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Water Quality Status in the U.T of Puducherry

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ENVIS CENTER

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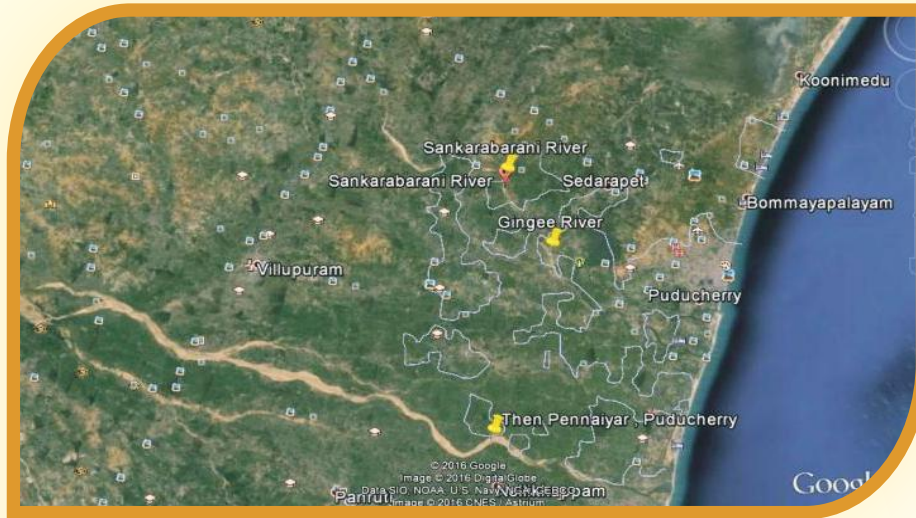
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INTRODUCTION

Puducherry region is situated on the Coromandel Coast between 11 ° 45' and 12 ° 03' N latitudes and 79 ° 37' and 79 ° 53' E longitudes with an area of 293 sq. km. It is divided into two municipalities viz, Puducherry and Ozhukarai, and five commune Panchayats viz., Bahour, Ariyankuppam, Villiyanur, Nettapakkam and Mannadipet.

RIVER



There are two major rivers in this region i) the Gingee river, which traverses the region diagonally from north-west to south-east and ii) the Ponnaiyar (Penniyar) river, which forms the southern border of the region. The river Gingee also known as the Varahanadi or Sankaraparani which has its source in the hills of Malayanur of Villupuram district, Tamil Nadu has a course of 34km in this region before it confluences with the Bay of Bengal. The river Ponnaiyar originates from the hills of Karnataka and enters the Puducherry region after flowing through the districts of Dharmapuri, Salem, Vellore and Cuddalore of Tamil Nadu. All the rivers are ephemeral in nature. About 82 tanks and 609 village ponds are there in the region. These tanks are interlinked and act as water storage for agricultural purposes as well as to recharge the ground water.

The entire irrigation is covered from ground water by means of tube wells which constitute 100 percent of the net area irrigated. Irrigation by tanks and other sources constitutes a meagre part of the net area irrigated.

RAINFALL AND CLIMATE

The region receives the rain under the influence of both southwest and northeast monsoons. Most of the precipitation occurs in the form of cyclonic storms caused due to the depressions in Bay of Bengal chiefly during Northeast monsoon period. Rainfall data analysis shows that the normal annual rainfall in the Puducherry region is 1240 mm. 62% of the annual rain is received during northeast monsoon season and about 26% during the southwest

monsoon season, with November being the rainiest month. The region enjoys a hot and tropical climate characterised by little variation of temperature and humid weather. The summer season, which is very oppressive, is from March to June. January to the end of February is comparatively cool. The relative humidity is generally high, being about 80% during October to April. It is at its minimum of 70 to 73% in June and July. Winds are moderately strong throughout the year, except during the months July to October. During May to September, winds are mainly south-westerly in the mornings. May and early part of June constitute the hottest period of the year with the mean daily maximum temperature at about 31.5°C and the mean daily minimum temperature at about 23.9°C. On individual days, the maximum temperature may even reach 43°C.

GEOMORPHOLOGY AND SOIL TYPES

Geomorphology

The Puducherry region in general is a flat plain with an average elevation of 15 m above mean sea level. The terrain becomes a little undulating with prominent high grounds varying from 30 to 100m above mean sea level towards northwest and northeastern parts of the region. Three major physiographic units are generally observed, viz., (i) Coastal plain, (ii) Alluvial plain and (iii) Uplands.

