



May 2019

Water Watch

Quality Matters



Springs

The Indicator of water exploitation

In Himalayas of Uttarkhand, the big glacier-fed rivers form gorges so deep that it is difficult to fetch water for everyday use. Therefore, the local people are sustained by the relatively small spring-fed rivers. Gagas is one of the myriad spring-fed rivers without which life would be almost impossible in the Himalayas. These springs serves as a crucial source of water in the winter when there is very little flow from the frozen glaciers. But 'Hindu Kush Himalayan Monitoring and Assessment Programme', stated, "About 50% of springs have gone dry. Springs have been particularly affected by the depletion of shallow water table because of reduced infiltration due to crust formation and by increased intensity of rainfall. They are further impacted by rapid socio-economic growth, demographic changes, and infrastructural developments, such as dams and road building."



**Centre for Urban Water Resource (CURE)
Water Knowledge Centre
DHAN Vayalagam (Tank) Foundation**

1A, Vaidyanathapuram East
Kennet Cross Road

Madurai 625 016. Tamil Nadu, INDIA

Tel.: +91 452 2302500; Fax: 2602247

Email: dhancure@dhan.org

Contents

1. Springs: A Reliable Water Source of Our Landscape	1
2. Springs in Nagamalai Hills and Azhagar Malai Hills	3
3. Few Inferences on springs	6
4. Water Wisdom at "The Nature's" academy	7
5. Vandiyur updates	9
6. Baseline Assessment Water and Scenario Analysis	10

Springs: A Reliable Water Source of Our Landscape

Tholkappiyam, the earliest Tamil literature has classified the landscape as five 'Thinai's' (ecosystems). Communities living in this landscape were dependent on different water sources. They have constructed structures to harvest surface and sub-surface water. They are as follows,

Kurinji (Mountains) - Waterfalls and springs,

Mullai (Forest, pasture) – Streams and springs,

Marudham (Agricultural areas, plain or valley) – Rivers, ponds and Wells,

Neithal (Coast) – Dug well in sandy soil,

In above four ecosystems, during dry spells, springs, Ooranis (drinking water ponds) and dug wells are the 'critical water sources'. If these sources fail, life in these landscape collapses and turns into the fifth ecosystem called 'Paalai (Parched wasteland)'.

The commonness among Springs, Ooranis and dug wells are their source. That is 'ground water', the source that was anciently abstracted only during the dry spells.

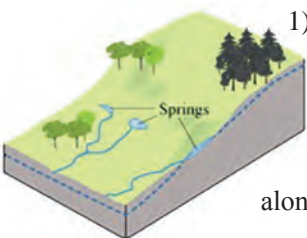
Ooranis are dug out drinking water ponds that collect rain water during monsoon showers and harvest ground water that flows sub surface.

Wells are dug outs created to intercept the water table (in case of unconfined aquifers) or phreatic line (in case of confined aquifers) and fetch the ground water.

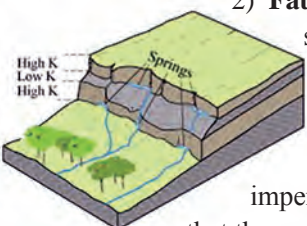
Both Ooranis and wells are artificial structures created out of ancient wisdom driven by the factor 'survival'.

But 'Springs' are natural points, where water flowing subsurface is forced to spring out of the ground surface. These are formed when the side of a hill, a valley bottom or other excavation intersects a flowing body of groundwater at or below the local water table, below which the subsurface material is saturated with water.

There are six major types of springs. They are as follows,

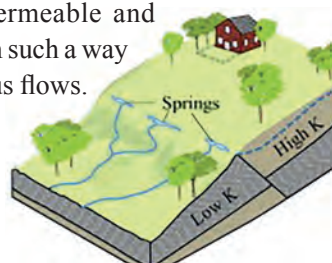


1) **Depression spring** - a spring where the earth's surface is coincident with the water table. These are also called as gravity spring. These springs form due to the pull of gravity. The water gets pulled down through the ground until it reaches a layer where it can't penetrate. Because it has nowhere else to go, it starts flowing horizontally until it reaches an opening and water comes out as a spring. These are usually found along hillsides and cliffs.

