



June 2018

Water *Watch*



Quality Matters



Watch the drinking water quality of
Madurai City

Arapalayam Water Works an idea of the British sanitary engineer, J A Jones, The first protected water supply was provided to Madurai City in the year 1892 from the river Vaigai to provide safe drinking water. The British were able to pump 30 lakh litre per hour through this system and were able to provide drinking water to the entire city that had 1 lakh population by the turn of the 20th century. The project which had a long run was abandoned in 1980 after the river was polluted by sewage which is narrated from the book '**Neerindri - the water resources of Madurai**'.



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Quality Matters!

Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection.

The world is facing a water quality challenge. Serious and increasing pollution of fresh water in urban areas poses a growing risk to public health, food security, biodiversity and other ecosystem services. Without a preliminary assessments of the current water quality situation, the magnitude of the challenge is still unknown. Quality of drinking water is a serious concern in urban areas of India, with cities facing problems of water contamination time to time. Better information is required on where the issues lie and what is needed to effectively and efficiently take action to protect and improve water quality.

844 Million

People don't have clean water.
 (Source: WHO/ UNICEF Joint Monitoring Programme (JMP) Report 2017)

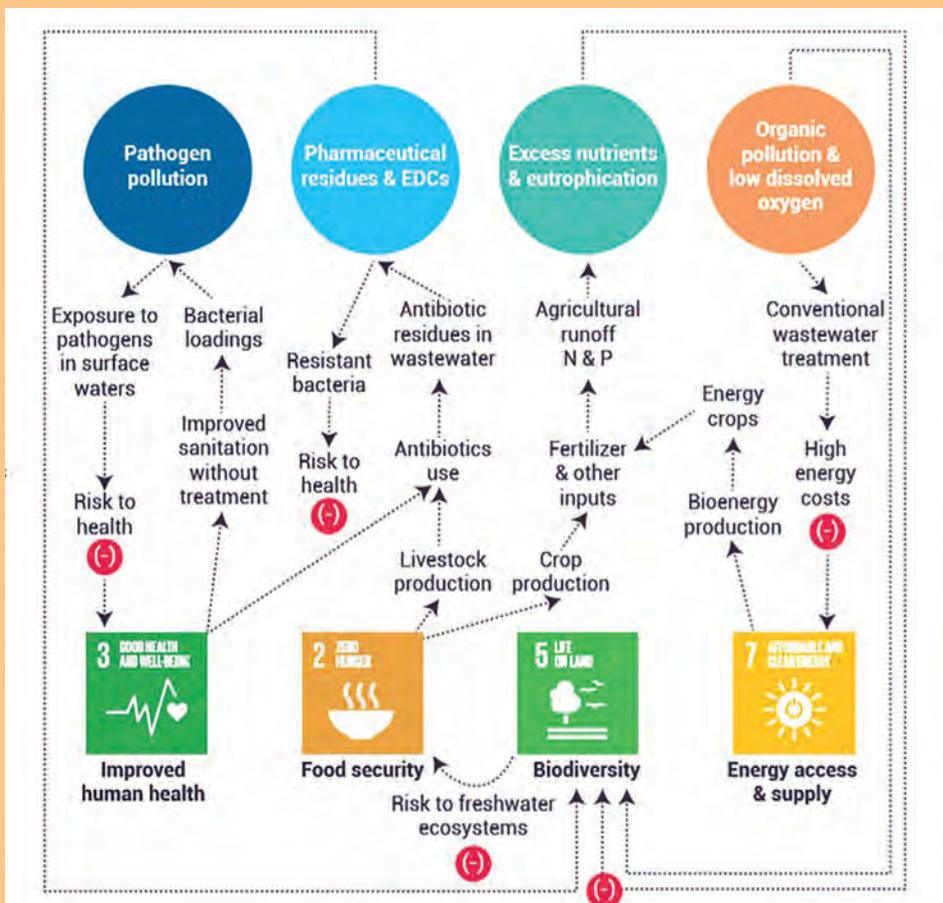
Every 2 minutes

Diarrhoea caused by dirty water and poor toilets kills a child under 5.
 (Source: WASHWatch.org)

\$1=\$4

Every \$1 invested in water returns an average of \$4 in increased productivity.