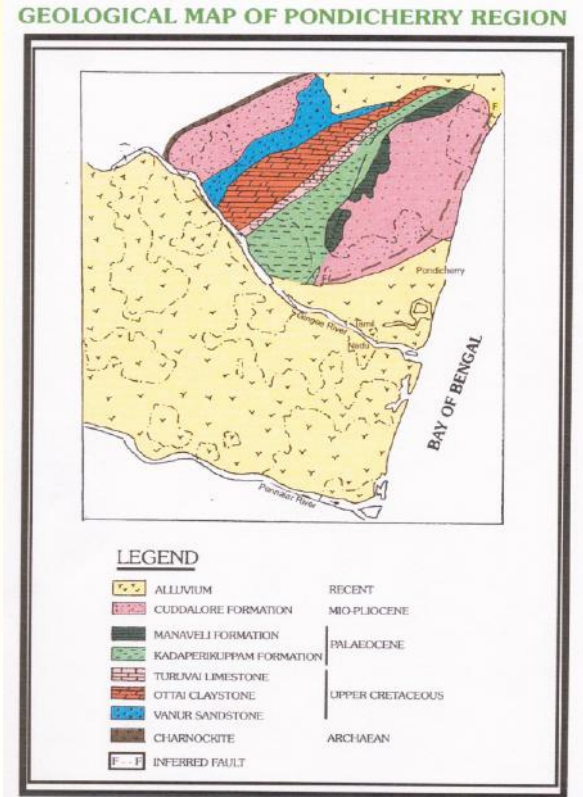
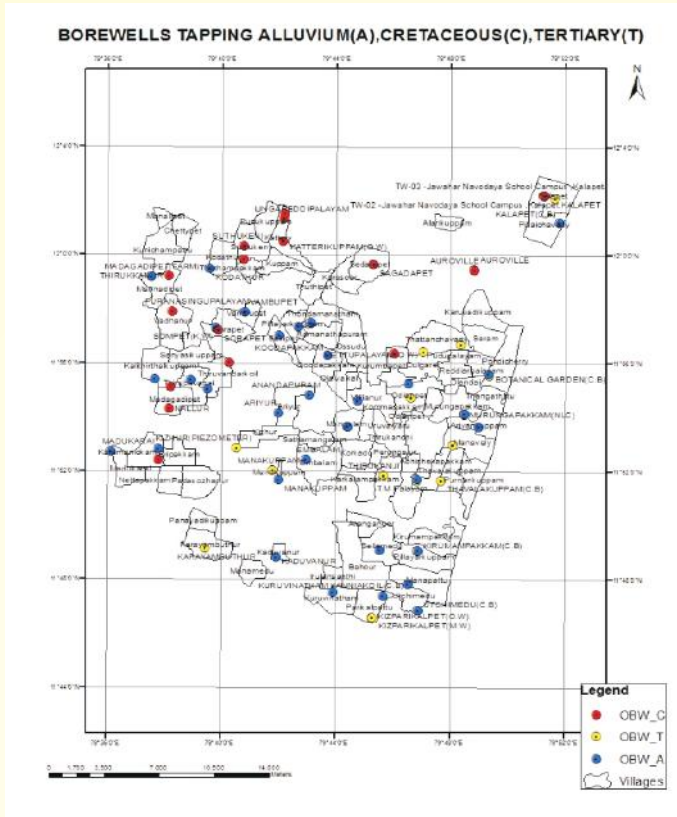
The coastal plain extends as a narrow stretch for about 22 km and of four to six hundred meters width on the eastern part of the region along the Bay of Bengal. The major part of the coastal plain comprises gently sloping land with a chain of sand dunes extending all along the coast. Other physiographic units which are characteristic of the coastal plains such as spit bars, mud flats, lagoons and tidal inlets also occur.

The alluvial plain, formed due to two major rivers namely Gingee and Ponnaiyar, in general is a monotonous plain with slope ranging from 1 to 3 percent. Besides the rivers and major canals, there are depressions acting as storage tanks, which are spread all over the terrain, to serve as surface water reservoirs.

The high grounds are known as Uplands with elevations of about 30 to 100m above mean sea level. These uplands which are popularly known as “Les Montagnes Rouges” or the “Red Hills of Puducherry” are intersected by a number of gullies and deep ravines giving rise to different land topography.

Ground Water Scenario

Ground water occurs in all the geological formations ranging in age from the Achaeans to Recent which can be broadly classified into two hydrogeological units viz., (i) Fissured and fractured crystalline formations and (ii) Porous sedimentary formations.



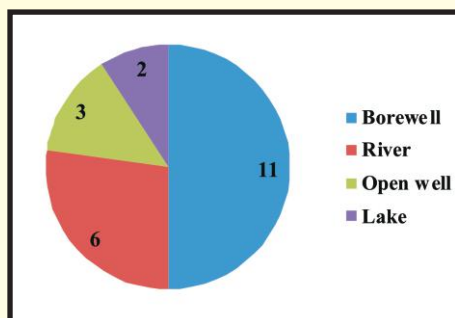
Water Quality Monitoring

Water quality monitoring is carried out by Puducherry Pollution Control Committee periodically at various locations with financial assistance from Central Pollution Control Board under National Water Quality Monitoring Programme (NWMP). Monitoring is done on quarterly basis in surface water bodies in Puducherry and Karaikal regions, Annually in Mahe and Yanam regions and during pre and post monsoon in the case of ground water.

