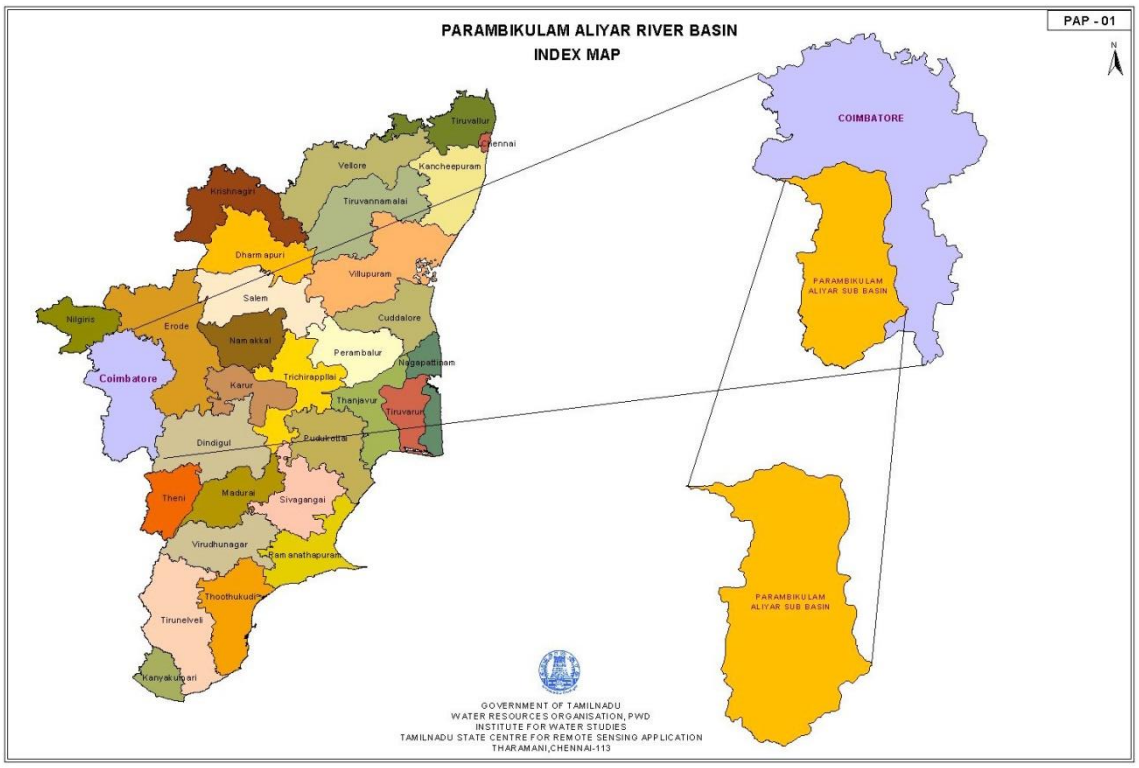
PAP BASIN

Introduction

Parambikulam-Aliyar basin is located in the south western part of the Peninsular India, and covers area in Kerala and Tamil Nadu States.Aliyar river rises in the eastern slopes of Anamalai hills of the Western Ghats in Coimbatore district at an elevation of 2250 m above msl and flows in the north-westerly direction on its 45 km runs from its origin, it is joined by a tributary namely the Palar river on its right bank traversing by another 15km west wards, it enters the Palaghat district of Kerala State through Palghat gap.Parambikulam-Aliyar river



basin has an undulating topography with maximum contour elevation in the plain is 300m. and the maximum spot height in the plain is 385m above MSL. One third of the basin area (822.73 sq.km) is covered with hills and dense forest cover. The total area of PAP basin is 2388.72 sq.km. The index map is shown in figure 1.

Figure 1 Index Map of ParambikulamAliyar River Basin

This basin is bounded in north and east by Cauvery basin, south and west by Kerala State. This basin area lies (except the ayacut area) within the coordinates of N .latitude between 10° 10’ 00” to 10°57’20” and E .longitudes 76°43’00” to 77° 12’30”.

The administrative setup of the basin is furnished below (Figure 2). The basin area lies within the Coimbatore district only (and the ayacut area is extent beyond Coimbatore district uptoVellakoil –Erode district).

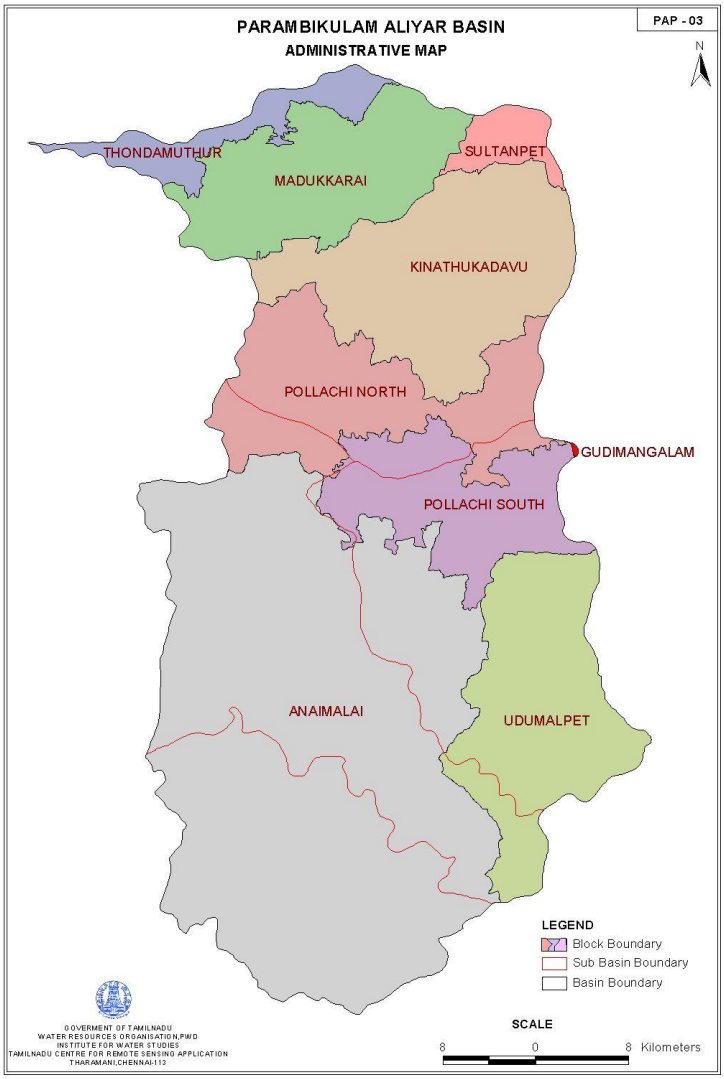


Figure 2 Administrative Map of ParambikulamAliyar River Basin

The administrative details of the PAP Basin with its area and percentage occupying the basin are shown in Table 1.

