvan Ar

Koluvan Ar originates from the surplus of Kamalakkudi tank in Avudaiyarkoil taluk of Pudukkottai district. traverses a distance of 23 Km and finally confluences with Palk bay at Mimisal. There are 4 Anicuts, one Open Off-take and 27 Nos of tanks having a command area of 2183.98 Ha.

MANIMUTHAR SUB BASIN

Thirumanimuthar

Thirumanimuthar originates near Malaipatti village at an altitude of 500m above MSL. At about 1Km north of Vengaippatti, one arm separates from Thirumanimuthar and

joins with Palar near Singampunari. The length of Thirumanimuthar from the point of origin to this confluence point is 29 Km. It has 3 Anicuts and these anicuts feed six tanks. The other arm of Thirumanimuthar falls into Kadampatti tank. The surplus of the tank is called as Uppar odai and it traverses through Nagappanpatti, Pappakkudipatti and Nainapatti and at this point it divides into two arms. One arm of uppar odai joins with Nattarmangalam big tank and the other arm joins with Eriyur tank. The surplus of the Eriyur tank originates as Manimuthar, which is one of the major tributaries of Pambar.

Palar

The Palar is a tributary of Virusuliar... The total length of Palar from its origin to its infall point into Tiruppathur Big tank is 54Km. The surplus of this tank joins with Virusuliar at 1 Km east of Manampatti. Manniya Kanmoi anicut has been constructed in this surplus course. The ayacut fed by this anicut through Manniya kanmoi tank is 62.97 Ha. The river Palar has 13 anicuts. These anicuts feed a total of 140 tanks. Thirumanimuthar joins Palar at an intermediate point i.e., near Singampunari, located at the 34th Km point of Palar.

Virusuliar

The surplus of this Vaduganendal tank near Nerkuppai is the origin of Virusuliar. Virusuliar passes through Nemminippatti, Magipalanpatti, Paiyur, Kandavurayanpatti, Ukkalattanpatti, Valaiapatti and Kandaramanickam and confluences with Manimuthar at 1Km west of Kil Avandipatti village. Virusuliar has 10 anicuts, feeding 32 tanks and having an ayacut of 1763.10 Ha. The total length of Virusuliar from its point of origin to the point where it joins with Manimuthar is 39 Km.

Manimuthar

Sunnambu Iruppar, Virusuliar and Kooraiyar are the tributaries of Manimuthar. Manimuthar has its origin from Eriyur tank.. At 1Km west of KilAvandipatti, Virusuliar joins with Manimuthar and this point is above Poyyalur anicut. upstream of Devakottai. From this point to Hanumanthakudi, the river Manimuthar is called Devakottai Ar because it passes through Devakottai town. Manimuthar has 10 anicuts, feeding 94 tanks having a total ayacut area of 4795.79 Ha. Hanumanthakudi anicut commands two channels one on either side. In the right side supply channel, (called Tiruppakkottai surplus course or branch of Manimuthar river) two anicuts have been constructed. They are Kunjankulam anicut feeding an ayacut of 152.57 ha and Nagarikattan-Akkalur Anicut feeding an ayacut of 231.51 ha. From Hanumanthakudi, the river Manimuthar divides into two arms. The left arm passes through Kirani, Manikkankottai, Kidangur and Mekkavayal and finally joins with Pambar. The total length of Manimuthar river from Eriyur tank to its confluence point with Pambar near Mekkavayal village is 65 Km. The Right arm called as Varshalei Ar passes through Odaiyakkankudi, Pirandanvayal, Samburani, Gangavilasam, Sirunallur, Mallanur, Karuttappattai and finally it confluences with Palk bay at Narendal village.

Sunnambu Iruppar

This river after traversing for a length of 14.5 Km from its point of origin, joins with Manimuthar near Kandaramanickam village. Pannai- Thiruppi anicut has been constructed across this river to feed Pannai Thiruppi Tank and Mangandiendal tank having a total ayacut of 88.27 ha.

KOTTAKARAIYAR SUB BASIN

Nattarkal river, Suriyankottaiyar, Nattar, Saruganiar, Kottakaraiyar and Uppar river are the main rivers of Kottakaraiyar sub basin.