(Source: WHO, 2012)



Linkages of water quality with selected Sustainable Development Goals.
 From UNEP 2016, Snapshot

Objective

- More data are urgently needed in order to better understand the Madurai's water quality challenge, which is affecting key freshwater ecosystem services such as drinking water, health, biodiversity and food security.
- This water quality assessment would provide policymakers and other stakeholders with information they need in order to make informed decisions to address this issue.

Waterwatch Answers

An assessment of the Madurai water quality situation is needed to address many different important questions.

Such as

- What is the water quality situation in different parts of the Madurai with regards to different water quality parameters?
- What is the trend of water quality, and what are the main drivers of these trends?
- For a particular location, what is the relationship between pressures, impacts, and responses to water quality degradation?
- What are the various alternatives for technical measures or management strategies to protect good water quality or reduce water pollution?
- What is the role of governance in maintaining or restoring water quality?

Water Supply by Madurai Corporation

Madurai Corporation meets its water demand through surface and subsurface sources through water supply schemes on the Vaigai River. First protected water supply was provided to Madurai City in the year 1892 through head works at Arappalayam in the river vaigai. The water abstracted from the Vaigai River through infiltration galleries was pumped directly into the distribution system. In 1924 another head works was installed at Kochadai in the river vaigai. The above two head works were balanced as the sand bed over the infiltration galleries were found thoroughly washed off.

Considering the increasing population and additional demand, head works were installed early in the 1970's at Melakkal, Thatachampathu and Kochadai Collector well on the Vaigai river bed and they are utilized to convey water through pumping to the north zone (i.e., North of River Vaigai) during monsoon season and when there is sufficient flow in the river. Head works at Mannalur and Thiruppuvanam down stream of Madurai City were utilized to pump water to the South Zone (i.e., South of River Vaigai) and are partly functioned depending upon the availability at source. (Source: Madurai Corporation official website)



The present available source of water supply for Madurai Corporation are listed below:

No.	Source	Amount of water in MLD	Remarks
1	Vaigai water supply scheme	115 MLD	Scheme I: 68MLD Scheme II: 47MLD
2	Cauvery Integrated Water Supply Scheme	10 MLD	Also they are working on future expansion
3	From river bed Source	34 MLD	Melakkal- 16MLD Manalur- 9MLD Kochadai- 2MLD Kuruvithurai- 7MLD

Future Plan on water source

A dedicated water supply scheme from Mullai Periyar River at Lower Camp (Theni Dt.) to Madurai at an estimated cost of ₹1140 crore. The city will have 240 MLD of water each day to ensure that there is continuous supply.