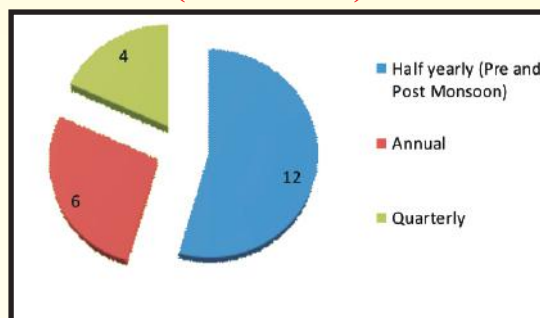
Objectives of Water Quality Monitoring

- ❖ The water quality monitoring is performed with following main objectives:
- ❖ To understand the nature and extent of pollution control and measures required.
- ❖ To evaluate the extend of pollution control required and effectiveness of pollution control measures already in existence.
- ❖ To assess water quality trends over a period of time.
- ❖ To assess assimilative capacity of a water body thereby reducing cost on pollution control.
- ❖ To understand the environmental fate of different pollutants
- ❖ To assess the fitness of water for different uses.

Water body wise (number of stations)



Frequency wise Quality Monitoring Station (in Numbers)

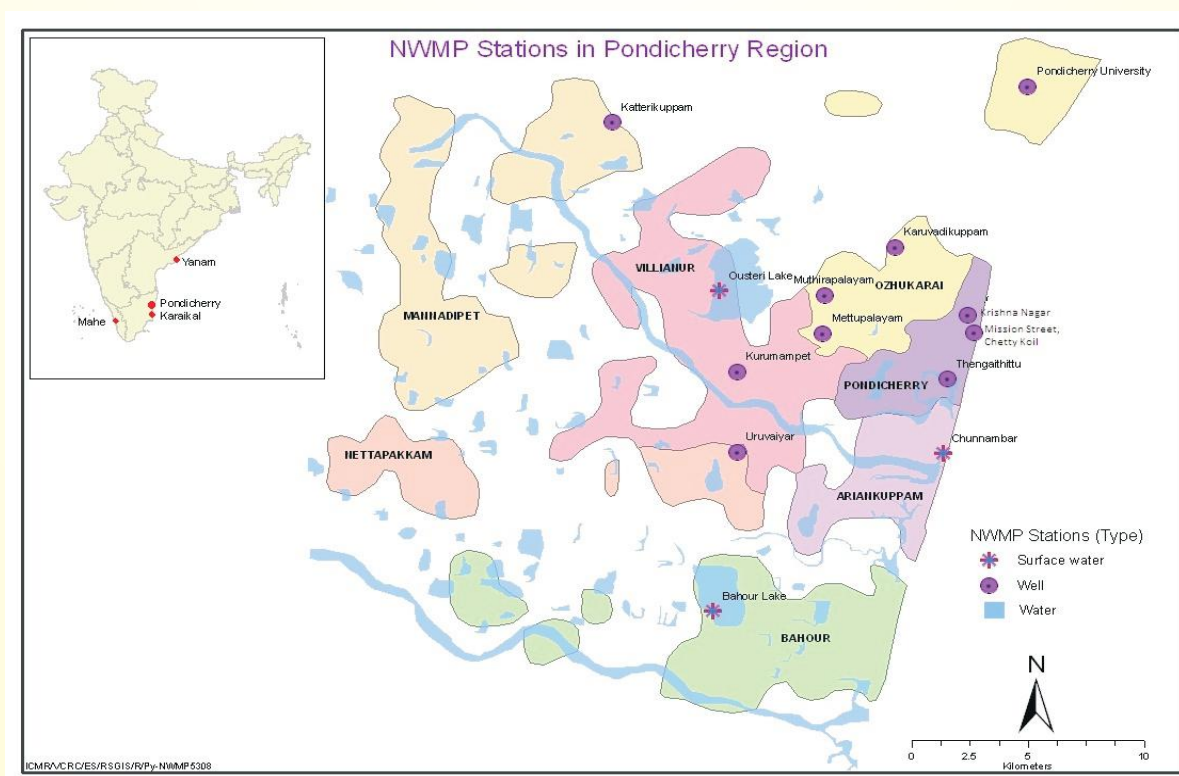


List of Parameters assessed under National Water Quality Monitoring Programme

Field observation	Core parameters	General Parameters	Bio-Monitoring	Trace Metals
<ul style="list-style-type: none"> Weather Depth of Stream/ Water table Colour and Intensity Odour Visible effluent Discharge Human activities around station Station detail 	<ul style="list-style-type: none"> pH Temperature Conductivity $\mu\text{mhos/cm}$ Dissolved Oxygen mg/l BOD mg/l Nitrate-N mg/l Nitrite-N mg/l 	<ul style="list-style-type: none"> Turbidity NTU Phenolphthalein alkalinity as CaCO_3 Total Alkalinity as CaCO_3 COD mg/l Chloride mg/l Ammonia-N mg/l Calcium as CaCO_3 mg/l Magnesium as CaCO_3 mg/l Sulphate mg/l Sodium mg/l Total Dissolved Solids mg/l Fixed Dissolved Solids mg/l Total Suspended Solids mg/l Orthophosphate mg/l Boron mg/l Potassium mg/l Fluoride mg/l % sodium mg/l SAR 	<ul style="list-style-type: none"> P/R ratio 	<ul style="list-style-type: none"> Hexavalent chromium mg/l

Water Quality Monitoring station in Puducherry region:

Station Code	Location	Type	Latitude	Longitude	Date of Inception
1396	Ousteri	Lake	11° 56' N	79 ° 44' E	11-01-90
1397	Krishna Nagar	Borewell	11° 56' N	79 ° 50' E	11-01-90
1398	Thengaithittu	Borewell	11° 54' N	79 ° 49' E	11-01-90
1453	Muthirappalayam	Borewell	11° 56' N	79 ° 46' E	01-01-92
1454	Pondicherry University, Kalapet	Borewell	12° 10' N	79 ° 51' E	01-01-92
1688	Katterikuppam	Borewell	12° 00' N	79 ° 42' E	15-05-02
1686	Bahour	Lake	11° 48' N	79 ° 44' E	15-05-02
1687	Chetty Koil, Mission Street	Openwell	12° 01' N	79 ° 51' E	15-05-02
1689	Chunnambar	River	11° 52' N	79 ° 47' E	15-05-02
2009	Kurumbapet	Borewell	11° 55' N	79 ° 45' E	16-05-06
2010	Mettupalayam	Borewell	11° 56' N	79 ° 47' E	15-05-06