Nattarkal

The length of Nattarkal river is 16 Km and the number of tanks benefited is 11, having an ayacut of 649.18Ha.

Nattar

There are 4 anicuts in this river and the total number of tanks benefited by this river is 17 having an ayacut area of 688.04 Ha.

Saruganiar

There are 11 anicuts feeding 126 tanks having a command area of 7810.65 hectares.

Kottakaraiyar

The length of Kottakaraiyar is about 35 Km and feeding an ayacut of 686.80 ha.

Surface water data

There are a total of 7602 tanks situated in the basin. There are no reservoirs in the basin. But anicuts and supply channels divert water from tributaries and rivers to the command areas.

The last anicut across Pambar is Thiruppunavasal anicut. The flow details of the anicut are available only from the year 1992. From 1992, there has been surplus flow in the river only during five occasions of which 1998 is high with 8.34Mcum. The last anicut across Kottakaraiyar is R.S. Mangalam anicut. The flow details of the anicut are available only from the year 1992. From 1992, there has been surplus flow in the river only during four occasions of which this sub basin has been highly affected by flood in the year 2005.

Surface water potential

Monthly Runoff Simulation (MRS) Model assesses the surface water potential for 75% dependable yield for southwest, northeast and non-monsoon periods. The following influential rainfall stations having long-term records are considered for analysis.

Raingauge stations considered for analysis

S. No.	Name of subbasins	Subbasin area (sq.km.)	Raingauge stations
1	Pambar	1467.946	Thirumayam, Karaikudi, Aranthangi, Thirhandathanam
2	Manimuthar	2316.475	Pulipatti, Thaniyamangalam , Thirupathur, Vattanam, Natham
3	Kottakaraiyar	2126.392	Sivagangai, Manamadurai, Paramakudi, Ramanathapuram, Thiruvadana, Thondi, Ilayankudi
Total		5910.813	

The surface water potential at 75% dependable rainfall is worked out by Monthly Run Off Simulation (MRS) Method and is presented in Table- 7.

Table-7 :75% Dependable Surface Water Potential for Pambar & Kottakaraiyar River Basin

Sl. No.	Name of Sub basin	75% Dependable Surface Water Potential in Mcum			
		SW	NE	NM	Annual
1.	Pambar	114.90	66.93	32.44	214.27
2.	Manimuthar	93.72	137.28	44.44	275.44
3.	Kottakaraiyar	35.81	219.27	16.06	271.13
Total		244.43	423.48	92.94	760.84
South West Monsoon Potential		244.43 (or) 244 Mcum			
North East Monsoon Potential		423.48 (or) 424 Mcum			
Non Monsoon Potential		92.94 (or) 93 Mcum			
Annual Potential		760.84 (or) 761 Mcum			

Surface Water Potential of Pambar & Kottakaraiyar River Basin is 761 Mcum.

The Existing Surface Water Supply System

There is no reservoir in this basin. The surface water is drawn for usage from Tanks. This basin has more number of tanks of about 7602. The sub basin wise anicuts across Pambar and Kottakaraiyar River basin is given in Table-8.

TABLE-8: SUB BASIN WISE ANICUTS ACROSS PAMBAR AND KOTTAKARAIYAR RIVER BASIN

Sl. No.	Name of the Sub basin	Main rivers of the sub basin	No. of Anicuts	No. of tanks	Total ayacut (ha)
1	Pambar	Pambar	11	90	3250.75
		Thenar	3		571.11
2	Manimuthar	Thirumanimuthar	3		33.39
		Palar	13		2828.22
		Virusuliar	10		1763.10
		Manimuthar	10		4795.79
3	Kottakaraiyar	Saruganiar	11		7810.65
		Nattarkal River	3		649.18
		Nattar	4		688.04

Total	68	90	22390.23
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TANKS

The Raja Singa Mangalam tank of this basin is one of the biggest tanks in Tamil Nadu. Its bund is 20.8 Km long and has two large masonry weirs on either flanks to surplus flood flows. The Northern flood surplus flow of Raja Singa Mangalam tank is called Kottakaraiyar and the southern flood surplus flow of the tank is called Uppar river.