Table 1 Administrative Set Up Of PAP Basin

Sl.No.	Block Name	Area of the block in sq.km	Full block area in sq km.	% of the block
1	Gudimangalam	0.45	309.7	0.15
2	Pollachi North	247.64	285.57	86.72
3	Pollachi South	184.3	206.36	89.31
4	Udumalaipet	280.69	900.13	31.18
5	Anamalai with Valparai area	1017.38	1017.38	100
6	Sultanpet	38.39	295.75	12.98
7	Madukarai	228.96	358.82	63.81
8	Thondamuthur	73.96	414.5	17.84
9	Kinathukidavu	316.95	325.75	97.3
	Total Area	2388.72		

The Parambikulam –Aliyar project is the symbol of co-operation of two neighbouring States in diverting the surplus water of one State to irrigate the dry lands of another State. Highly imaginative in concept, bold in its approach, indigenous in planning and beneficial on its completion, this Inter-State, multipurpose multi-Valley project is truly a unique one. It successfully accomplishes the diversion and integration of eight west-flowing rivers, six in the Anamalai hills and two in the plains for the benefit of the drought prone areas in the Coimbatore and Erode districts of Tamilnadu.

The six rivers on Anamalai hills are

Anamalaiyar	Sholayar	Thunacadavu
Nirar	Peruvaripallam	Parambikulam

The two rivers on the plains are 1. Aliyar 2. Palar

Storage and diversion works on the eight rivers with interconnecting tunnels have been constructed. The tunnels divert the waters impounded in the reservoirs to the plains of the Coimbatore and Erode district of Tamilnadu falls in Cauvery river basin and Chittoorpuzha area of the Kerala States. The reservoirs lie at various elevations ranging between EL.1146 m (+ 3760 ft) and 320 m (+ 1050 ft) and this difference in elevation has made it possible to utilize the drop between them for the development of hydro–power.

The agreement between the State of Tamilnadu and Kerala provides for the diversion of 30.5 TMC of water to Tamilnadu, when all the components of diversion and storage works contemplated in the agreement are completed. The potential at the various component works was anticipated as follows.

1.	Upper Nirar weir	9.0 TMC
2.	Lower Nirar weir	2.5 TMC
3.	Sholayar	2.5 TMC
4.	Parambikulam Group of rivers	14.0 TMC
5.	Diversion from Anamalaiyar river	2.5 TMC
	Total	**30.5 TMC**

The construction of Anamalaiyar Dam will have to be taken up after the construction of the Idamalayar Project of Kerala State. The scheme proposals are still awaiting clearance from Kerala Government. This work will be taken up after it is cleared by the Kerala Government and a supplemental agreement is concluded on this aspect. Hence the total potential created is 28 TMC against 30.5 TMC. The base map is given in Figure 3.

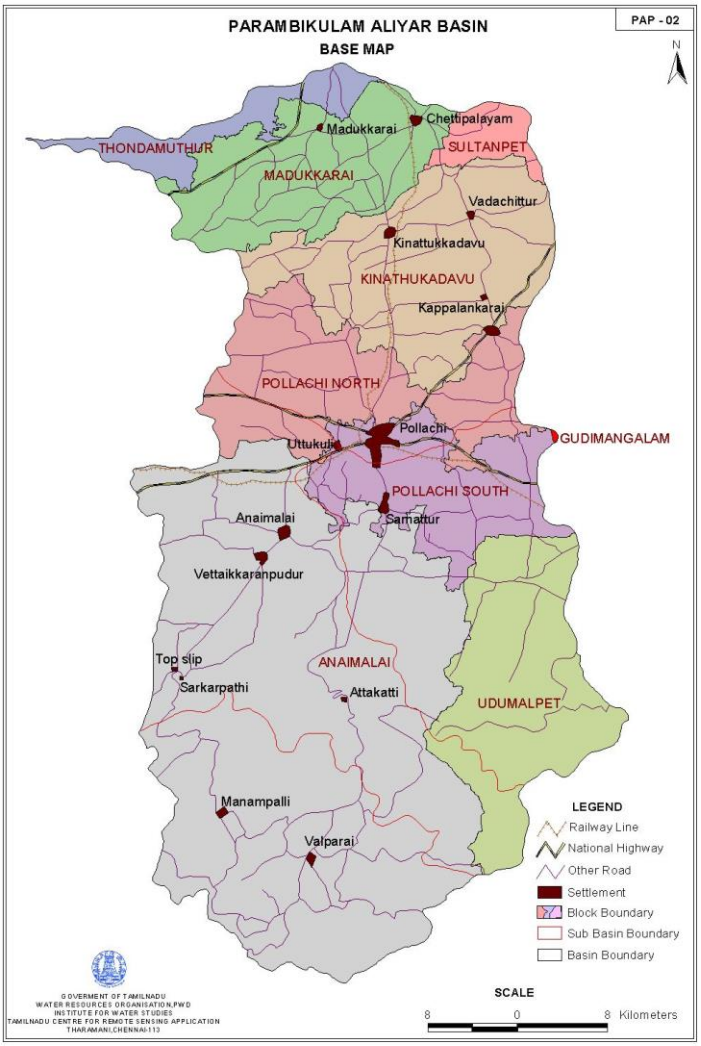


Figure 3 Base Map of PAP Basin

Physiography

The Valayar Reservoir is located in the NW of the basin area. But for irrigation, no contributionis done through this reservoir for this basin. For promoting Irrigation and power generation in Coimbatore and Erode district, weirs, dams, reservoirs, tunnels, open channels and contour - canal have been constructed in the above eight west-flowing rivers to divert west flowing water to east. The reservoirs lies at various elevation ranges between 1146 m and 320 m, and this difference in elevation has made it possible to utilize the drop between them for the development of hydro power.