2011	Uruvaiyar	Borewell	11° 53' N	79 ° 45' E	15-05-06
2012	Maruthi school, Karuvadikuppam	Borewell	11° 58' N	79 ° 48' E	15-05-06



WATER QUALITY INDEX

Water Quality Index (WQI) provides information about water quality in a single value. WQI is commonly used for the detection and evaluation of water pollution and may be defined as a reflection of composite influence of different quality parameters on the overall quality of water. The water quality parameters are selected based on its direct involvement in deteriorating water quality for human consumption. The standards for the drinking water, recommended by the Indian Standard Institution (ISI) are considered for the computation of quality rating (Q_n) and unit weight (W_n). For the purpose of calculation of water quality index, eleven water quality parameters have been selected. They are pH, Turbidity, TDS, Calcium, Magnesium, Chloride, Fluoride, Sulphate, Alkalinity, Hardness and Nitrate. The standard values of water quality parameters and the corresponding ideal values and unit weights are given in the table.

Standard values of water quality parameters and their corresponding ideal values and unit weights

Sl. No	Parameters	Standard (Sn)	Ideal Value (V id)	K Value	Unit weight
1	pH	6.5-8.5	7	0.16069	0.02143
2	Turbidity	1.0	0	0.16069	0.16069
3	TDS	500	0	0.16069	0.00032
4	Calcium	75	0	0.16069	0.00214
5	Magnesium	30	0	0.16069	0.00536
6	Chloride	250	0	0.16069	0.00064
7	Sulphate	200	0	0.16069	0.00080
8	Fluoride	1.0	0	0.16069	0.16069
9	Nitrate as NO ₃	45	0	0.16069	0.00357
10	Alkalinity	200	0	0.16069	0.00080
11	Hardness	200	0	0.16069	0.00080

WQI Calculation

The WQI is calculated by using the expression given in Equation.

$$WQI = \sum q_n W_n / \sum W_n$$

Where,

q_n = Quality rating of n^{th} water quality parameter.

W_n = Unit weight of n^{th} water quality parameter.

Quality rating (q_n)

The Quality rating (q_n) is calculated using the expression given in Equation

$$q_n = [(V_n - V_{id}) / (S_n - V_{id})] \times 100$$

Where,

V_n = Estimated value of n^{th} water quality parameter at a given sample location.

V_{id} = Ideal value for n^{th} parameter in pure water.

(V_{id} for pH = 7 and 0 for all other parameters)

S_n = Standard permissible value of n^{th} water quality parameter.

Unit Weight

The unit weight (W_n) is calculated using the expression given in Equation.

$$W_n = K / S_n$$

Where

S_n = Standard permissible Value of n^{th} water quality parameter.