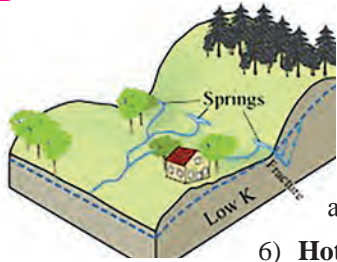


2) **Fault spring** - When an aquifer encounters a vertical fracture in the Earth's crust, it sometimes emerges from the fault as a surface spring. Halted by an impermeable rock wall, the water is forced up along the fault to a place where it bubbles out onto the landscape as a fault spring.

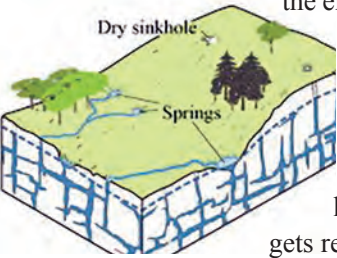
3) **Contact spring** - results when a permeable and impermeable rock intersects the ground surface in such a way that the groundwater is deflected to the surface and thus flows.



4) **Fracture spring** - results from the interconnection of fractures and joints system through which the groundwater flows.



5) **Karst springs/ Sinkhole springs:** Karst is a topography formed from the dissolution of soluble rocks such as limestone, dolomite, and gypsum. It is characterized by underground drainage systems with sinkholes and caves. Karst springs occur at places of contact between carbonate masses and impermeable layers.

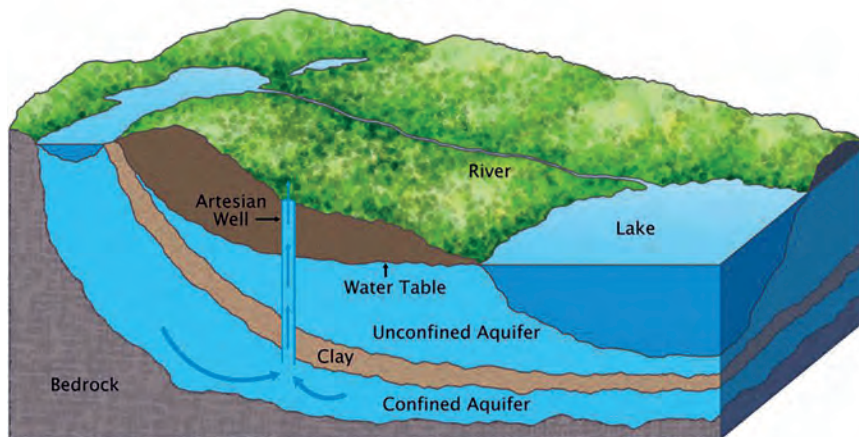


6) **Hot water spring/ Igneous spring:** A hot water spring is a spring produced by the emergence of geothermally heated groundwater that rises from the Earth's crust.

The amount of water that flows from springs (spring discharge) depends on the rainfall pattern, the recharge area characteristics, nature and character of the aquifers that feed these springs. When the rainfall is erratic, when the top soil is eroded, when rock structures are disturbed due to stone quarrying, when land use-land cover of recharge area (springshed or spring basin) is altered the spring discharge gets reduced. Springs either dry out or falls seasonal.

Ground water that shoots out as spring contributes to the streams and rivers by extending their flow period. Therefore, reduction in spring discharge directly affects the flow of spring fed rivers.

Aquifer



Madurai Corporation, one of the largest corporations of Tamil Nadu hydrologically falls under Sattiyar and Gridhumal river sub basins. Both Sattiyar and Gridhumal rivers are seasonal and spring fed rivers. The Sattiyar river originates from 'Sirumalai Hills' and 'Alagarkoyil hills' and the Gridhumal river starts from 'Nagamalai Hills'. These springs in these hills feed the streams that feeds the Tank cascades in Madurai City.

Activities such as stone quarrying and sand mining for infrastructures, over grazing of goats, deforestation, erosion of top soil, forest fires attributed by erratic rainfall consequently limited the amount of rainwater that infiltrates to recharge the groundwater aquifers. Which dried the springs and ultimately reduced the flow of water in both the rivers.