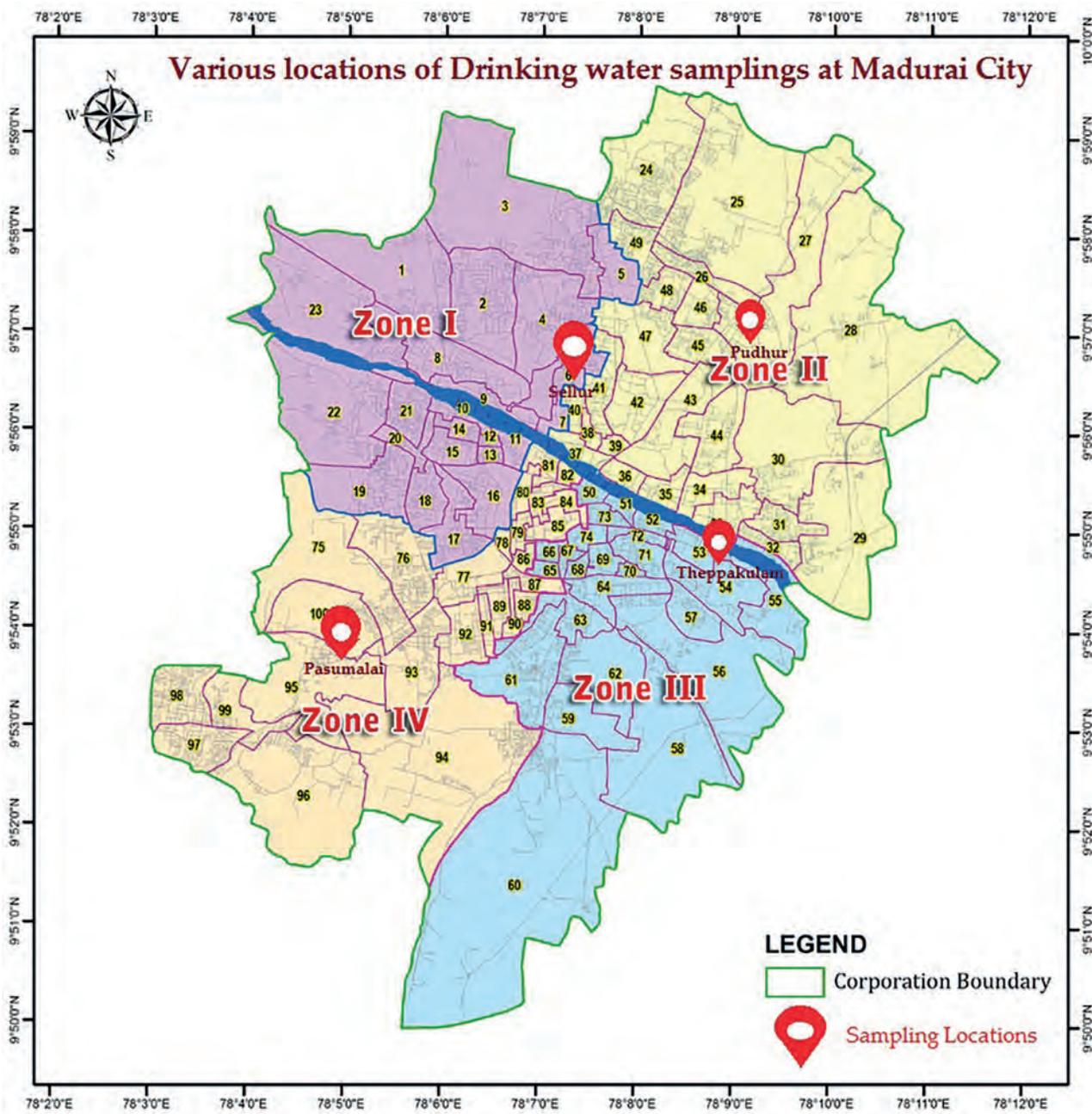


Baseline Assessment Water and Scenario Analysis

A spatial temporal assessment of the Madurai urban water quality to provide an understanding of the relative condition of water quality in different sources of water supplies such as Lorry water, Corporation water, Groundwater, Surface water which are all utilised for drinking purpose. In order to cover all four zones, we collected the drinking water sample in the each zone under Corporation boundary. The Locations are

1. Sellur- Zone-I;
2. Pudhur- Zone-II;
3. Thepakulam- Zone-III;
4. Pasumalai- Zone-IV





Sampling Locations

Based on literature reviews and from expert guidance, we categorise the different source of drinking water so we collected more than 16 samples with in Corporation boundary where In each demographical zone we collected four samples of different sources.

Different Sources of Drinking Water in Madurai City:



Water supply through Pipe Network- Corporation Supply



Water Supply through Vehicles - Lorry Supply



Packaged drinking water- Can water Supply



Bore well water- Ground water

KNOW ABOUT PARAMETERS

Physical Parameters	1. Total Dissolved Solids (mg/L)	TDS is a measure of the combined content of all inorganic and organic substances contained in water in molecular, ionized or micro-granular (colloidal sol) suspended form. Filterable Residue
	2. Appearance	All type of consuming water to be appeared as Crystal & Clear.
	3. Colour	Safe drinking water should be colourless. Dissolved organic matter from decaying vegetation or other inorganic materials can impart colour to the water.
	4. Odour	Drinking water must have unobjectionable odour
	5. Turbidity	Turbidity is the cloudiness or haziness caused by individual particles which makes the water appear non-transparent. If a large amount of suspended solids are present in water, it will appear turbid in appearance indicating presence of impurities.
	6. Electrical Conductivity (Micro mho/cm)	The presence of salts significantly affects plant growth, and therefore is the most important parameter in determining the suitability for irrigation