K = Constant of proportionality and it is calculated by using the expression given in Equation.

$$K = [1 / (\sum 1/S_n = 1, 2, \dots, n)]$$

Source: CPCB

WQI and corresponding water quality status

WQI	Status	Possible Uses
0-25	Excellent	Drinking, Irrigation and Industrial
26-50	Good	Domestic, Irrigation and Industrial
51-75	Poor	Irrigation and Industrial
76-100	Very poor	Irrigation
>100	Unsuitable for drinking	Restricted use for Irrigation
Above 150	Unfit for drinking	Proper treatment required before use

Water Quality Index 2011- 2015 in Puducherry region

Sl.No.	Station Code	Station Name	Water quality Index (Year wise)				
			2011	2012	2013	2014	2015
1	2009	Kurumbapet	4.98	3.35	4.73	4.61	7.03
2	1397	R.K.Nagar	10.91	5.43	10.45	10.54	-
		Krishna Nagar	-	-	-	-	5.4
3	2012	Karuvadikuppam	5.57	2.46	5.62	-	-
		Maruthi school (Karuvadikuppam)	-	-	-	5.41	8.1
4	1454	Pondicherry University	4.37	5.18	4.96	0.77	5.15
5	2011	Uruvaiyar	9.82	1.87	8.33	10.43	13.3
6	1398	Thengaithittu	6.19	4.40	2.90	6.90	8.52
7	1688	Katterikuppam	3.82	1.24	3.75	8.57	9.91
8	1453	Muthirapalayam	8.13	3.11	4.2	5.46	6.69
9	2010	Mettupalayam	8.35	5.97	8.55	8.56	12.1
10	1687	Mission Street	6.02	2.13	3.93	4.47	6

Status of Ground Water Quality

During 2011-15, it is noticed that the concentration of certain parameters, viz., Alkalinity, Chloride, Total hardness and Total Dissolved Solids (TDS) are higher at particular locations viz., Katterikuppam, Ramakrishna Nagar, Uruvaiyar and Thengaithittu. In other locations, all the parameters are well within the permissible limit.

In Katterikuppam, the concentration of Alkalinity varies from 257 mg/l to 355mg/l. In Uruvaiyar the concentration of chloride, total hardness and total dissolved solids ranges from 308 mg/l to 906 mg/l, 364mg/l to 766mg/l and 1406mg/l to 2484mg/l respectively. Similarly, in Ramakrishna Nagar the level of chloride varies from 1000mg/l to 1479mg/l, total hardness from 520mg/l to 1056mg/l and total dissolved solids from 1912mg/l to 4035mg/l. The yearly variation observed in Ramakrishna Nagar location may be attributable to the fact that the sampling is done in different borewells in the same location due to non-continuous operation of borewells. In Thengaithittu the concentration of Alkalinity and TDS fluctuates from 195.8mg/l to 253mg/l and 656mg/l to 758mg/l respectively. In Chetty Koil (Open well) the TDS level ranges between 743mg/l and 920mg/l.

Though the level of Alkalinity, Chloride, Total hardness and Total Dissolved Solids (TDS) exceeds the acceptable limit in Katterikuppam and Thengaithittu, these parameters are well within the permissible limits. In Ramakrishna Nagar and Uruvaiyar, the concentration of Chloride, Total hardness and Total Dissolved Solids (TDS) are high and exceeds both the acceptable and permissible limits.

The high concentration in these two locations may be due to intrusion of saline water and geological condition of the area.

Status of Surface Water Quality

It is observed that pH is slightly alkaline during 2011 in Chunnambar river and Bahour lake in January quarter and in Ousteri lake during October quarter. During 2012 and 2013 sample was not collected due to non availability of water for the period January, April, July Quarters. The parameters pH, DO, BOD and Ammonical nitrogen are meeting the primary water quality criteria for October 2012 and 2013 quarter.

The concentration of BOD is more than 3mg/l during

- Jan'2014 quarter at Chunnambar river, Bahour lake and Ousteri lake,
- Sept'2014 quarter at Chunnambar and Ousteri and
- Oct'2014 quarter at Chunnambar, Ousteri and Bahour.
- Similarly BOD is more than 3mg/l in
- Jan'2015 quarter at Chunnambar,
- Apr'2015 quarter at Ousteri and Bahour and
- Oct'15 quarter at Chunnambar, Bahour and Ousteri lake.
- The other parameters DO and ammoniacal nitrogen are meeting the primary water quality criteria. The high concentration of BOD may be due to water stagnation and no flow of water in the water bodies.

Karaikal district

Karaikal district is one of the four districts of the Union Territory of Puducherry in India. Karaikal district is situated in more or less a flat land. There are no hills or forest in this district. The area of Karaikal region is 161 sq. kms which is about 150 kms south of Puducherry and is surrounded by Nagapattinam district of Tamil Nadu.