This water watch throws a lime light on the springs that are still functional in these hills.

There were more than 10 springs in the Nagamalai Hills. But now people were able to list only few springs, namely Pul oothu, Paal oothu, kakka oothu, Thaalai oothu, Naagar theertham, Yelu oothu and Naga amman oothu. Among which Paal oothu, kakka oothu and Yelu oothu are almost perennial, Pul oothu and Thaalai oothu are seasonal, Naagar theertham and Naga amman oothu are dysfunctional. The discharge from the springs were source for the River Gridhumal.

Topographically the region is dominated by steeply dipping mounds and depressions that alternates. Having originated from quartzite, the terrain is highly rough. The characteristic joints and fractures have resulted in micro valleys and thus rivulets were present all along the hill range.

Geologically the area forms a part of the Southern Indian high grade granulite-gneissic terrain. The important lithounits in the area are quartzite, gneisse, charnockite, granite, pegmatite and dolerite. The different types of gneisses include biotite gneiss, garnetiferous biotite gneiss, garnetiferous biotite sillimanite gneiss and hornblende gneiss. The springs flow through the jointed quartzite unit that forms the major part of the hill. The whole structure is intermediate in chemical composition which is represented by moderately thick vegetative cover.

Following are the description of few above mentioned springs.

Pul Oothu: The name implies that it is a spring that flows through the grass. Unlike the above two springs this one is not a water fall; the water just flows downstream. A rock pool has been built with an outlet, the water logs and flows from this pool.

The spring here is a contact gravitational spring. The spring seems to have resulted from an incised stream that originates from on top and flows subsurface until it reaches the foothill. At the foothill the subsurface flow is cut by the gently dipping surface contact. Thus there is not a fall but a gentle flow.



There is a myth among the people, that patients affected by Jaundice gets cured when they bath in this spring and drink its water for 42 days.

Before 10 years local communities were highly dependent on this spring discharge. It fulfilled their drinking, domestic and livestock needs. This is the only source of water for wildlife in this region during dry season. Due to over drafting of ground water in the springshed zone, the spring discharge has reduced to a greater extent. Currently, people use it only during high flow period.

Paal Oothu: After seeing the colour of the water, one can understand the reason for the name. The water is milky in colour, tastes better, odourless. It is one of



Springs in Nagamalai Hills and Azhagar Malai Hills

the perennial springs of this region. Similar to Pul oothu, this spring is also a gravitational spring. There is a myth that 'chicken pox marks' in the affected patient will fade if he/she drinks it

Before three decades, a small water harvesting structure was constructed to store the spring discharge. There are two sluice structures to release the harvested water to nearby farms. About 10 acres of land were under cultivation which were irrigated by this structure. It was a technically sound design. Unfortunately, due to lack of maintenance and poor restoration interventions the structure is dysfunctional in recent years. Communities use this water harvesting structure during high flow season for fulfilling their agricultural and domestic demands.

The milky water is neutral in nature with pH 6.5. This spring water is turbid and rich in iron with **1.6 mg/l**. The reason being soil is rich in Iron. But the acceptable limit as per BIS drinking water standard is 0.3 mg/l. Therefore, the communities should use **bio-sand filter** for removing the iron content.

People around 5 km radius collect water from this spring for their drinking purpose, even now. Despite summer, the spring is discharging 1 litre of water per minute. Local communities have constructed a collecting well with prefabricated RCC rings. During low flow period people use this water only for drinking purpose.

Kakka Oothu: The reason calling this spring as Kakka oothu (crow spring) is unidentified. This perennial spring is not a water fall but a gently flowing spring. The spring discharge oozes out through pores created by the root of an age old big banyan tree. It is interesting to see honey bees in the damp root nodes of this banyan tree. There is a check dam constructed at the downstream of spring at a distance of 30 metres from the spring. The spring is in the boundary of Kamatchipuram Village.

This spring is also a gravitational spring. During high floods, spring discharge feeds the stream that feeds the Madhiyettan irrigation tank at the downstream of the spring's crook and used for irrigation. During dry spells people use this water for their drinking and



domestic purpose. There are close to 100 families in this Kamatchipuram village that are dependent on this spring for drinking water.