Chemical Parameters	7. pH	pH of water an expression of the Hydrogen ion concentration. Alkaline water is with pH of above 7 and acidic water has pH of below 7; whereas water with pH 7 is neutral.
	8. Total Alkanyity as CaCo3	The total alkalinity (TA) is a measure of how much of the alkaline substances there are in the water.
	9. Total Hardness as CaCo3	In fresh water, the principal hardness causing ions are calcium and magnesium which precipitate soap. Total hardness is defined as the sum of the calcium and magnesium concentration, both expressed as CaCO ₃ , in mg/L.
	10. Calcium as Ca	Water described as "hard" is high in dissolved minerals, specifically calcium and magnesium. Hard water is not a health risk, but a nuisance because of mineral build up on fixtures and poor soap and/or detergent performance.
	11. Magnesium as Mg	
	12. Iron as Fe	High levels of iron can cause an objectionable colour and taste and can stain cooked food, fixtures and laundry. Drinking-water with high concentrations of iron will not make people sick. Iron, however, can turn water into red-orange colour
	13. Manganese as Mn	Manganese is associated with iron minerals and occurs in nodules in ocean, fresh water and soils. Manganese is used in steel alloys, batteries and food additives.
	14. Free Ammonia as NH3	Free Ammonia (Ammonium Ion) is soluble in water which is most toxic of all forms of nitrogen are extremely sensitive to this gas.
	15. Nitrite as NO2	Usually present in low quantities as it is unstable, but important as extremely toxic to fish and other aquatic species
	16. Nitrate as NO3	Most oxidised form of nitrogen, can be fatal if present in large quantities
	17. Chloride as Cl	Chloride ion may be present in combination with one or more of the cations of calcium, magnesium, iron and sodium. Excessive chloride in water indicates presence of septic tank effluents, animal feeds, industrial effluents, irrigation drainage, and seawater intrusion in coastal areas.
	18. Fluoride as F	Fluoride is a naturally occurring compound derived from fluorine. It is found in many rocks and minerals in the soil and enters drinking water as water passes through these soils. Fluoride has been shown to prevent tooth decay, but too much fluoride can cause teeth discoloration.
	19. Sulphate as SO4	Sulphates are of concern as they reduce to sulphides which are both odorous and corrosive to pipes and mechanisms. Sulphates can also upset the biological process if the concentration is high
20. Phosphate as PO4	Phosphorous is the limiting parameter for algae and cyanobacteria growth. Orthophosphates (or just "Phosphates") are in a form that is directly available for biological metabolism. Their presence provides ideal conditions for algae growth.	

The results of each zone of water samples are discussed.

Results of various drinking water sources in Sellur area (Zone 1)

Type of Source		Acceptable Limit as per BIS 10500-2012	Permissible Limit*	Corporation Water	Can Water	Lorry Water	Ground Water
Date of Collection				14/05/2018	14/05/2018	14/05/2018	14/05/2018
Location of Sample				Zone 1 Sellur			
Physical Parameters	1. Total Dissolved Solids (mg/L)	500	2000	962	39	224	1617
	2. Appearance	Crystal & Clear		Blackish	C&C	C&C	C&C
	3. Colour			Blackish	None	None	None
	4. Odour	Unobjectionable		Obj.	Unobj.	Unobj.	Unobj.
	5. Turbidity	1	5	30	0	2	0
	6. Electrical Conductivity (Micro mho/cm)			1375	56	320	2310
Chemical Parameters	7. PH	6.5-8.5	6.5-8.5	6.7	6.6	6.7	7.6
	8. Total Alkanity as CaCo ₃	200	600	360	20	92	440
	9. Total Hardness as CaCo ₃	200	600	240	10	100	440
	10. Calcium as Ca	75	200	48	2.4	24	96
	11. Magnesium as Mg	30	100	29	1	10	48
	12. Iron as Fe	0.1	1	4	0	0	0
	13. Manganese as Mn	0.1	0.3	NT	NT	NT	NT
	14. Free Ammonia as NH ₃	0.5	0.5	12	0	0.08	0
	15. Nitrite as NO ₂	0.5	0.5	0.252	0	0	0
	16. Nitrate as NO ₃	45	45	1	1	2	11
	17. Chloride as Cl	250	1000	232	6	32	400
	18. Fluoride as F	1	1.5	0.6	0.2	0.2	1
	19. Sulphate as SO ₄	200	400	42	1	20	53
	20. Phosphate as PO ₄	0.5	0.5	3.55	0	0.14	0

