



Groundwater Quality Assessment: A Case Study in Perungalathur, Chennai, Tamil Nadu, India

Jeya Rathi J*, Poornima K P

Jeya Rathi J, Department of Botany, Madras Christian College (Autonomous), Chennai 600 059

Poornima K P, Department of Botany, Madras Christian College

(Received: 16 January 2026

Revised: 25 February 2026

Accepted: 17 March 2026)

KEYWORDS

Groundwater, Water, Perungalathur, Physical-chemical properties, BIS, water quality index, drinking water standards.

ABSTRACT:

Introduction: Groundwater is primary source of water for billions of people around the world. Only a miniscule percentage of freshwater is available on Earth for human utilisation. Groundwater is generally high-quality freshwater that is safe for drinking. However, exploitation of natural resources and generation of more wastes in the environment have led to the contamination of groundwater.

Objectives: This study was primarily carried out to find out the current status of groundwater quality, pollutants, contaminants and threats in and around Perungalathur.

Methods: The groundwater samples were collected from wells or borewells randomly from each ward of Perungalathur. The analysis of important physical and chemical properties revealed the quality of water. These values were compared with the standards of drinking water framed by Bureau of Indian Standards (BIS 10500: 2012).

Results: All water samples were found to align with the drinking water standards or lesser than the drinking water standards within the permissible limit of BIS. The formulation of a water quality index also reveals the same.

Conclusions: The water in the area of Perungalathur can be used for drinking without any further considerations. This justifies that the water is healthier for the human consumption in Perungalathur area.

1. Introduction

Water is life for all living being on the planet Earth. Of all the water available on the planet, nearly 99 percent of the water is inaccessible for human consumption. Only a miniscule percentage of freshwater is available on Earth for human utilisation. Water is a precious resource whose importance can be understood when we lose the water we have [1].

Most of the freshwater used for human consumption exist underground and cannot be seen. Groundwater is generally high-quality freshwater that is safe for drinking. The groundwater marks the most significant source of freshwater for human use [2]. Since groundwater passes between rocks and sand, they are enriched with mineral content which also benefits the human health and moreover as the groundwater pass through the porous rocks they are mineralized naturally. Groundwater is stable and they are available throughout the year. The largely available unfrozen freshwater is the groundwater and it is connected to numerous Earth processes at varying time scales.

With the increasing population and industrial sectors, the demand for drinking water is also increasing. Due to massive advancements in well constructions during the 20th century, developments in drilling and pumping technology allowed groundwater to be utilized for industrial, irrigation, and domestic purposes. Exploitation of natural resources and generation of more wastes in environment have led to the contamination of groundwater. Overexploitation is threat to the entire water cycle. Inadequate solid wastes and hazardous waste management combined with rapid industrialisation frequently cause groundwater to deteriorate and become unfit for human consumption. Pollution is a serious issue across the world with limited supply of fresh water on one hand and increasing disposal of wastes into water bodies such as rivers, lakes, sea renders severe problem to aquatic life and disrupts ecological balance [3]. In recent years, the lakes and ponds are shrinking and the anthropogenic activities have led way for the depletion of groundwater. The presence of 12 major and 46 medium rivers in our country forms the backbone of India's water resource. These rivers flow yearly or seasonally providing water for all the living beings. However, the quality of groundwater is changing due to the intervention of humans



and the various activities of human. The physical surroundings, the source and flow of water all affect the natural groundwater quality. Water undergoes changes in its original quality as it passes through hydrological cycle due to variety of chemical, physical and biological processes [4].

The quantity of runoff, rainfall pattern, types of monsoon and other climatic conditions are the natural factor that affects the groundwater and surface water. The constructions of dams close to the waste water discharge area has contaminated the surrounding water. The leakage of oil from vehicles gets deposited on the pavements and all these materials are carried by rainwater to the underground layer where it gets deposited [5]. The primary consumer of groundwater and a major source of non-geogenic pollutant is agriculture. Managing water use and groundwater discharge is essential for groundwater availability for future [6].

Perungalathur is considered as one of the famous sites for freshwater bodies which supports many birds and life forms. In the present work, the physical and chemical properties of groundwater quality was studied to find out whether the water can be used for human consumption. The study aims to assess the physiochemical parameters of water such as pH, hardness, turbidity, calcium etc., and to check the suitability of groundwater across wards of Perungalathur for drinking. The values are compared with Bureau of Indian Standards (BIS) to ensure the samples are pollution free.