There is a myth that the water is having herbal content in it and so people having skin disease gets cured by taking bath in this spring for a prolonged period.

The spring water is colourless, odourless and tasteless. It is slightly acidic in nature with pH near to 6.2. It is also a mineral less water with TDS less than 50.

Naga amman oothu: This is the first spring identified in the Nagamalai hills. The ancient Nagamalai settlements were established around the spring. These communities constructed an oorani just after the spring to harvest high discharge water during rainy season. The oorani also received



seepage water from the surrounding area. During dry spells, communities used this spring for fulfilling their drinking water demand.

The joints and fractures in the rock structure act as conduits for the water to flow through. Hence there is concentrated water flow through the fractures resulting in gravitational Joint springs.

Rest of the springs are either on the foothill or mid-way down the hill. Whereas this spring is at a distance from the foot of the hill. The reason being, the buried pediments that extends all this way and the joints in the same. The spring was perennial before 15 years, turned seasonal in later years and dysfunctional for past 8 years. Establishment of settlements in the spring shed area, followed by deep bore well extractions affected the aquifer and made the spring dysfunctional.

Elders of the village shared their memory of spring as, 'We used to sit on the rock beside the spring and collect the water using pots. The water used to be tasty and it is believed holy. The water is used for rituals of adjacent 'Bala Nagamma temple'. Youngsters added, 'Last year we filled the 'spring out' location with external water and celebrated the festival'.

There is a myth that snakes resides in the rock holes of the spring, they watch people who fetch the water. If any women fetch water during her menstrual period, the snake warns her by encircling her legs. They still believe that the snakes are around the spring protecting it.

Rakatchi oothu, is the only accessible perennial spring present in Azhagar Malai that discharges water to rivulets flowing towards Madurai. It is about 19 kms from the temple town of Madurai. The Rakatchi oothu is also called as Nupuragangai and Ishra Siddhi. Previously it was a water fall. The altitude of Azhagar Malai being 300 meters above the sea level, the hill also has numerous streams and rivulets. This spring has been listed in 'Silappatikaram' as springs found in Azhagar Koyil hills. Except Rakatchi oothu, other springs named 'Sraavanam' and Bava Tarani' are inaccessible today.



There is dominance of mural Joints in the rocks. These Mural joints act as conduits for the water to flow through. Hence there is concentrated water flow through the fractures resulting in gravitational-Joint springs. The spring being perennial; implies the presence of a larger pool of water either above or below the surface that forms the source of water for the spring.

The hill is comparatively smaller in size as against the Sirumalai range. This range is characterized by Incipient Charnockite, Garnetiferous quartzite-Feldspathic Granulite, Quartzite and Gneiss. The age of these rocks being almost contemporaneous with the Sirumalai range, except for the Quartzites.

The water is, colourless, odourless and acidic in nature with least mineral content (TDS<100).

The water is, colourless and odourless. But the taste of the water 'fizzy'. pH of the water is 5.3 which shows that the water is acidic in nature. The water also contains least minerals. The Total Dissolved Solids (TDS) in this water is just 34.

There is a myth that this spring water washes away their sins and cures medically. As spring was considered holy, devotees come to the spring every day. To use the water in spring even in the lean season, a pool was constructed. Spring discharge is connected to this pool and water is served to the devotees through pipes. Spring contributes to the rivulets. This stream is a dependable source for Local communities during summer. It is used for domestic, livestock demand and wildlife demand.