*Permissible limit are acceptable in the absence of alternate sources. Bureau of Indian Standards recommends that acceptable limits to be implemented.

*All Chemical parameters are expressed as milligram per Litre (mg/L)

*Red indication are the values beyond the acceptable limit

Inference from the Zone 1 result

S.No	Parameter	Inference
1	Turbidity and Iron/Corporation water	Corporation water sample is chemically 'NON-POTABLE' since turbidity and Iron are exceeds the maximum allowable limits
2	Ammonia/ Corporation water	Due to inflow of waste water in the drinking water pipeline leads corporation water with objectionable odour and indicate the ammonia pollution
3	TDS/ Ground water	Sellur region having high dissolved solids. May be due to mismanaged surfaced water body and insufficient recharge.
4	Minerals/Can water	Due to Reverse Osmosis Technology (RO), The drinking water is almost demineralised.



Apparatus for fluoride test

Results of various drinking water sources in Pudhur area (Zone 2)

Type of Source		Acceptable Limit as per BIS 10500-2012	Permissible Limit*	Corporation Water	Can Water	Lorry Water	Ground Water
Date of Collection				14/05/2018	14/05/2018	14/05/2018	14/05/2018
Location of Sample				Zone 2 Pudhur			
Physical Parameters	1. Total Dissolved Solids (mg/L)	500	2000	224	40	413	1113
	2. Appearance	Crystal & Clear		C&C	C&C	C&C	C&C
	3. Colour			None	None	None	None
	4. Odour	Unobjectionable		Unobj.	Unobj.	Unobj.	Unobj.
	5. Turbidity	1	5	0	0	0	2
	6. Electrical Conductivity (Micro mho/cm)		320	58	590	1590	2310
Chemical Parameters	7. PH	6.5-8.5	6.5-8.5	7.4	6.6	7.1	7.2
	8. Total Alkanity as CaCo3	200	600	72	20	140	408
	9. Total Hardness as CaCo3	200	600	100	8	120	360
	10. Calcium as Ca	75	200	16	1.6	24	80
	11. Magnesium as Mg	30	100	14	1	14	38
	12. Iron as Fe	0.1	1	0	0	0	0
	13. Manganese as Mn	0.1	0.3	NT	NT	NT	NT
	14. Free Ammonia as NH3	0.5	0.5	0	0	0	0
	15. Nitrite as NO2	0.5	0.5	0	0	0	0
	16. Nitrate as NO3	45	45	1	2	6	2
	17. Chloride as Cl	250	1000	36	6	60	212
	18. Fluoride as F	1	1.5	1	0.2	0.6	0.6
	19. Sulphate as SO4	200	400	37	1	35	46
	20. Phosphate as PO4	0.5	0.5	0	0	0.15	0.12