This basin area is covered by denudational, fluvial landforms and structural hills – Anamalai hills at the southern part. Parambikulam - Aliyar river basin includes the Parambikulam main canal, Udumelpet canal and high level canal in Palar sub basin and VettaikaranPudur canal, Sethumadai canal and Aliyar feeder canal in the Aliyar sub basin and their distributaries.

Drainage

Parambikulam – Aliyar basin is drained by eight west flowing rivers viz. Valayar, Koduvadiaru, UpparAliyar, Palar, Parambikulam, Nirar and Sholayar and spread over an area of 2388.72 sq.km. They are grouped into 4 sub basins such as Valayar and Koduvadiaru together called as Valayar sub basin, Uppar and Aliyar together called Aliyar sub basin, Palar sub basin, Parambikulam and Sholayar together called as Sholayar sub basin. Figure 4 gives the detailed description of the individual sub basin is given below.

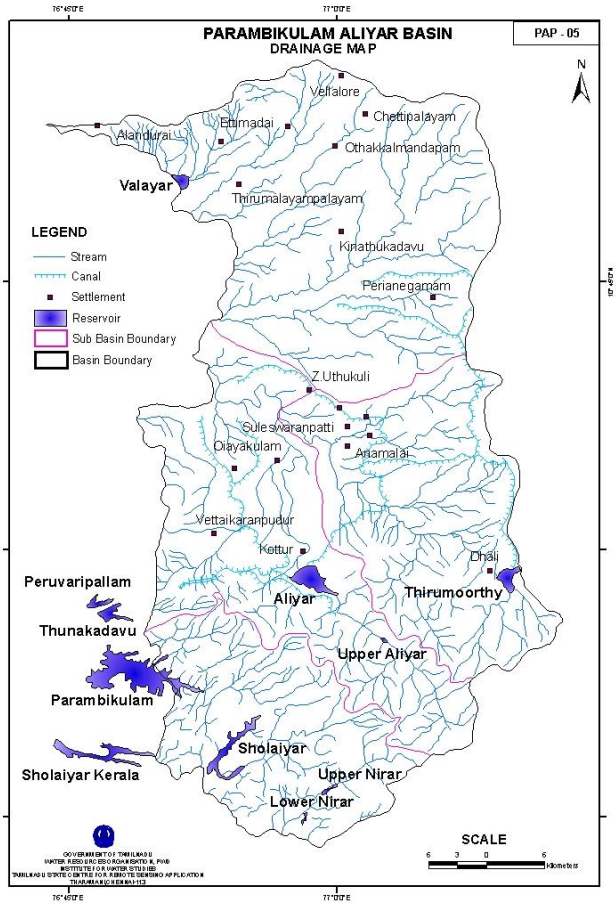


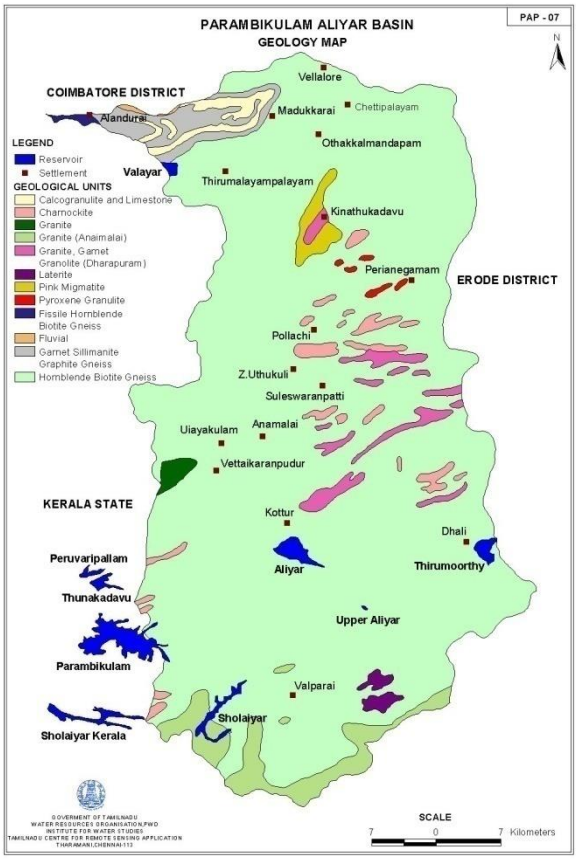
Figure 4 Drainage Map of PAP Basin

Relief

ParambikulamAlilyar project basin contemplates diversion of surface water from Anamalai hills of Western Ghats to irrigate dry command areas of Coimbatore and Erode districts. The southern part of this region is covered by structural hills - Anamalai hills, Aliyar, Sholayar and lower Nirar reservoirs. The Aliyar and Thunakadavu reservoir are located along major lineaments. The relief map is shown in Figure 5.

Geology

Parambikulam and Aliyar river basin comprises mainly of crystalline rocks of Archaean age. Charnokites form the major rock type of the basin followed by the granites, granitic gneisses, dunites, limestones, quartzite basic and ultra-basicintrusives of pegmaties and quaternery veins. Charnockites and associated migmatites occupy a major part of the area. The Anamalai hill ranges are composed of charnockites and their magmatisedequivalents. The



geology map is given in Figure 6.

Figure 6 Geology Map of PAP Basin

Hydrogeology

Groundwater occurs as phreatic aquifer in the crystalline rocks. In the ayacut area the average weathered thickness is 9.3 to 10 m.

. In the ayacut area the depth of the well ranges from 5 to 25 m and the average thickness of weathered mantle is 10m. Summer water level ranges from 3 to 23 m,

draw down is from 3 to 8 m. Recuperation hours during summer varies from 24 to 48 hrs.

Borehole details indicate that the general depth to bedrock varies from 20 to 80 m. Discharge in borewell vary from 25 lpm to 428 lpm. Transmissivity values range from 1300 to 10000 gpd/foot. The depth to bottom of aquifer map is given in Figure 7.