Karaikal city (about 16 km north of Nagappattinam and 12 km south of Tarangambadi) is the regional headquarters. Karaikal region consists of five Communes viz. Kottucherry, Nedungadu, Tirunallar, Neravy and Tirumalarajanpattinam, besides Karaikal municipality.

Geography

Karaikal district occupies an area of 160 square kilometres.

Location

Karaikal is a small coastal enclave of territory which was formerly part of French India. Together with the other former French enclaves of Pondicherry, Yanam, and Mahe, Karaikal

forms the Union Territory of Puducherry. Karaikal is surrounded on the North and South by Nagapattinam district of Tamil Nadu state, on the west by Tiruvarur district (also belonging to Tamil Nadu), and on the East by the Bay of Bengal. The enclave is located 132 km south of the city of Puducherry, and is known for its rich cultural heritage.

Rivers

The main branches of Kaveri below Grand Anicut are the Kodamurutti, Arasalar, Virasolanar and the Vikramanar. Although Arasalar and its branches spread through Karaikal, the waters of Kodamurutti and Virasolanar also meet the irrigation needs of the region.

Topography

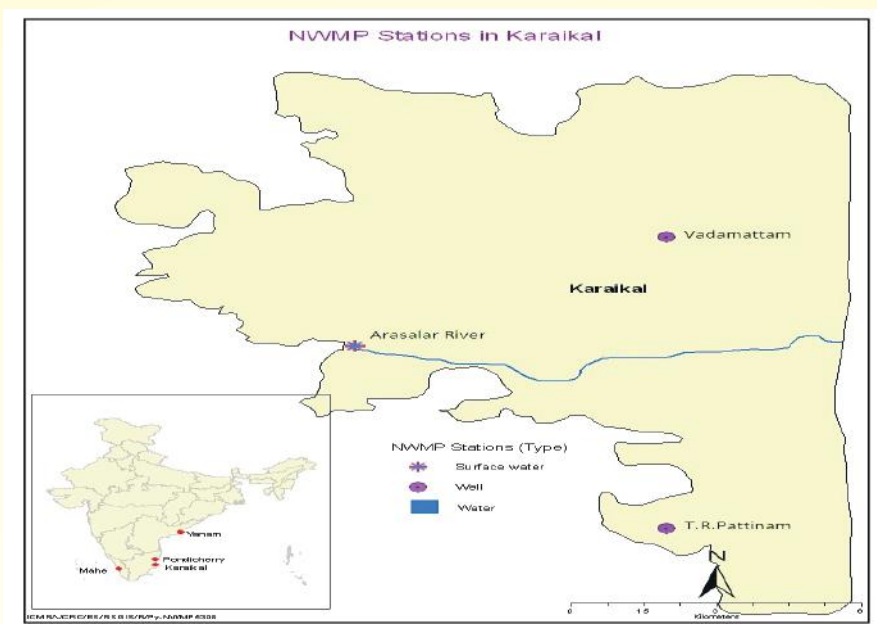
Forming part of the fertile Cauveri delta the region is completely covered by the distributaries of Cauveri. Covered completely by a thick mantle of alluvium of variable thickness, the lie of the region is flat having a gentle slope towards the Bay of Bengal in the east. It is limited on the north by the Nandalar and on the south-east by the Vettar. The group of rocks known as Cuddalore formations is met within the area contiguous to Karaikal region in Nagappattinam District.

Climate

Karaikal is situated on the east coast of India, near latitude 11° N in the deltaic region of the Cauveri, experiences tropical maritime type of climate with small daily range of temperature and moderate rainfall. Karaikal has an annual average rainfall of about 126 cm. 68 percent of which occurs during October to December. The amount of rainfall during the south-west monsoon period is small, being less than 20 per cent of the annual. November is the rainiest month, accounting for about one third of the annual total. The range of variation of annual rainfall is wide. December and January are the coolest months with the maximum at about 28°C and the minimum at about 23°C. Minimum temperature as low as 16°C may sometimes be recorded. The diurnal ranges of temperature are generally small throughout the year, being highest (about 10° C) in May and June, and the least (about 5 °C) during November to February

Water Quality Monitoring station in Karaikal region:

Station Code	Location	Type	Latitude	Longitude	Date of inception
1685	Arasalar	River	10° 54' 562" N	79 ° 49' 066" E	15-05-02
2013	T.R.Pattinam	Borewell	10° 50' 485" N	79 ° 49' 918" E	16-05-06
2014	Vadamattam	Borewell	11° 56' 773" N	79 ° 49' 771" E	16-05-06



Water Quality Index 2011- 2015

Sl. No.	Station Code	Station Name	Water quality Index (Year wise)				
			2011	2012	2013	2014	2015
1	2013	T.R.Pattinam, Karaikal	11.43	2.28	2.63	8.98	12.2
2	2014	Vadamattam, Karaikal	10.6	2.2	2.65	6.64	9.94

Status Of Ground Water Quality

In T.R.Pattinam the concentration of Alkalinity, Chloride and TDS varies from 343 mg/l to 367 mg/l, 305 mg/l to 350 mg/l, 830 mg/l to 1144 respectively. Similarly, in Vadamattam the concentration of Alkalinity, Chloride and TDS ranges from 321 mg/l to 384, 235 mg/l to 330 mg/l, 732 mg/l to 917 mg/l respectively.