This basin can aptly be called as “Basin of Tanks” since it is enclosing about 7602 tanks. The total Ayacut irrigated by these tanks is 1,33,008 Hectares. The sub basin wise details of tanks and ayacut in hectare is given in Table- 9.

Table-9: Sub basin wise details of tanks and ayacut in hectare

Details	No. of Tanks				Ayacut in Hectare			
	Pambar sub basin	Mani-muthar sub basin	Kotta-karaiyar sub basin	Total	Pambar sub basin	Mani-muthar sub basin	Kotta-karaiyar sub basin	Total
System tanks	334		146	480	8048.91		12026.85	20075.76
Non System tanks maintained by PWD	318	421	315	1054	18886.48	16921.19	17424.05	53231.72
Tanks maintained by Panchayat Union	4491		1577	6068	31436.16		28264.47	59700.63
Total	5564		2038	7602	75292.74		57715.37	133008.11

INTER BASIN TRANSFER OF WATER

In this basin, there is inter basin transfer of water from Vaigai basin. The Raja Singa Mangalam tank receives supply from lower Vaigai feeder canal. The lower Vaigai feeder canal originates from the Vaigai river at about 2 Km east of Paramakudi town. It then passes through Kil Ayykudi, Valasai, Pithambarandal, Arambakkottai, Ariyankottai and feeds Raja Singa Mangalam big tank.

Occurrence of groundwater in the sub basins of Pambar Kottakaraiyar River basin

1. Pambar sub basin

There are 18 observation wells are in this sub basin. The winter water level varies from 1.90 to 10.80 m and the summer water level ranges from 2.60 to 11.70m below ground level.

2. Manimuthar sub basin.

There are 29 observation wells in this sub basin. The winter water level varies from 2.90 to 8.70 m and the summer water level varies from 4.00 m to 10.50m

3. Kottakaraiyar sub basin

There are 20 observation wells are in this sub basin. The winter water level varies from 2.80 to 10.50m and the summer water level ranges from 3.00m to 10.70m.

Groundwater Potential in the Study Area

The total available groundwater potential as on March 2013 is worked out as 811.97 Mcum and is shown in Table 10.

Table 10 Ground Water Potential Calculation as on Mar 2013

Name of District covered	Area covered in %	Net water available	Ground water potential District wise
Dindigul	6.59	58016.67	3823.299
Madurai	4.86	63797.96	3100.581
Pudukottai	13.25	98591.79	13063.412
Ramanathapuram	17.64	51962.52	9166.189
Sivaganga	56.65	90618.63	51335.454
Tiruchirappalli	1.01	70069.09	707.698
Total			81196.633 Ha.m 811.966 M.cum

PRESENT AND FUTURE WATER DEMANDS

Domestic water demand

The technical sub-committee for Urban, Rural, Domestic, Livestock Water Supply & Sanitation Sector of the Water Resources Control and Review Council (WRCRC) has recommended the water demand norms to be used for Water planning and the same is adopted for estimating the water demands in the Pambar & Kottakaraiyar basin (i.e. 100 lpcd for Urban and 70 lpcd for Rural population). The tabulation of domestic water demand of this basin is given in Table-13.

Table-13 Projected Domestic water demand of Pambar and Kottakaraiyar basin

Year		Population	Demand		
2001	Urban	573000	MLD	MLD	MCM
	Rural	1297000			

2011	Urban	522209	48.10	114.18	41.68
	Rural	1652098	66.08		
2017	Urban	588095	46.61	118.02	43.08
	Rural	1785223	71.41		
2020	Urban	624088	49.46	123.69	45.15
	Rural	1855756	74.23		
2030	Urban	760760	60.29	144.75	52.84
	Rural	2111618	84.46		
2040	Urban	927362	73.50	169.61	61.91
	Rural	2402756	96.11		
2050	Urban	1130449	89.59	198.95	72.62
	Rural	2734036	109.36		

Livestock water demand

Table 14 shows the details of livestock population and livestock water demand of Pambar and Kottakaraiyar basin.