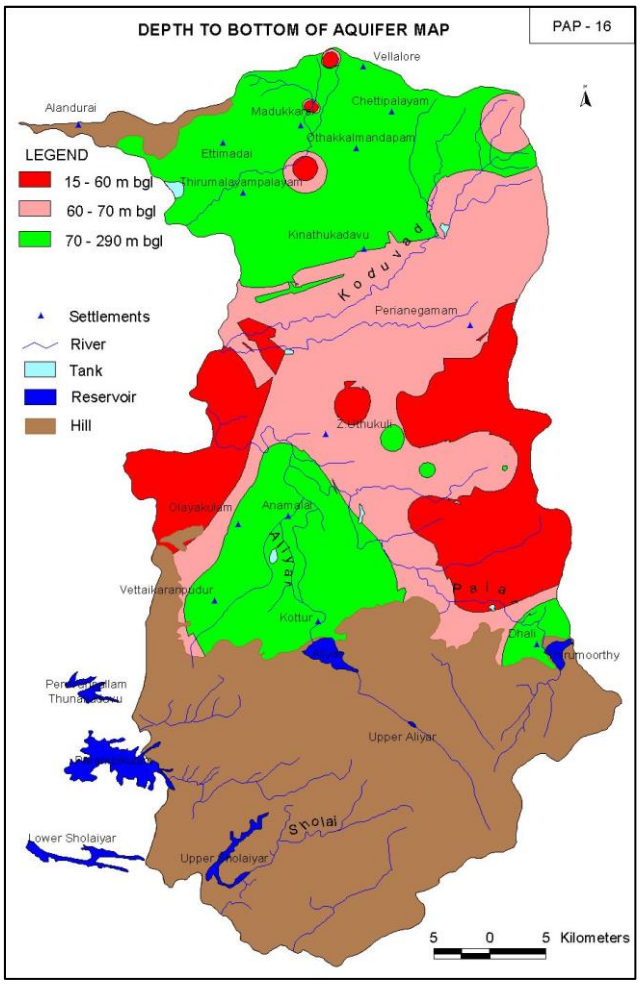


Figure 7 Depth to bottom of Aquifer Map of PAP Basin

Geomorphology

Integration of geomorphology and lineament bring information about Ground water occurrence and condition at different stages of aquifers in shallow and deeper horizons.(Figure 8)Many rivers and major nullahs have been developed probably due to the structural deformation. Several patterns of sheared and fractured zones are noticed along the contact zones and also between varied geological formations. The intersections of lineaments are proven to be potential zones.

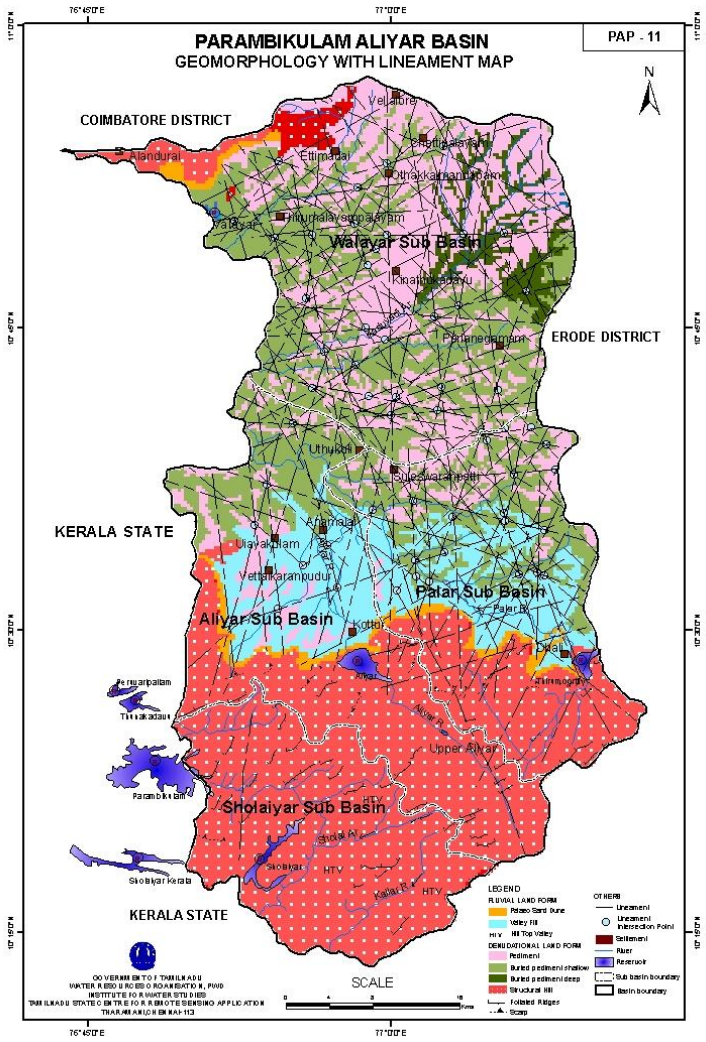


Figure 8 Geomorphology with Lineament Map of PAP Basin

Land Use

The land use study of Parambikulam&Aliyar basin has been attempted to identify and map the various types of land use classes both in visual & digital interpretation method. The various classification of land use of the study area and their aerial extent and coverage in percentage are given in the table 2 below:

Table 2 Parambikulam - Aliyar River Basin
Landuse Area

S.NO	FEATURES	AREA IN SQ.KM	PERCENTAGE(%)
1	Settlement	15.16	0.63
2	Tank	0.29	0.01
3	Reservoir	15.1	0.63
4	Crop land	1006.78	42.15
5	Dry crop	52.26	2.19

6	Barren land	66.22	2.77
7	Barren outcrop	436.91	18.29
8	Plantation	283.35	11.86
9	Structural hill	55.51	2.32
10	Thick forest	457.12	19.14
	Total	**2388.7**	**100.00**