Through the level of Alkalinity, Chloride and TDS exceeds the acceptable limit in T.R.Pattinam and Vadamattam, these parameters are well within the permissible limit.

Status Of Surface Water Quality

In Arasalar river during 2011- 2014 it is noticed that the concentration of pH, DO and Ammonical nitrogen are meeting the primary water quality criteria except BOD which is slightly high (4 mg/l) during October 2015 quarter.

Yanam

Yanam [French: **Yanaon**] is a town in the Indian union territory of Puducherry, located in Yanam district, which forms a 30 km² enclave in the district of East Godavari in Andhra Pradesh. It has a population of 32,000, most of whom speak Telugu. For 200 years it was a French colony, and, though united with India in 1954, is still sometimes known as *French Yanam*. It possesses a blend of French and Telugu culture prevailing in Andhra Pradesh.

Soil

Yanam's soil is alluvium consisting of sand clay and gravel. It is greyish black and clayey in composition. A few thin layers of sandy clay or sand, not exceeding 0.3-metre in thickness, are intercalated with the clay soil. The river sands on the bank of Gauthami, Godavari consist of quartz, felspar and muscovite mica. A few grains of monazite are also found in the black streaks. There are no minerals of economic value in the region.

Irrigation

Yanam receives irrigation water via the Bank Canal, which begins at the Dowleswaram headworks (Sir Arthur Cotton's barrage on the River Godavari, downstream from Rajahmundry). The canal runs towards east to Pillanka, a village near Yanam, and is popularly known as *French Channel*, having been built under a 1949 agreement between the then French Government and the Government of India. It provides irrigation and drinking water to the areas west of the Coringa River.

After merger, irrigation was provided to about 5.6 km² of dry land on the eastern side of the Coringa River by constructing an irrigation canal, the *Adivipolam Channel*, from the tail end of Tallarevu South Canal and the starting point of the Neelapalli Channel on the right side.

Climate

Yanam's climate is characterised by high humidity (over 70% in the day and 60% in the evenings throughout the year), an oppressive summer season (with humidity of 68 to 80%), and plentiful rainfall. It enjoys the benefits of both the Southwest and Northeast monsoons. Average annual rainfall is 1226 mm.

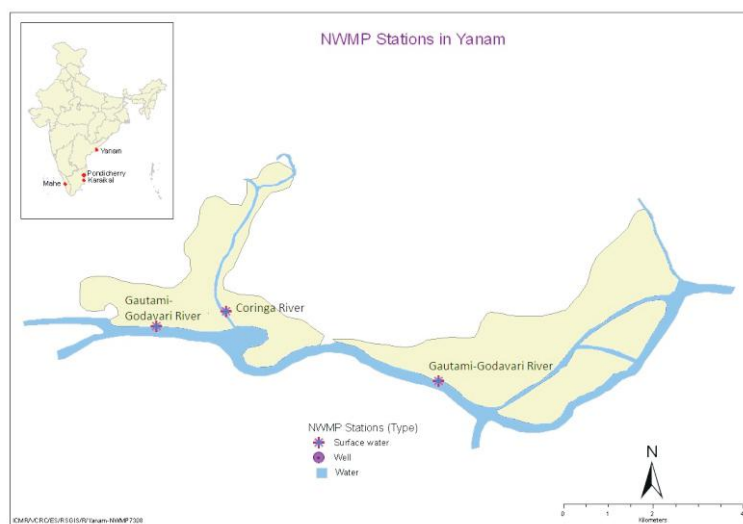
Temperature

Temperatures in Yanam range from 27 °C to 45 °C in summer, and 17 °C to 28 °C in winter. From February, temperatures start rising rapidly until May, which is the hottest month, with the mean maximum around 37 °C and mean minimum around 28 °C. Humidity being high, the heat is exhausting. The maximum temperature on some days in May or early June, before the onset of the south-west monsoon, may touch 47 °C. The sea breeze affords some relief in the afternoons.