Few Inferences on springs



- Number of functional springs in these three hills around the Madurai Urban has reduced to greater extent. Names of the springs and their locations were told predominantly by the elder members of the communities. It is visible that there is huge loss in memory of springs over generation. This shows that the dependency on the spring has reduced.
- Every spring and its water is considered as holy by the local communities. Some of the springs such as Rakatchi Theertham and Naagar Theertham were already institutionalized as temples. Rest of the springs are slowly getting institutionalized by the local communities (Naga amman oothu).
- Spring discharges are major source for water for streams and rivulets in post monsoon period. Communities used this water for agriculture purpose by connecting the spring to an irrigation tank or other similar structure. They have also connected the spring discharge with ooranis (drinking water ponds) to fulfil their drinking/ domestic water demand. During summer, communities were highly dependent on springs for their drinking water.
- Most of the springs in these hills are gravitational springs in nature. Water quality tests reveal that all the spring waters in these region are slightly acidic in nature, pH value ranging 5-6.5. Total Dissolved solids were below 50. This shows that there is very minimal or no dissolution of rock minerals in this spring water. And rest of the parameters were parallel to RO water. Continuous drinking of water having pH lower than 6.5 might affect outer most layer of Oesophagus and disturb the digestive activities of the human body. It is better to store the water in a large open vessel and allow it to interact with the atmosphere for 2 to 3 days and later it shall be consumed by communities.
- All spring water are considered as holy water. There is some kind of myth that these spring water are herbal water and can cure few diseases. But there is no scientific evidence for the same. Researches shall be carried out on the same.
- Younger generation of the local communities see the springs as a recreational spot. One can notice lot of alcohol bottles, plastic bottles and cups around the spring.
- As most of this springs are located in or near reserve forest zone, wildlife in this region are highly dependent on this spring for water throughout the year and especially during summers. Pollution created by the drunkards disturbs the wildlife adversely.
- An age old giant tree could be noticed adjacent to the springs and most of the springs were spotted in region with higher green cover. In the leeward side of Nagamalai hills no springs were spotted. This evidentiates relation between green cover and springs.

Water Wisdom at "The Nature's" academy

Before four decades, villages near the hills were highly dependent on springs for drinking water. Springs were their only source of water during hot summers. Therefore they protected these springs. 'Holiness', a social condition was tagged with the springs to protect and conserve the same. In those ages, to ensure 'water security' community invested their time and human labour to protect these springs.

Innovation of tube wells, followed by bore wells shifted the communities thought process on 'water security' towards ground water abstraction. Ground water was considered as most reliable source. It was considered as 'Atchayapatra', an infinite resource. As decades passed, ground water abstraction changed into exploitation. Too many more wells in the springshed area collapsed the aquifer systems and made spring dysfunctional.

The irony of this age is, people are filling the spring pool with external water source to celebrate their festival.

Before jumping into solutions such as 'springs rejuvenation programs' and 'watershed conservation programs' that comprises of contour bunding, gully plugs, check dams, gabion walls, trenches, mass tree plantation etc. There is an important question before us.

Do the local communities really want to rejuvenate springs?





Their immediate answer is ‘No’ or ‘Impossible’. Even few villagers believe that recent settlements of ‘scheduled caste’ people in the springshed region made the goddess angry, which resulted in failure of these ‘springs’.

When DHAN Foundation had a ‘water literacy stall’ at Chithirai Exhibition, kids were around the ‘Traditional Well’ model. They were very eager to know about it. Parents were sharing their past memories of wells to the kids. They taught them how to fetch water from a well.

Above two instances that there is a huge knowledge gap among us in understanding ‘water’ and it’s ‘cycle’.

How a generation that lag in ‘knowledge of water’ can move towards ‘water security?’

An old Keethari Kizhavi (goat rearing grand ma) after drinking the RO water told that ‘There is no life in this water’. She further continued that ‘We can feel it when we drink. It tells its land of origin. We, Goatherds have tasted water from springs, streams, rivers, ooranis and wells of different region. We can say the type of soil/rock the water has travelled to reach our hands. Water is milk of mother earth. It may be similar but not same.’

‘Who can talk about the nomadic life of water better than Goatherds?’ added her husband.

These Goatherds from Ramnad district have travelled over decades across all four landscapes. They have tasted water from every source. These ancestors have chewed the essence of it. They have attained the ‘wisdom’ of water. They have attained this wisdom not from a school but from ‘The Nature’. Our traditional water bodies and social structures to protect these water bodies are evidences for the same.

It is time to translate this ‘ancient wisdom’ of ancestors as knowledge and transfer it to the younger generations. This necessitates a rigorous action campaign on ‘water literacy’ at various levels through exposure visits, exhibitions, seminars, symposiums, workshops, literacy camps, etc.

This ‘water literacy’ drive should be inclusive in nature and inclusive of ‘the Nature’.