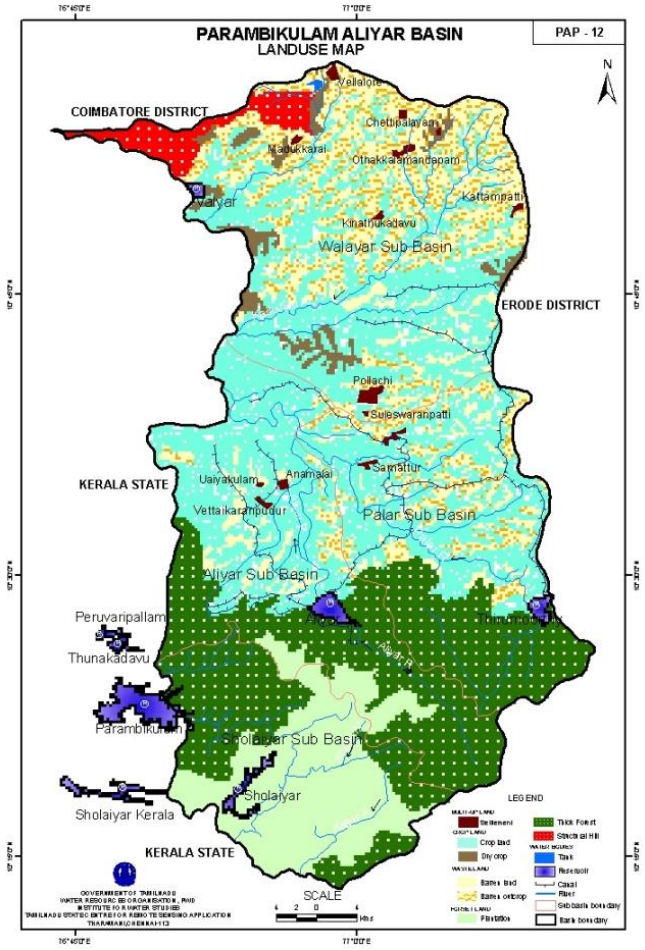


Figure 9 Landuse Map of PAP Basin

Figure 9 gives the landuse map of the PAP basin.

Waste lands

The barren land and barren rocky out crop are the major waste lands noticed in the study area. It is an area of rocky exposures of varying lithology often bore and devoid of soil cover and vegetation. The total area comes under this category is 503.13 sq.km. The waste land map is given in Figure 10.

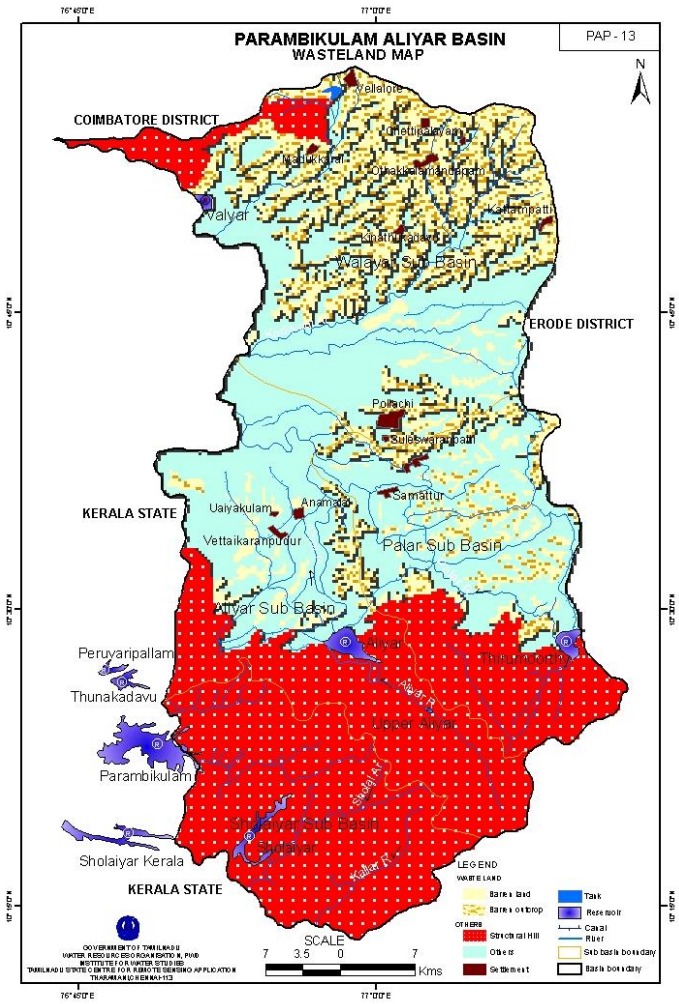


Figure 10 Wasteland Map of PAP Basin

Table 3 Wasteland Area Calculation

Sl. No	Catagories	Features	Area in Sq. Km	Percentage (%)
1	**Wastelands**	Barren land	66.22	2.77
		Barren rocky/Stoney waste	436.91	18.29
	Waterbodies	Reservoir/Tanks/River/Stream	15.39	0.64
	Builtup land	Settlements	15.16	0.63

2	**Other than wastelands**	Croplands/Structural hill/Forest	1855.02	77.66
	Total		**2388.70**	**100**

Soils

The soils of the PAP Basin have been shown in Figure 11. The predominant soil types found in this river basin are Inceptisols, Alfisoland Entisol. Due to different stage of weathering of parent material, the above soil types are met with in combination.

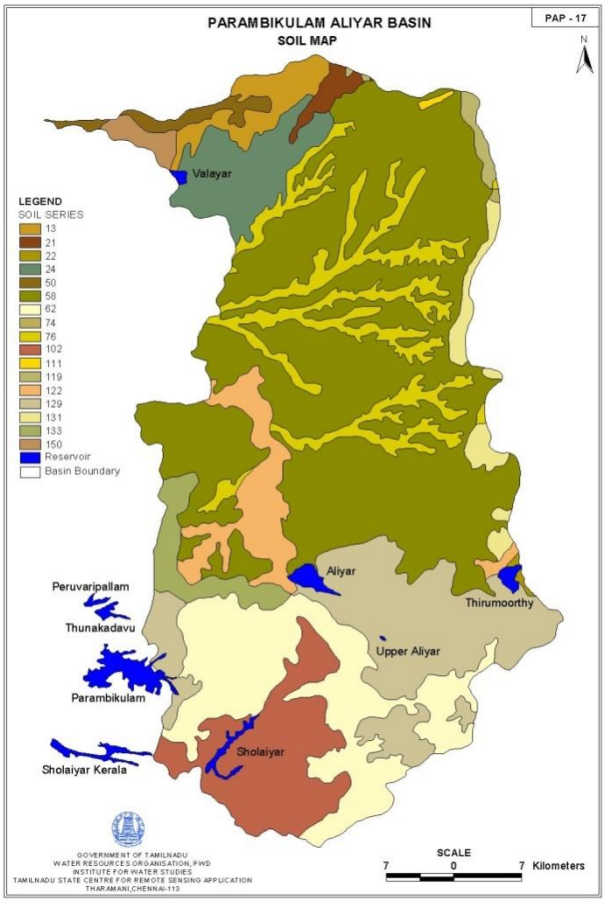


Figure 11 Soil Map of PAP Basin

Population Size: Urban and Rural

The PAP basin covers part of Coimbatore district only. The rural population for Coimbatore district is 0.359 Million. The urban population for Coimbatore district is 0.406 Million. The total Urban and Rural population is 0.406 Million and 0.359 Million

respectively. The basin is divided into four sub basins. The sub basin wise population is given below.