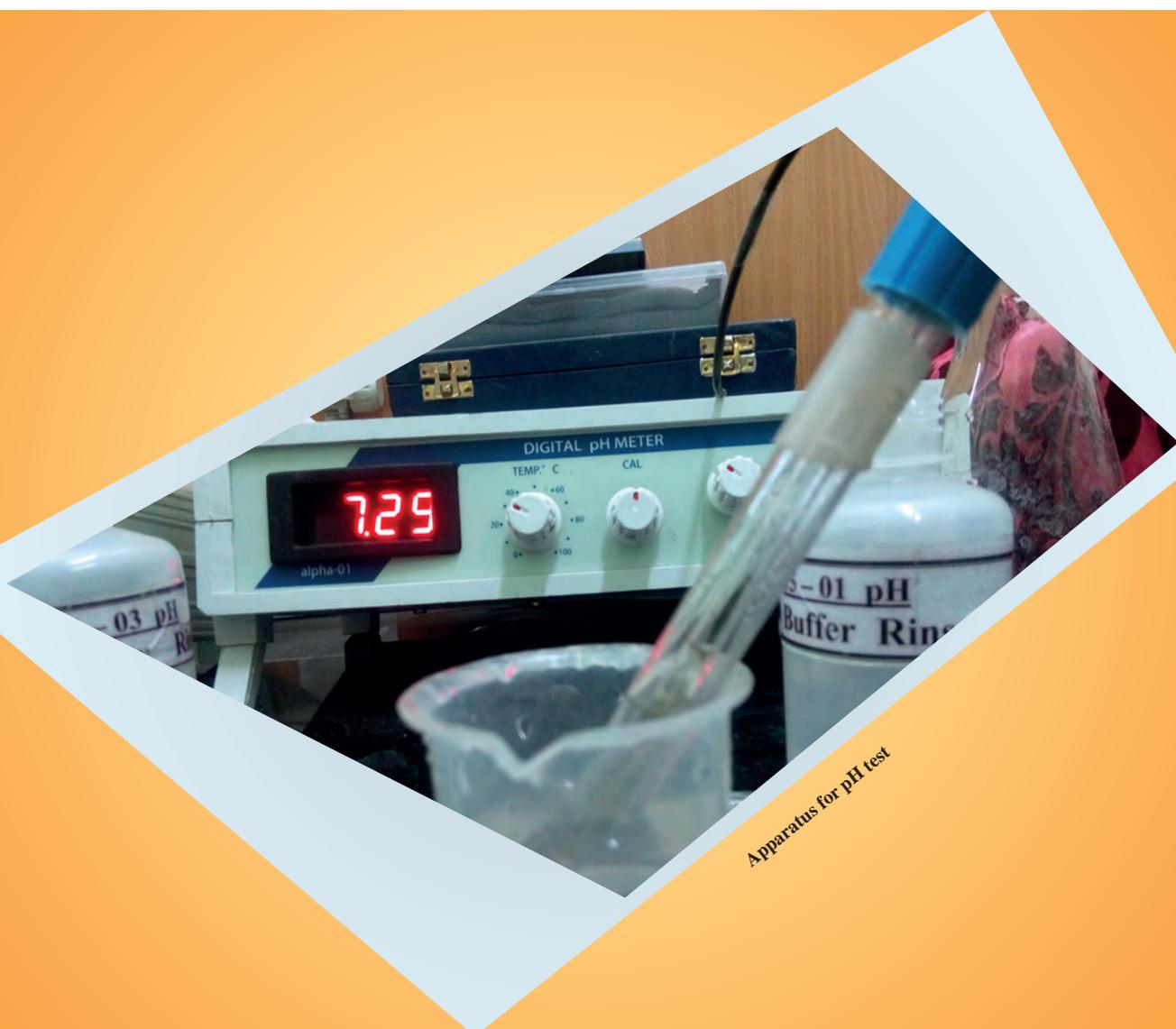
*Permissible limit are acceptable in the absence of alternate sources. Bureau of Indian Standards recommends that acceptable limits to be implemented.

*All Chemical parameters are expressed as milligram per Litre (mg/L)

*Red indication are the values beyond the acceptable limit

Inference from the Zone 2 result

S.No	Parameter	Inference
1	TDS(Total Dissolved Solids) / Corporation water	Corporation water supply in some region of Pudhur having excellent TDS value. Almost 200mg/l of TDS in drinking water refers tasty water.
2	Alkalinity and Hardness/ Lorry water	May be mixing of ground water in to Corporation's treated water which leads to increase of hardness.
3	TDS/ Ground water	Pudhur region having high dissolved solids. May be due to insufficient recharge and high population density
4	Minerals/Can water	Due to Reverse Osmosis Technology (RO), The drinking water is almost demineralised.