Sl. No.	Name	Standard Norms in lpcd	Demand 1997	Demand 2017	Demand 2020	Demand 2030	Demand 2040	Demand 2050
1	Cattle	225	29.78	32.39	32.8	34.2	35.67	37.19
2	Buffalo	225	4.84	1.98	1.73	1.11	0.71	0.45
3	Bovine	100	15.39	15.39	15.39	15.39	15.39	15.39
4	Sheep	5	0.55	0.54	0.54	0.53	0.52	0.52
5	Goats	5	0.4	0.63	0.67	0.84	1.05	1.31
6	Ovine	110	20.88	20.88	20.88	20.88	20.88	20.88
7	Horses & Ponies	100	0.021	0.021	0.021	0.021	0.021	0.021
8	Donkeys	25	0.017	0.017	0.017	0.017	0.017	0.017
9	Pigs	206	0.62	0.244	0.212	0.133	0.084	0.053
10	Dogs	20	0.48	0.48	0.48	0.48	0.48	0.48
11	Rabbits	10	0.002	0.002	0.002	0.002	0.002	0.002
12	Poultry	0.05	0.01	0.071	0.091	0.207	0.472	1.074
13	Duck	10	0.008	0.008	0.008	0.008	0.008	0.008
14	other birds	10	0.001	0.001	0.001	0.001	0.001	0.001
	Total		72.999	72.654	72.833	73.81	75.296	77.387

Industrial water demand

The Pambar & Kottakaraiyar basin comprises Large and Medium Industries and Small Scale Industries. The norms for water requirement is adopted as 2500 cum / day for large and medium industries and 2.5 cum / day for small scale industries. Accordingly, the yearly requirement of water for small scale industries during the year 2017 is assessed as 26.76 Mcum and for the large and medium industries it is assessed as 72.09 Mcum. Hence, the total annual water requirement for Industries in this basin is 98.85 Mcum.

For forecasting the water demand of Industries for future years, a simple arithmetic increase of 8% per annum over the present requirement has been adopted. The annual water demand for the Industries during the planning periods are given in Table 16.

Table 16 WATER DEMAND CALCULATION FOR SMALL, MEDIUM AND LARGE INDUSTRIES BASED ON INDUSTRY CENSUS AS TAKEN FROM IWS

Sl. No.	Type of industry	Average Rate of Water consumption as given in IWS m ³ /day	2006		2017		2020		2030		2040		2050	
			No. of industry as per IWS	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand	No. of industry	Water Demand
1	Small scale industry	2.5	12577	11.48	29325	26.76	36941	33.71	79753	72.77	172181	157.12	371725	339.2
2	Medium & large scale industry	2500	34	31.03	79	72.09	100	91.25	216	197.1	465	424.31	1005	917.06
Total Demand in M.Cum				42.51		98.85		124.96		269.87		581.43		1256.26

WATER BALANCING

Water balancing for Pambar and Kottakaraiyar river basin at 75% dependability which includes water potential, demand and deficit for the projected years are given in Table-21.

Table-21: Water Balancing for Pambar and Kottakaraiyar River Basin at 75% dependability

Sl. No	Name of the basin	Area of the basin (in Sq.Km)	No. of Sub basins	Year	Demand of water in various sectors (MCM)						Water availability (MCM)				Surplus / Deficit in Mcum	
					Irrigation	Domestic	Industries	Live stock	Others	Total	Surface water potential	Ground water potential	Quantity of recycled water from Sewage	Quantity of water from desilting		Total
1	Pambar & Kottakaraiyar	5910.877	3	2017	1460.00	43.08	98.85	72.654	-	1674.58	648.00	811.966	-	-	1459.97	-214.62
				2020	1460.00	45.15	124.96	72.833	-	1702.94	648.00	811.966	-	-	1459.97	-242.98
				2030	1460.00	52.84	269.87	73.810	-	1856.52	648.00	811.966	-	-	1459.97	-396.55
				2040	1460.00	61.91	581.43	75.296	-	2178.64	648.00	811.966	-	-	1459.97	-718.67
				2050	1460.00	72.62	1256.26	77.387	-	2866.27	648.00	811.966			1459.97	-1406.30