Table 4 The Urban and Rural Population as per census 2001 (in Million)

Sl. No.	Name of the Sub basin	Urban Population	Rural Population	Total Population
1	Aliyar	0.059	0.052	0.111
2	Palar	0.022	0.099	0.121
3	Valayar	0.331	0.208	0.539
4	Sholayar	0.000	0.000	0.000
TOTAL		**0.412**	**0.359**	**0.771**

Population Density

The population density is the highest in Valayar (614 Persons per sq.km) and the lowest in Aliyar (193 Persons per sq.km) as shown in the following table. The average population density for the entire basin is 320 persons / sq.km which is well below the State average of 480 persons / sq.km

Table 5 Population Density in PAP Basin

Sl.No	Name of the sub basin	Area (Sq.km)	Total Population in Million	Density Persons/sq.km
1	Aliyar	574.76	0.111	193
2	Palar	533.75	0.121	227
3	Valayar	877.49	0.539	614
4	Sholayar	402.7	0.000	0
Average population density for the basin				**320**

Hydrometeorology

Rainfall

Tewnty five non-recording rain gauge stations in and around the basin are considered for analysis. The various agencies are maintaining these raingauge stations, and the number of rain gauge stations maintained by each agency is listed below:

S. No.	Name of the Agency	Numbers
1	Public Works Department	19
2	Revenue	6
	Total	**25**

The annual dependable rainfall with frequency distribution is given in Table 6.

Table 6 Annual Dependable Rainfall

Sl. No	Sub basin	25%	50%	75%	90%
1	Aliyar	212.63	157.51	130.69	105.99
2	Palar	117.48	94.94	64.26	52.19
3	Valayar	169.70	129.44	97.48	87.25
4	Sholayar	565.39	434.85	379.22	276.36

The annual rainfall contour map is shown in Figure 12.

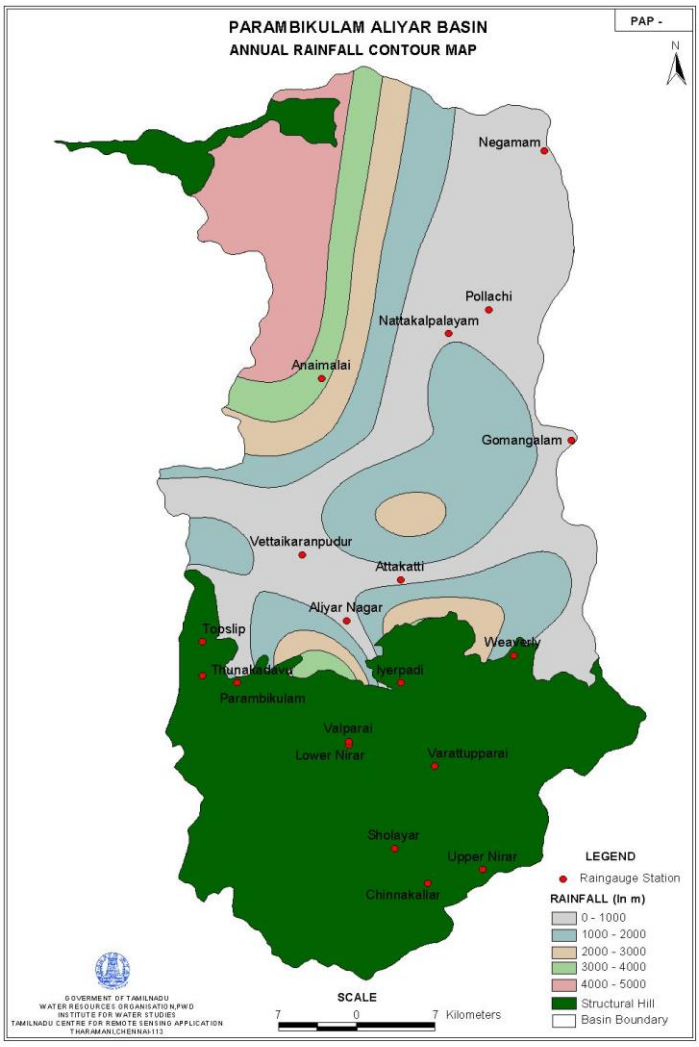


Figure 12 Annual Rainfall Contour Map of PAP Basin

Maximum, minimum and average rainfall

The maximum, minimum and average annual rainfall for various raingauge stations have been analysed and tabulated. The following observations are made Upper Nirar received the maximum rainfall of 9281.70 mm (2005-06) and Poolankinar received the minimum rainfall of 233 mm (1986-87). Average Annual rainfall varies from 540.85 mm (Nattakalpalayam) to 4806.61 mm (Upper Nirar).

Aridity Index for climatic classification

The aridity index (la) for all the 28 raingauge stations have been worked out and the classification is shown in Table 7.