Results of various drinking water sources in Pasumalai area (Zone 3)

Type of Source		Acceptable Limit as per BIS 10500-2012	Permissible Limit*	Corporation Water	Can Water	Lorry Water	Ground Water
Date of Collection				14/05/2018	14/05/2018	14/05/2018	14/05/2018
Location of Sample				Zone 3 Pasumalai			
Physical Parameters	1. Total Dissolved Solids (mg/L)	500	2000	847	84	273	1347
	2. Appearance	Crystal & Clear		C&C	C&C	C&C	C&C
	3. Colour			None	None	None	None
	4. Odour	Unobjectionable		Unobj.	Unobj.	Unobj.	Unobj.
	5. Turbidity	1	5	1	0	1	1
	6. Electrical Conductivity (Micro mho/cm)		320	1210	120	390	1925
Chemical Parameters	7. PH	6.5-8.5	6.5-8.5	7.3	7.5	6.6	6.8
	8. Total Alkanity as CaCo3	200	600	272	40	88	460
	9. Total Hardness as CaCo3	200	600	360	12	108	680
	10. Calcium as Ca	75	200	80	2.4	24	128
	11. Magnesium as Mg	30	100	38	1	12	86
	12. Iron as Fe	0.1	1	0	0	0	0
	13. Manganese as Mn	0.1	0.3	NT	NT	NT	NT
	14. Free Ammonia as NH3	0.5	0.5	0.16	0	0.08	0.32
	15. Nitrite as NO2	0.5	0.5	0	0	0	0
	16. Nitrate as NO3	45	45	6	1	7	7
	17. Chloride as Cl	250	1000	192	14	52	320
	18. Fluoride as F	1	1.5	0.2	0.2	0.4	0.6
	19. Sulphate as SO4	200	400	54	1	19	75
	20. Phosphate as PO4	0.5	0.5	0	0	0	0

*Permissible limit are acceptable in the absence of alternate sources. Bureau of Indian Standards recommends that acceptable limits to be implemented.

*All Chemical parameters are expressed as milligram per Litre (mg/L)

*Red indication are the values beyond the acceptable limit

Inference from the Zone 3 result

S.No	Parameter	Inference
1	Total Hardness /Ground water	Pasumalai's ground water is chemically NON POTABLE since Total hardness value exceeds the maximum allowable limits.
2	TDS/ Corporation water	Pasumali Corporation supply water having the high TDS which is beyond the acceptable limit
3	Chemical Parameters/ Ground water	Even after having good geographical location such as Thenkal tank one of the largest tank of Madurai. Due to no inflow of water leads to increase of chemical parameter in the ground water
4	Minerals/Can water	Due to Reverse Osmosis Technology (RO), The drinking water is almost demineralised. The reject of RO plant having high TDS and Hardness



Apparatus for conductivity test

Results of various drinking water sources in Theppakulam area (Zone 4)

Type of Source		Acceptable Limit as per BIS 10500-2012	Permissible Limit*	Corporation Water	Can Water	Lorry Water	Ground Water
Date of Collection				14/05/2018	14/05/2018	14/05/2018	14/05/2018
Location of Sample				Zone 3 Pasumalai			
Physical Parameters	1. Total Dissolved Solids (mg/L)	500	2000	259	91	During sampling, Lorry water is not available in that area	1113
	2. Appearance	Crystal & Clear		C&C	C&C		C&C
	3. Colour			None	None		None
	4. Odour	Unobjectionable		Unobj.	Unobj.		Unobj.
	5. Turbidity	1	5	1			
	6. Electrical Conductivity (Micro mho/cm)		320	370	130		1590
Chemical Parameters	7. PH	6.5-8.5	6.5-8.5	7.2	7		7.2
	8. Total Alkanity as CaCo3	200	600	108	20		500
	9. Total Hardness as CaCo3	200	600	100	14		220
	10. Calcium as Ca	75	200	16	2.4		48
	11. Magnesium as Mg	30	100	14	2		24
	12. Iron as Fe	0.1	1	0	0		0
	13. Manganese as Mn	0.1	0.3	NT	NT		NT
	14. Free Ammonia as NH3	0.5	0.5	0.08	0		0.16
	15. Nitrite as NO2	0.5	0.5	0	0		0
	16. Nitrate as NO3	45	45	3	1		6
	17. Chloride as Cl	250	1000	48	32		168
	18. Fluoride as F	1	1.5	0.2	0.1		0.6
	19. Sulphate as SO4	200	400	9	2		51
	20. Phosphate as PO4	0.5	0.5	0.01	0		0

*Permissible limit are acceptable in the absence of alternate sources. Bureau of Indian Standards recommends that acceptable limits to be implemented.