It shall start from visiting ‘Kakka Oothu’, a wonder of ‘the Nature’, not as a ‘picnic spot’ but as an ‘academy’.



Vandiyur updates

As part of project REVIVAL supported by HCL Foundation, aiming at revitalizing Vandiyur tank cascade system for better future, a team has visited some of the renovated urban tanks in Salem districts. Glimpse of the visit summarised as follows,

Salem Citizens forum, a volunteer group has restored Mookaneri and Kumaragiri lakes in Salem District. Mookaneri is a fresh water lake of 60 acres area, once an homage for domestic sewage, garbage & ritual garbage. This forum resurrected the lake from worst condition into a beautiful wetland-bird sanctuary. They have created 47 Man-made islands which serves as home for native trees and birds.

PTO....



Kumaragiri Lake is a sewage cum dye effluent fed urban lake which was considered as dead till 2013. Salem Citizen's forum diverting the sewage around the lake by creating a new bund and regulated the flow of water into the lake. They have created 37 island in the lake in it. They used water hyacinth for the natural treatment process. Unfortunately, water hyacinth proliferation was out of their control and the water quality is worsening day by day. Still, the forum is actively taking measures to remove water hyacinth manually. In both the cases, the ground water of the adjacent region has improved to greater extent. They have inculcated an idea of 'Eco Spirituality' by creating 'Mari Sthalam' among the public for conserving water bodies. The group of volunteers meet at regular interval to carry out clean-up activities in lake.



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.

To understand the trend of the water quality, we sampled the same location what we done on June 2018. The Locations are

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

Packaged drinking water-
CAN water Supply



Water supply through Pipe Network-
Corporation Supply





Zone 1 - Corporation Water

TOTAL DISSOLVED SOLIDS 413 mg/l 	TURBIDITY 0 NTU 	pH 7.8 	TOTAL ALKALINITY as CaCO₃ 192 mg/l
TOTAL HARDNESS as CaCO₃ 160 mg/l 	CALCIUM (Ca) 32 mg/l 	MAGNESIUM (Mg) 19 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0.024 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 5 mg/l 	CHLORIDE (Cl) 60 mg/l
FLUORIDE (F) 0.4 mg/l 	SULPHATE (SO₄) 6 mg/l 	PHOSPHATE (PO₄) 0.015 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.</p>			



Zone 1 - Ground Water

TOTAL DISSOLVED SOLIDS 1480 mg/l 	TURBIDITY 0 NTU 	pH 8 	TOTAL ALKALINITY as CaCO₃ 400 mg/l
TOTAL HARDNESS as CaCO₃ 400 mg/l 	CALCIUM (Ca) 88 mg/l 	MAGNESIUM (Mg) 43 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0.033 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 14 mg/l 	CHLORIDE (Cl) 380 mg/l
FLUORIDE (F) 1.2 mg/l 	SULPHATE (SO₄) 23 mg/l 	PHOSPHATE (PO₄) 0.15 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>It is observed that water is hard because of the presence of Calcium and Magnesium. Total dissolved solids(TDS) exceeds acceptable limit. It does not have direct health effects but solids which cause higher 'TDS' may be harmful to human health. Higher level of fluoride in drinking water may cause bone diseases and dental Fluorosis. This hard water is not recommended for drinking. If there is no other source of drinking water, then it shall be consumed.</p>			



Within acceptable limits



Within Permissible limits



Exceeds permissible limits

*Permissible limit are acceptable in the absence of alternate sources.

Bureau of Indian Standards recommends that acceptable limits to be implemented.



Zone 1 - Packaged Can Water

TOTAL DISSOLVED SOLIDS 38 mg/l 	TURBIDITY 0 NTU 	pH 7.8 	TOTAL ALKALINITY as CaCO₃ 18 mg/l
TOTAL HARDNESS as CaCO₃ 8 mg/l 	CALCIUM (Ca) 1.6 mg/l 	MAGNESIUM (Mg) 1 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 1 mg/l 	CHLORIDE (Cl) 6 mg/l
FLUORIDE (F) 0.2 mg/l 	SULPHATE (SO₄) 0 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR

All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.