Table 7 Aridity Index (I_a) for Climatic Classification

S. No.	Name of Station	Annual Ave. Precipitation P mm	PET mm	Total deficit P-PET mm	Ia Aridity Index (%)	Classification
1	**Aliyar Nagar**	854.48	1439.87	-585.39	-40.66	Semi arid
2	**Attakatti**	1124.66	1439.87	-315.21	-21.89	Dry humid
3	**Topslip**	1359.25	1439.87	-80.62	-5.60	Dry humid
4	**Vettaikaranpudur**	735.46	1439.87	-704.41	-48.92	Semi arid
5	**Weaverly**	1812.00	1439.87	372.13	25.84	Arid
6	**Upper Nirar**	4806.61	1439.87	3366.74	233.82	Arid
7	**Valparai**	2953.08	1439.87	1513.22	105.09	Arid
8	**Varattuparai**	2199.30	1439.87	759.43	52.74	Arid
9	**Iyerpadi**	2618.95	1439.87	1179.09	81.89	Arid
10	**Lower Nirar**	3832.70	1439.87	2392.83	166.18	Arid
11	**Anaimalai**	3548.56	1439.87	2108.70	146.45	Arid
12	**Chinna Kallar**	4629.79	1439.87	3189.92	221.54	Arid
13	**Sholayar**	3723.72	1439.87	2283.85	158.62	Arid
14	**Negamam**	819.34	1439.87	-620.53	-43.10	Semi arid
15	**Pollachi**	837.71	1439.87	-602.15	-41.82	Semi arid
16	**Sulthanpet**	551.21	1439.87	-888.65	-61.72	Semi arid
17	**Parambikulam**	2255.03	1439.87	815.17	56.61	Semi arid
18	**Thunakadavu**	1715.21	1439.87	275.34	19.12	Arid
19	**Thirumurthy Nagar**	724.10	1439.87	-715.77	-49.71	Semi arid
20	**Amaravathy Nagar**	708.90	1439.87	-730.96	-50.77	Semi arid
21	**Nallar**	787.24	1439.87	-652.63	-45.33	Semi arid
22	**Poolankinar**	571.61	1439.87	-868.26	-60.30	Semi arid
23	**Nattakalpalayam**	540.85	1439.87	-899.02	-62.44	Semi arid
24	**Pedappampatti**	589.51	1439.87	-850.35	-59.06	Semi arid
25	**Udumalpet**	689.14	1439.87	-750.72	-52.14	Semi arid

Climate

The weather stations considered are furnished below:

Name of the weather station	Maintained by
Aliyar Nagar	PWD (GW)
Sethumadai	PWD (GW)

The climatological values of this river basin are given below.

Table 8 Climatological Parameters

S. No	Climatological Parameter	Aliyar Nagar	Sethumadai
1	Average monthly temperature Maximum. in. ^{0} Celsius	33.58	31.47
2	Average monthly temperature Minimum. in. ^{0} Celsius	23.78	25.53
3	Average mean temperature in ^{0} Celsius	28.68	28.50
4	Average relative humidity in %	78.13	73.46
5	Average wind velocity in km/hour	2.68	2.99
6	Average Sunshine hours / day	5.30	5.31
7	Pan Evaporation in mm	122.14	135.58

Eto values (mm/month) of FCS for PAP basin													
Name of the basin & FCS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**	**Average**
PAP basin - Uthamapalayam FCS	102.0	112.0	146.0	147.0	158.0	156.0	149.0	152.0	138.0	115.0	96.0	93.0	130.3
PAP basin - Sethumadai FCS	105.0	109.0	136.0	126.0	130.0	99.0	96.0	102.0	108.0	102.0	90.0	84.0	107.3
PAP basin - Suddakampal	108.5	112.0	148.8	150.0	151.9	126.0	117.8	120.9	129.0	114.7	96.0	93.0	122.4

ayam FCS													

Surface Water Potential

Surface Water Data

This basin is having eight west flowing rivers, six in Anamalai Hills and two in the plains. The water has been diverted from the west flowing rivers to east by constructing weir, reservoirs, tunnels, open channels and contour canal etc. to irrigate the drought prone areas of Coimbatore and Erode Districts. The salient features of the dams and tanks present in the PAP basin is given in tables 9 and 10 below.

Table 9 Salient Features Of The Dam

Sl.No.	Name of the Reservoir	Catchment Area Sq.Km	Capacity at FRL TMC	Maximum height in ft.
1	Upper Nirar Weir	75.11	0.04	85
2	Lower Nirar Dam	96.35	0.27	141
3	Sholayar Dam	121.73	5.39	345
4	Parambikulam Dam	230.51	17.82	240
5	Thunakadavu Dam	43.36	0.66	85
6	Peruvaripallam Dam	15.80	0.62	91
7	Aliyar Dam	196.84	3.86	145
8	Thirumurthy dam	80.29	1.94	128
9	Upper Aliyar Dam	16.52	0.94	265

Table 10 Canal and Ayacut Details

Sl.No.	Name of the Canal	Ayacut in Acres
1	PollachiCanal	23488
2	VettaikaranpudurCanal	11181
3	AliyarFeederCanal	4665
4	UdumalpetCanal	58292

5	SethumadaiCanal	5044
6	High Level canal	2477
7	Old AliyarAyacut	6400
8	ParambikulamMainCanal	316383
9	Dhali Channel	2800
10	Indirect Ayacut in three tanks	934
		431664
	Sub - basin wise Ayacut	
1.	Aliyar Dam old and New Ayacut	51558
2.	ThirumurthyDam- Old and New Ayacut	380106
		431664 or 4.32 Lakhs Acres.

The irrigation map is shown in Figure 13. It helps to identify the flow diagram of the basin.