2. Objectives

The Primary objective was to evaluate the physio-chemical properties of groundwater such as pH, Electrical conductivity (EC), Total Dissolved Solids (TDS), Calcium etc. The work aimed to check the suitability of ground water in the area of Perungalathur and ensure the values are within the Bureau of Indian Standards.

3. Methods

Study area:

Perungalathur is located at the southern part of Chennai city, Tamil Nadu, India (Figure 1). It lies between 12. 9051°N and 80. 0948 °E. It is a part of Tambaram taluk, situated in the Chennai metropolitan area, Tamil Nadu, India. In 2021, it was placed and merged into zone 4 of Tambaram municipal corporation under Chengalpattu district. The wards comprise of 'old' Perungalathur, 'new' Perungalathur and Peerkankaranai panchayats. The Perungalathur is divided into 6 wards namely ward 55, ward 56, ward 57, ward 58, ward 59 and ward 61 respectively.



Figure 1: Map of Tamil Nadu showing Perungalathur Location

Sample collection:

Groundwater samples were collected in ten different places from each ward of Perungalathur area. About 2 litres of water samples was collected in pre - rinsed plastic cans.

Physio - chemical parameters of groundwater:

The physical parameters such as pH, Electrical Conductivity (EC), Total Dissolved Solvents (TDS) and Turbidity were analysed using digital meters. The chemical parameters such as alkalinity, total hardness, calcium, magnesium, sulphate, fluoride, chloride and nitrate were determined using standard methods according to APHA, 2017 [7].

Water Quality Index (Horton, 1965)

To value the quality of water, water quality index is widely used. It is the expression of all the notable parameter's value into a single number. Water Quality Index (WQI) is calculated using the following formulae for the ground water samples.

$$WQI = \frac{\sum W_n Q_n}{\sum W_n}$$

Where,

W_n Unit weight of selected parameters

Q_n Sub-index

4. Results

The results obtained from physical-chemical parameters analysis of the Perungalathur wards groundwater were compared with drinking water standards formulated by Bureau of Indian Standards (BIS). (Table 1).

**Table 1: Physio-chemical parameters of Perungalathur wards groundwater samples**

S. No	Parameters	W55	W56	W57	W58	W59	W61	BIS Value
1	pH	8.19 ± 0.056	8.23 ± 0.059	8.07 ± 0.13	8.26 ± 0.083	7.73 ± 0.085	8.07 ± 0.05	6.5-8.5
2	EC (µs)	1388 ± 1.82	1421 ± 0.151	1548 ± 1.23	1409 ± 0.107	1287 ± 1.05	1513 ± 1.3	-
3	Turbidity (NTU)	0.31 ± .0531	0.58 ± 0.275	0.31 ± 0.06	0.93 ± 0.464	0.35 ± 0.067	1.71 ± 0.171	1-5
4	TDS (mg/L)1513	972 ± 0.48	1142 ± 1.42	1142 ± 1.41	991 ± 0.75	898 ± 0.03	1059 ± 0.78	500-2000
5	Alkalinity (mg/L)	0.320 ± 0.02	0.80 ± 0.113	0.41 ± 0.156	0.60 ± 0.246	0.42 ± 0.202	0.58 ± 0.54	200-600
6	Total hardness (mg/L)	425 ± 0.29	440 ± 0.73	495.20 ± 0.78	359.60 ± 0.58	347 ± 0.04	524 ± 0.60	200-600
7	Fluoride (mg/L)	-0.005 ± 0.002	-0.007 ± 0.004	-0.0027 ± 0.002	-0.0087 ± 0.002	-0.0275 ± 0.003	-0.015 ± 0.002	1-1.5
8	Chloride (mg/L)	0.13 ± 0.012	0.15 ± .0262	0.22 ± 0.038	0.14 ± 0.018	0.11 ± .014	0.16 ± 0.01	250-1000
9	Calcium (mg/L)	93.46 ± 0.20	110 ± 0.47	129.85 ± 0.86	92.82 ± 0.332	102.60 ± 0.01	148 ± 0.98	75-200
10	Magnesium (mg/L)	46.75 ± 0.27	39.94 ± 0.913	41.60 ± 0.197	31.10 ± 0.662	22.16 ± 0.64	37.32 ± 0.9	30-100
11	Sulphate (mg/L)	31.44 ± 0.97	81.46 ± 0.75	88.56 ± 0.41	83.16 ± 0.088	75.17 ± 0.41	83.03 ± 0.5	200-400
12	Nitrate (mg/L)	3.60 ± 0.052	37.59 ± 0.64	6.92 ± 0.094	7.80 ± 0.364	65.08 ± 0.72	8.29 ± 0.23	45