Similarly, pre-monsoon thunder-showers may also bring relief on some days. With the onset of the monsoon in June the temperature falls rapidly, and usually remains steady until September. In this season the mean maximum temperature is around 32 °C, and night temperatures fall rapidly until December or January, when day temperatures are around 27 °C, and night temperatures around 19 °C. At times the minimum temperature may drop to 14 °C. December and January are the coolest months.

Water Quality Monitoring station in Yanam Region:

Station Code	Location	Type	Latitude	Longitude	Date of inception
2442	Gowtami –Godavari river Near Balayogi Bridge	River	16° 72' 597" N	82 ° 20' 216" E	07.01.2009
2443	Gowtami –Godavari Near Adavipolam	River	16° 71' 519" N	82 ° 26' 158" E	-do-
2444	Gowtami –Godavari Coringa River (Tidal Lock)	River	16° 73' 000" N	82 ° 21' 747" E	-do-



Status Of Surface Water Quality

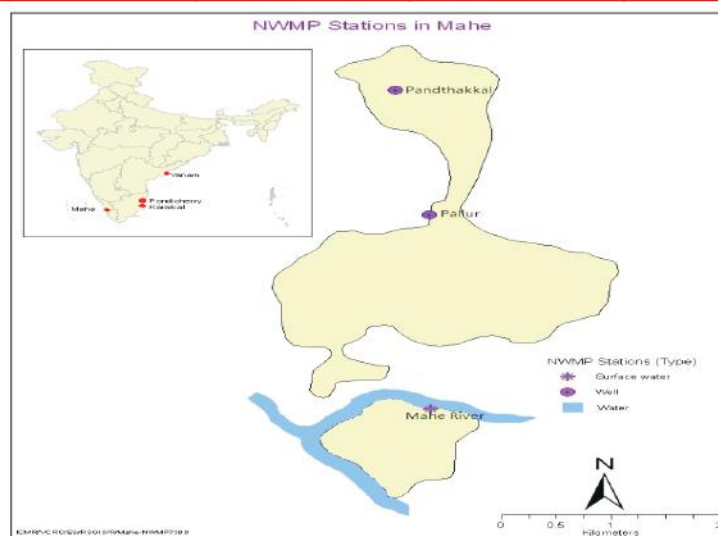
BOD is slightly high in Coringa river (5 mg/l) and in Godavari Gawtami river near Adavipolam (4 mg/l) during 2013. Other parameters are meeting the primary water quality criteria.

Mahe Region

Mahe is a small area bounded on the south west by the Arabian Sea, on the north by the River Ponniyam (Moolakadavu) and on the other sides by a stretch of calcareous hills of medium height which are linked to the ghats by a series of wooded hillocks. The river Mahe which flows towards the west, divides the region into two parts. The average temperature in Mahe is 7.0 °C. The average annual rainfall is 463

Water Quality Monitoring station in Mahe Region:

Station Code	Location	Type	Latitude	Longitude	Date of Inception
2445	Mahe river	River	11° 42' 275" N	75 ° 32' 594" E	07.01.2009
2446	Pallur	Openwell	11° 43' 960" N	75 ° 32' 460" E	-do-
2447	Panthakkal	Openwell	11° 45' 123" N	75 ° 32' 284" E	-do-



Water Quality Index 2011-2015

Sl. No.	Station Code	Station Name	Water quality Index (Year wise)				
			2011	2012	2013	2014	2015
1	2447	Pandakkal, Mahe	0.33	3.86	6.39	2.34	2.46
2	2446	Pallur, Mahe	3.04	6.68	3.55	4.47	3.59

Status of Ground Water Quality

During 2011 – 2015, it is noticed that the concentration of all parameters are well within the acceptable limit.

Status of Surface Water Quality

In Mahe river during 2011- 2015 though pH, DO and Ammonical nitrogen meets the primary water quality criteria, BOD is slightly high (4 mg/l) and pH is slightly low (6.41mg/l) during 2013.

Conclusion and Corrective measures

From the above facts & figures the Water Quality Index from 2011-2015 indicates that the water quality is found to be under excellent scale, the reason may be due to absence of any polluting source. The water is used for drinking, irrigation and industrial purpose. Though the concentration of Chloride, Total hardness and Total dissolved solids exceeds the permissible limit in Ramakrishna Nagar and Uruvaiyar, the reason may be due to intrusion of saline water and geological condition of the area. Similarly in Karaikal, even the content of Alkalinity, Chloride and Total Dissolved Solids exceeds the acceptable limit, the parameters are within the permissible limit. The excess concentration may be due to sea water intrusion. The high concentration of BOD in Coringa River is due to discharge of domestic waste water.

To prevent the intrusion of sea water, extraction of borewell water may be restricted and digging of new borewells may be strictly prohibited in Puducherry and Karaikal Regions. Domestic waste water may be treated and put into use so as to minimise the intake of ground water and to avoid contamination of surface water bodies.

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