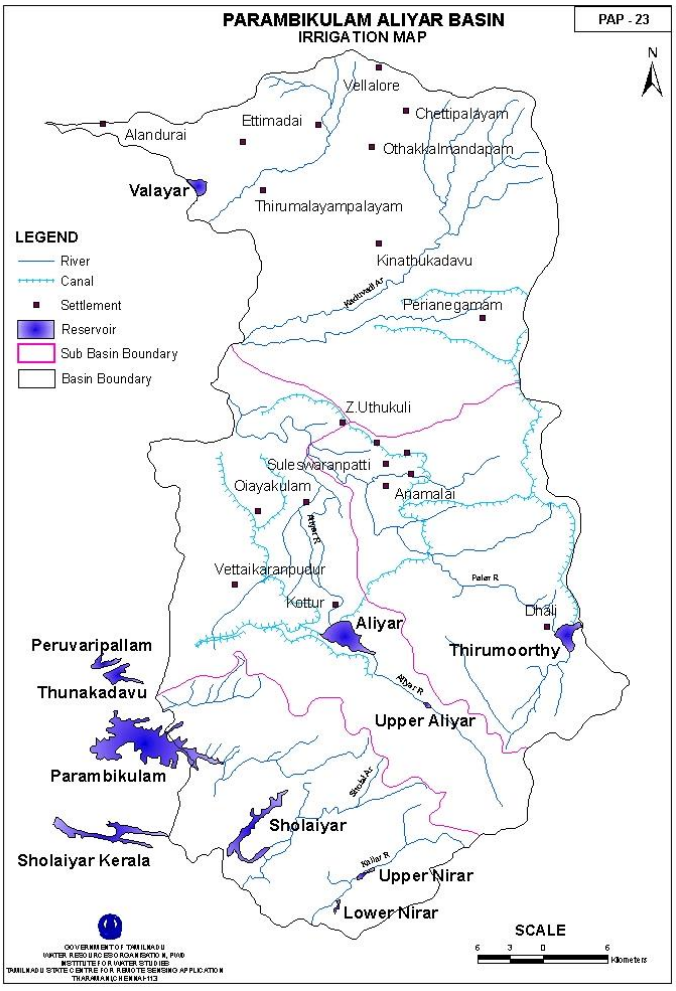


Figure 13 Irrigation Map of PAP Basin

Assessment Of Surface Water Potential

The availability of surface water in this basin is mainly from the diversion of the West flowing rivers of Anamalai hills to East to give irrigation to the dry areas of Coimbatore and Erode Districts. This involves inter basin transfer of water from KeralaState to TamilNaduState. As per agreement, the share for Tamil Nadu from the diverted water at present is 28 TMC and for Kerala it is 19.55 TMC. To know whether the required quantities are met out in each year as per agreement, the flows are being measured at each diversion structure.

Surface Water Potential

The surface water potential is calculated for 75% dependability, as per actual measurement forSholayar ,Aliyar and Palar and by running MRS Model for Valayar.

Table 11 Surface Water Potential

Sl. No	Name of Sub basin	Total Potential in Mcum	Release to Kerala in Mcum	Balance available potential at Tamil Nadu in Mcum
1	Sholayar Sub basin			
	a). Nirar	264	34	
	b). Sholayar	259	147	
	c).Parambikulam	202	-	
	Total	725	181	544
2	Aliyar	243	205	38
3	Palar	13	-	13
4	Valayar	80	-	80
	TOTAL	1061	386	**675**

Groundwater potential

Occurrence of Groundwater in the four sub basins of ParambikulamAliyar River Basin

1. Sholayar sub basin

The predominant rock types found in this sub basin is crystalline rocks of Archean age. There is one observation well in this sub basin. The winter water level varies from 16.00 m to 18.00 m and the summer water level ranges from 18.00 m to 18.25m below ground level.

2. Palarsub basin

It constitutes denudation forms such as pediment, pediment with black cotton soil and shallow pediments. Aluvial forms such as bazadas occur along the foothills of Anamalai hill ranges of Western Ghats. The area of this sub basin is 534 sq km. There are four observation wells in this sub basin. The winter water level varies from 4.75 m to 15.00 m and the summer water level varies from 15.00 m to 15.25m

3. Aliyar sub basin

The major area present denudation forms such as pediment, pediment with black cotton soil and shallow pediments. The aluvial landforms such as bazadas occur along the foothills of Anamalai hill ranges of Western Ghats. The sub basin has an area extent of 575 sq km. There are five observation wells in this sub basin. The winter water level varies from 3.75 m to 7.80m and the summer water level ranges from 7.80m to 9.00m.

4. Valayar sub basin

The predominant rock types found in this river basin is crystalline rocks of Archean age. There are seven observations well in this sub basin. The winter water level varies from 4.00 to 18.00 m and the summer water level ranges from 18.00 to 18.25m below ground level.

Ground Water Potential Calculation as on March 2013

Name of District covered	Area covered in %	Net water available	Ground water potential District wise
Coimbatore	88.00	44950.83	39556.7304
Tiruppur	12.00	45375.57	5445.0684

Total	45001.7988	Ha.m
	450.02	M.cum

Present and future water demand

Domestic water demand

The population projection for the years 2017, 2020, 2030, 2040 and 2050 are done using exponential projection with their demand calculated based on the norms provided by WRCRC are done and projected in Table 13.

Table 13 Projected domestic water demand for PAP Basin

Year		Population	Demand		
			in MLD	in MLD	in Mcm
2011	Urban	351834	29.07	45.37	16.56
	Rural	407578	16.3		
2017	Urban	396222	32.74	50.36	18.38
	Rural	440420	17.62		
2020	Urban	420474	34.74	53.05	19.36
	Rural	457821	18.31		
2030	Urban	512556	42.35	63.19	23.06
	Rural	520943	20.84		
2040	Urban	624802	51.62	75.33	27.5
	Rural	592768	23.71		
2050	Urban	857720	70.87	97.85	35.72
	Rural	674496	26.98		

Industrial water demand

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 computed values for the years 2017, 2020, 2030, 2040 and 2050 have been tabulated.

The annual water demand for the Industries during the planning periods are given below:

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	9169	8.37	**21379**	**19.51**	26931	24.57	58142	53.05	125525	114.54	270999	247.29
2	Medium & Large scale industry	2500	46	41.98	**107**	**97.64**	135	123.19	292	266.45	630	574.88	1360	1241
Total Demand in M.Cum				**50.35**		**117.15**		**147.76**		**319.5**		**689.42**		**1488.3**

Water balance

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 availabilty (MCM)					Gap
					Irrigation	Domestics	Industries	Live stock	Others	Total	Surface water potential	Ground water potential	Quantity of recycled water from Sewage	Quantity of water from desilting	Total	
1	PAP	2388.7	4	**2017**	840	18.38	117.15	11.47	-	**987.001**	675	450.02	-	116.908	**1241.9**	**-254.92**
				2020	840	19.36	147.76	11.4		**1018.52**	675	450.02	-	116.908	**1241.9**	**-223.4**
				2030	840	23.06	319.5	11.33		**1193.89**	675	450.02	-	116.908	**1241.9**	**-48.035**
				2040	840	27.5	689.42	11.43		**1568.35**	675	450.02	-	116.908	**1241.9**	**326.43**
				2050	840	35.72	1488.3	11.72		**2375.73**	675	450.02		116.908	**1241.9**	**1133.8**