Colour and odour:

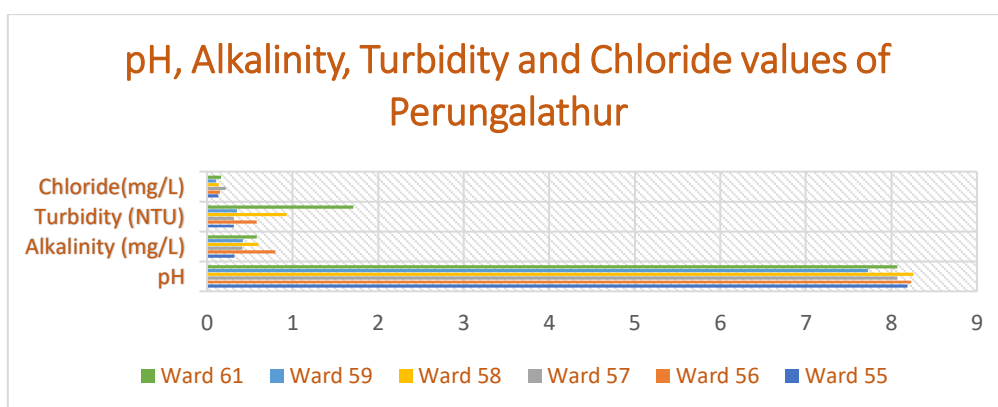
At the time of collection, the water samples were observed for its colour and odour. All the water samples were colourless and odourless.

pH:

The Perungalathur ward No: 59 showed neutral pH whereas Perungalathur wards 55, 56, 57, 58 and 61 showed slightly alkaline pH as showed in Table 1 (Figure 1).

Electrical Conductivity (EC):

In general, the groundwater has higher electrical conductivity. All the wards of Perungalathur exceeded above 1000 with very high increase in EC. However, EC was found to be highest in ward 57 (1548 µs), and lowest in ward 59 (1287 µs) (Table 1).

**Figure 1: Graph showing values of pH, Alkalinity, Turbidity and Chloride values of Perungalathur wards**



Turbidity:

The acceptable limit of turbidity in Nephelometric Turbidity Units (NTU) is 1- 5 according to BIS. In the present study the maximum turbidity was seen in ward 61 with 1.718 NTU followed by ward 58 with 0.9392 NTU. The wards 55, 57 and 59 showed values higher than 0.3 NTU. The total turbidity of the water in Perungalathur area was found to be 0.70 NTU (Table 1) (Figure 1).

Total Dissolved Solids (TDS):

The TDS of all the water samples except ward 57 was found to be within the limits of BIS. Ward 57 showed significantly high TDS of about 1142 mg/L (Table 1).

Alkalinity:

The alkalinity showed highest value of 0.80 mg/L in ward 56 and lowest value of 0.41 mg/L in ward 57 respectively. The lower alkalinity implies that water has less buffering capacity to resist changes in pH (Table 1) (Figure 1).

Total Hardness (TH):

Calcium and magnesium ions contribute to the total hardness of the water. In the current study the total hardness of Perungalathur area ranges from 347 mg/L to 524 mg/L and total average value for Perungalathur is about 432 mg/L (Table 1), which is well within the standards of BIS (Figure 2).

Fluoride (F⁻) and Chloride (Cl⁻):

The standard limit of fluoride in drinking water is found to be less than 1.5 mg/L. The fluoride content in the present study area (Perungalathur) was negligible (>1).

The chloride contributes to the taste of drinking water and low level can give water a bland taste. The amount of chloride in the water samples collected from wards of Perungalathur was found to be 0.13 mg/L, 0.15 mg/L, 0.22 mg/L, 0.14 mg/L, 0.11 mg/L and 0.16 mg/L in the ward 55, ward 56, ward 57, ward 58, ward 59 and ward 61 respectively. These values were below the acceptable limit of drinking water standards of BIS (Table 1) (Figure 1).