*All Chemical parameters are expressed as milligram per Litre (mg/L)

*Red indication are the values beyond the acceptable limit

Inference from the Zone 4 result

S.No	Parameter	Inference
1	TDS/ Corporation water	In Thepakkulam area, the sampled location show decent result on pipeline supply
2	Electrical conductivity/ Ground water	Higher EC refers the presences of solids in the water. Ground water alarms the higher EC.
3	Minerals/Can water	Due to Reverse Osmosis Technology (RO), The drinking water is almost demineralised. The reject of RO plant having high TDS and Hardness



Analysis Of Mitigation Options

In most of the places drinking water pipe line is below the Underground drainage (UGD). Even small breakage in the UDG leads to entry of drainage water into drinking water pipeline. Proper installation and continuous supervision are needed to ensure the pipeline water quality

1

2

Only 20% of the total number of manufacturers of packaged drinking water (Can water) in Madurai have licences of operation. Water is usually drawn from areas like Alagarkoil Road, Kadachanendal, Pudur, Mangalakudi, Kochadai, Thuvariman and Melakkal which have rich groundwater base and most place comes under village panchyat. Prominently the reject are not properly treated in these plant. The legal action are immediately needed on unauthorised operators

It is not possible to drink groundwater without proper treatment in most parts of Madurai. The higher presence of TDS could be due to the absence of rainfall and failure to maintain storage in waterbodies.

3

4

The sustainable solution specifies certain critical steps for integrated urban water management (IUWM). The IUWM looks at the entire water cycle – water sources, supply, waste water and storm water – as one system that should be contextualised within an urban water framework. It also insists that surface water, groundwater, rainwater, storm water, black water (sewage) and grey water (used water from kitchen).

Governance Reflection

We brought the issue of contaminated supply of Corporation water in the Sellur region to the Madurai Corporation Commissioner Dr. Aneesh Sekar.

He responded that, Corporation is seriously working on this issue, He clarified that Madurai Corporation supply's water once in four days due to scarcity. In the non supply day's public are repeatedly using hand pumps on the bare pipeline, these creates negative pressure in the water supply pipe line. This pressure absorbs the nearby surface water (Mostly drainage water). These leads to contaminated outlet of water. He also pointed out this problem are happening in all the Urban areas.



Drinking water supply tank installed by corporation

Country Profile INDIA



2018 EPI Country Rank (out of 180)

177

EPI Score [0=worst, 100=best]

30.57

Population (millions)	1324.2
Land Area (sq. km)	2,973,190
GDP (PPP 2011\$ billions)	8,067.7
GDP <i>per capita</i>	6,093
SDG Index*	58.1

Country Scorecard



RESULT OF ENVIRONMENTAL PERFORMANCE INDEX (EPI) FROM WORLD ECONOMIC FORUM :

The 2018 Environmental Performance Index (EPI) ranks 180 countries on covering environmental health and ecosystem vitality. The EPI is produced jointly by Yale University and Columbia University in collaboration with the World Economic Forum.

Meteorological Updates

Rainfall Data

Station Name: DHAN Central Office, Madurai

Device: Automated rain gauge.

Average Annual rainfall for Madurai: 840mm

MAY 2018 - Rainy days	
Date	Intensity (mm/d)
02/05/2018	2
04/05/2018	1
08/05/2018	10
09/05/2018	21
22/05/2018	22
24/05/2018	18
Total rainfall	73 mm



Percentage of May month's rainfall (at DHAN Station alone) from Annual average of Madurai: 8.6% of 840mm



Temperature Data

MAY 2018 - Temperature		
	Date	Temperature
Highest temperature	02/05/2018	41°C
Lowest temperature	08/05/2018	25°C
Average temperature	40°C/28°C	

We sincerely acknowledge the Laboratory

Water Quality Testing Laboratory
The Institution of Engineers (India)
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For Suggestion/Comments please write us on



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