Zone 2 - Corporation Water

TOTAL DISSOLVED SOLIDS 350 mg/l 	TURBIDITY 0 NTU 	pH 7.6 	TOTAL ALKALINITY as CaCO₃ 180 mg/l
TOTAL HARDNESS as CaCO₃ 160 mg/l 	CALCIUM (Ca) 32 mg/l 	MAGNESIUM (Mg) 19 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 5 mg/l 	CHLORIDE (Cl) 40 mg/l
FLUORIDE (F) 0.4 mg/l 	SULPHATE (SO₄) 23 mg/l 	PHOSPHATE (PO₄) 0.011 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR

All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.





Zone 2 - Ground Water

TOTAL DISSOLVED SOLIDS 357 mg/l 	TURBIDITY 0 NTU 	pH 8.4 	TOTAL ALKALINITY as CaCO₃ 168 mg/l
TOTAL HARDNESS as CaCO₃ 140 mg/l 	CALCIUM (Ca) 32 mg/l 	MAGNESIUM (Mg) 14 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0.066 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 5 mg/l 	CHLORIDE (Cl) 40 mg/l
FLUORIDE (F) 0.8 mg/l 	SULPHATE (SO₄) 22 mg/l 	PHOSPHATE (PO₄) 0mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.</p>			



Zone 2 - Packaged Can Water

TOTAL DISSOLVED SOLIDS 56 mg/l 	TURBIDITY 0 NTU 	pH 7.2 	TOTAL ALKALINITY as CaCO₃ 26 mg/l
TOTAL HARDNESS as CaCO₃ 14 mg/l 	CALCIUM (Ca) 2.4 mg/l 	MAGNESIUM (Mg) 2 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 2 mg/l 	CHLORIDE (Cl) 8 mg/l
FLUORIDE (F) 0.2 mg/l 	SULPHATE (SO₄) 1 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.</p>			

Within acceptable limits

Within Permissible limits

Exceeds permissible limits



Zone 3 - Corporation Water

TOTAL DISSOLVED SOLIDS 245 mg/l 	TURBIDITY 0 NTU 	pH 7.8 	TOTAL ALKALINITY as CaCO₃ 108 mg/l
TOTAL HARDNESS as CaCO₃ 100 mg/l 	CALCIUM (Ca) 24 mg/l 	MAGNESIUM (Mg) 10 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 5 mg/l 	CHLORIDE (Cl) 36 mg/l
FLUORIDE (F) 0.4 mg/l 	SULPHATE (SO₄) 2 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.</p>			



Zone 3 - Ground Water

TOTAL DISSOLVED SOLIDS 1120 mg/l 	TURBIDITY 0 NTU 	pH 7.6 	TOTAL ALKALINITY as CaCO₃ 540 mg/l
TOTAL HARDNESS as CaCO₃ 240 mg/l 	CALCIUM (Ca) 48 mg/l 	MAGNESIUM (Mg) 29 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 11 mg/l 	CHLORIDE (Cl) 128 mg/l
FLUORIDE (F) 1.4 mg/l 	SULPHATE (SO₄) 18 mg/l 	PHOSPHATE (PO₄) 0.19 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>It is observed that Total dissolved solids(TDS), Total Alkalinity, Total Hardness, Fluoride exceeds, acceptable limit. It does not have direct health effects but solids which cause higher 'TDS' may be harmful to human health. This hard water is not recommended for drinking. If there is no other source of drinking water, then it shall be consumed.</p>			

Within acceptable limits

Within Permissible limits

Exceeds permissible limits



Zone 3 - Packaged Can Water

TOTAL DISSOLVED SOLIDS 115 mg/l 	TURBIDITY 0 NTU 	pH 6.6 	TOTAL ALKALINITY as CaCO₃ 28 mg/l
TOTAL HARDNESS as CaCO₃ 12 mg/l 	CALCIUM (Ca) 2.4 mg/l 	MAGNESIUM (Mg) 1.44 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 2 mg/l 	CHLORIDE (Cl) 32 mg/l
FLUORIDE (F) 0.2 mg/l 	SULPHATE (SO₄) 1 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR

All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.