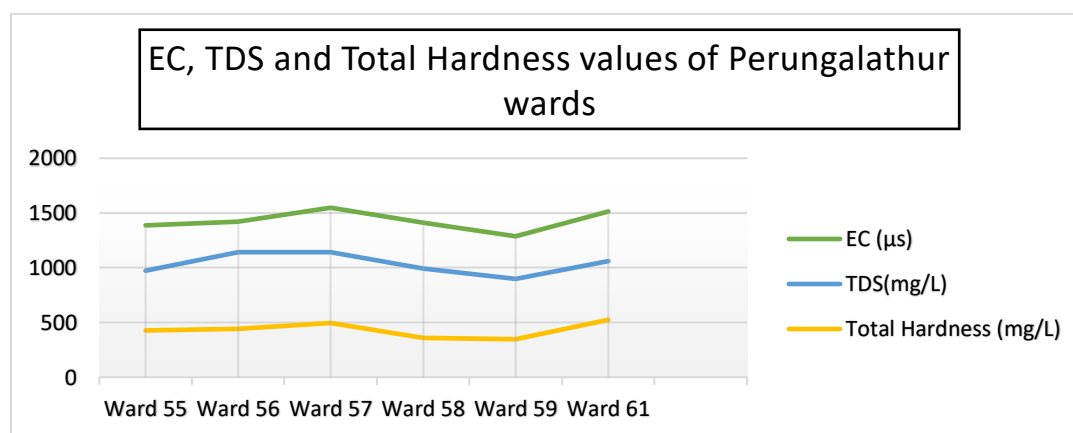


Figure 2: Graph representing values of EC, TDS and Total hardness in the wards of Perungalathur

Calcium (Ca²⁺) and Magnesium (Mg²⁺):

The calcium was found to be highest in ward 61, 148 mg/L which was within the acceptable limit of BIS. The total average calcium and magnesium values of Perungalathur area were 112.97 mg/L and 36.48 mg/L respectively (Table 1). This value indicates that the groundwater of Perungalathur has balanced mineral content (Figure 3).

Sulphate (SO₄²⁻) and Nitrate (NO₃⁻): The water samples from the study site varied from lower limit 31.44mg/L in ward 55 to higher limit of 88.56 mg/L in ward 57 which was less than the acceptable limit of the 200 mg/L as per the BIS standards (Table 1).

The nitrate content in ward 59 showed highest value of 65.08 mg/L (Table 1) which exceeded the BIS limit. Ward 55 has low value of 3.60 mg/L, this may be due decomposition of animal and human wastes that can lead to high nitrate content in Perungalathur.

Water quality index (WQI):

The water quality index was also calculated for overall groundwater status of Perungalathur by taking average mean of all wards. Most of the groundwater samples of Perungalathur area were within the standards of drinking water as devised by BIS. It is inferred that



WQI level of all wards of Perungalathur is less than 25 (Table 2).

WARD	Water Quality Index	Water Quality Status	Water Quality Grading
Ward 55	14.3076	Excellent	A
Ward 56	15.96253	Excellent	A
Ward 57	14.54449	Excellent	A
Ward 58	15.06739	Excellent	A
Ward 59	10.9282	Excellent	A
Ward 61	17.37676	Excellent	A

Table 2: WQI of Perungalathur Wards

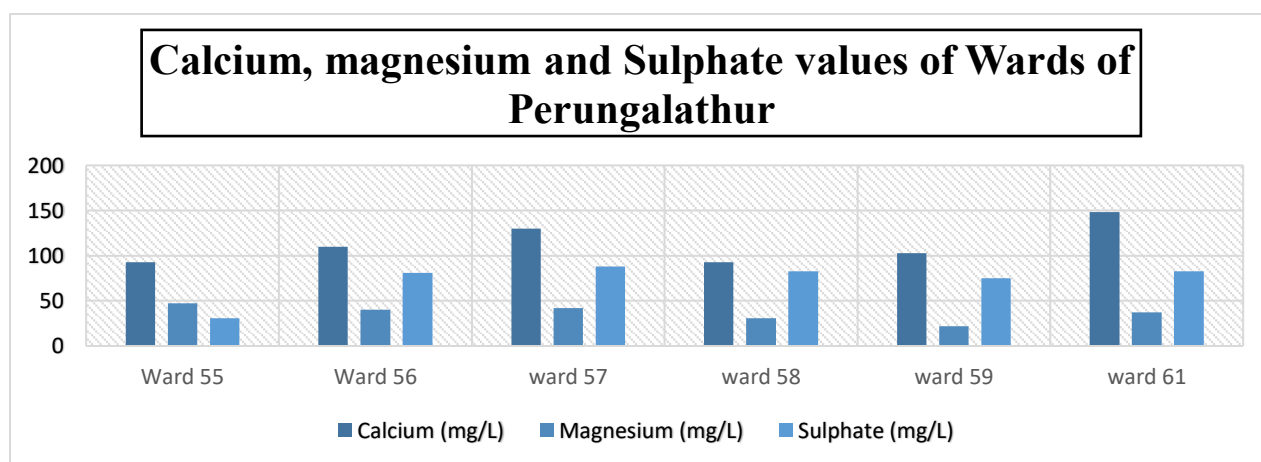


Figure 3: Graph representing values of Calcium, Magnesium and Sulphate in the wards of Perungalathur