Zone 4 - Corporation Water

TOTAL DISSOLVED SOLIDS 227 mg/l 	TURBIDITY 0 NTU 	pH 7.2 	TOTAL ALKALINITY as CaCO₃ 100 mg/l
TOTAL HARDNESS as CaCO₃ 80 mg/l 	CALCIUM (Ca) 16 mg/l 	MAGNESIUM (Mg) 10 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0.083 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 5 mg/l 	CHLORIDE (Cl) 32 mg/l
FLUORIDE (F) 0.6 mg/l 	SULPHATE (SO₄) 5 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR

All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.



WITHIN ACCEPTABLE LIMITS



WITHIN PERMISSIBLE LIMITS



EXCEEDS PERMISSIBLE LIMITS



Zone 4 - Ground Water

TOTAL DISSOLVED SOLIDS 752 mg/l 	TURBIDITY 0 NTU 	pH 7.7 	TOTAL ALKALINITY as CaCO₃ 300 mg/l
TOTAL HARDNESS as CaCO₃ 260 mg/l 	CALCIUM (Ca) 56 mg/l 	MAGNESIUM (Mg) 29 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0.166 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 7 mg/l 	CHLORIDE (Cl) 140 mg/l
FLUORIDE (F) 1 mg/l 	SULPHATE (SO₄) 13 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>It is observed that water is hard because of the presence of Calcium and Magnesium. Total dissolved solids(TDS) exceeds permissible limit. It does not have direct health effects but solids which cause higher 'TDS' may be harmful to human health. This water is not recommended for drinking.</p>			



Zone 4 - Packaged Can Water

TOTAL DISSOLVED SOLIDS 87 mg/l 	TURBIDITY 0 NTU 	pH 6.6 	TOTAL ALKALINITY as CaCO₃ 34 mg/l
TOTAL HARDNESS as CaCO₃ 14 mg/l 	CALCIUM (Ca) 2.4 mg/l 	MAGNESIUM (Mg) 2 mg/l 	IRON (Fe) 0 mg/l
FREE AMMONIA (NH₃) 0 mg/l 	NITRITE (NO₂) 0 mg/l 	NITRATE (NO₃) 2 mg/l 	CHLORIDE (Cl) 20 mg/l
FLUORIDE (F) 0.2 mg/l 	SULPHATE (SO₄) 1 mg/l 	PHOSPHATE (PO₄) 0 mg/l 	WATER IS CRYSTAL CLEAR & FREE OF ODOUR
<p>All the drinking water parameters are within the acceptable limits. Therefore the water is recommended as safe for drinking.</p>			



Within acceptable limits



Within Permissible limits



Exceeds permissible limits

~~UN~~LIMITED



Meteorological Updates

Rainfall Data

Station Name: IMD Station, Madurai

Device: Automated rain gauge.

Average Annual rainfall for Madurai: 840mm

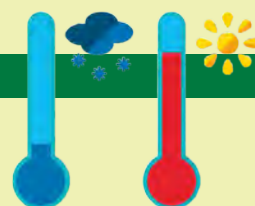
May 2019 - Rainy days

Date	Intensity(mm/d)
08/05/2019	04
09/05/2019	02
17/05/2019	24
24/05/2019	01
Actual Rainfall	39 mm
Normal Rainfall	83 mm
% Departure	$\frac{39 - 83}{83} \times 100 = -53\%$



Temperature Data

	Temperature	Humidity
High	42 °C (05 May, 14:30)	99% (09 May, 05:30)
Low	21 °C (09 May, 05:30)	24% (03 May, 17:30)
Average	34 °C	56%



* Reported 1 May 05:30 — 31 May 23:30, Madurai. Source: CustomWeather, © 2019

We sincerely acknowledge the Laboratory

Water Quality Testing Laboratory
Water Watch Centre
The DHAN Academy
T. Malaipatti, Thenkarai (BO)
Mullipallam (SO), Melakkal via
Madurai 625 207.

For Suggestion/Comments please write us on



Centre for Urban water Resources (CURE)
Water Knowledge Centre
DHAN Vayalagam (Tank) Foundation
1A, Vaidyanathapuram East, Kennet Cross Road
Madurai 625 016. Tamil Nadu, INDIA
Tel: +91 452 2302500 Fax: 2602247
Email: dhancure@dhan.org, Website: www.dhan.org