5. Discussion:

The results obtained from this work represents the quality of water in the Perungalathur area, Tambaram taluk, Chengalpattu district, Chennai, Tamil Nadu. The physio-chemical parameters tests showed that the concentration of all the ions and non-metals. The pH of the water in Perungalathur area was found to be slightly alkaline which was found similar to the study of water sample of Palakonda mandal, Andhra Pradesh [8]. Electrical conductivity determines the number of chemical reagents needed to treat the water sample. The average EC value of Perungalathur was found to be 1427.93 μ S when compared to the Ethiopia region, 192.14 μ S/cm [9]. Turbidity is due to numerous tiny particles that are invisible to naked eyes. The turbidity of ground water samples of Perungalathur is 0.70 NTU whereas Calabar Municipality, Nigeria has a range of 0.69 NTU - 0.111 NTU [10]. The

average TDS of the study area is 1009 mg/L that falls within BIS standards, the study in Sheikhpura district, Bihar witnessed TDS of 731 mg/L respectively [11]. Total alkalinity is capacity of water to neutralize strong acid. The water samples from Perungalathur shows minimal amount of 0.52 mg/L. The higher alkalinity of Velliangadu area, Coimbatore district showed 226 mg/L to 444 mg/L [12].

High level of hardness makes water unsuitable for domestic purposes. The hardness in Perungalathur area is found to be within BIS limits (432 mg/L). Total Hardness of 1320 mg/l was recorded in the arid region of Hyderabad [13]. Fluoride value of groundwater in Perungalathur area is below the BIS limit, but the Raichur city exceeded the BIS fluoride value [14]. The groundwater of Perungalathur has lower amount of sulphate than the acceptable limit. This is one such good indicator of quality of water of the area. The nitrate in the



groundwater of Perungalathur is within the standard of BIS which is in line with analysis in Mangalagiri, Andhra Pradesh showed lesser than the BIS range from 0.018 mg/L to 35.28

mg/L [16]. The water quality status of Perungalathur can be recommended for drinking purposes. Contrastingly, Durairaj *et al* in 2018 made analysis on groundwater quality in the Ambattur industrial estate, recorded the WQI value in the range of 63.30 – 208.67 indicating poor water quality [17].

6. Conclusion:

Perungalathur is a rapid developing area located on the outskirts of southern Chennai. The quality of ground water was assessed in Perungalathur area. This study was primarily focused on the current status of groundwater quality, pollutants, contaminants and threats. The groundwater samples were collected from wells or borewells from each ward of Perungalathur and physical and chemical properties were tested. On analysing the overall water quality of Perungalathur, the quality of water was within BIS limits and this justifies that the water is healthier for human consumption. This investigation of water quality is studied for limited time period from October 2023 to January 2024, further monitoring and analysing at regular intervals could support better understanding of groundwater quality of Perungalathur.

References:

- Kılıc Zeyneb. (2020). The importance of water and conscious use of water. *International Journal of Hydrology*. <http://dx.doi.org/10.15406/ijh.2020.04.00250> 4(5): 239-241.
- Bi Pan., Pei Lixin., Huang Guanxing., Han Dongya and Song Jiangmin. (2021). Identification of Groundwater Contamination in a Rapidly Urbanized Area on a Regional Scale: A New Approach of Multi Hydrochemical Evidences. *International Journal of Environmental Research and Public Health* DOI:10.3390/ijerph182212143.
- Rasulmeera S., Kungumapriya Rajkumar., Kasturi Revathi., Sundaravalli K., Akilan Anitha and Smith J. (2020). A study on the physico-chemical 45 parameters and the microbial flora of a eutrophic lake -pallavaram lake (periyar lake), Zamin Pallavaram, Chennai, Tamilnadu, India. *Annals of the Romanian Society for Cell* <https://doi.org/10.22271/fish.2021.v9.i3d.2495>
- Tamilchelvan P and Muralimohan N. (2019). A Case Study on "Assessment of Groundwater Quality in and Around Namakkal District in Tamil Nadu". *International Research Journal of Multidisciplinary*

- Technovation. 1: 662-667. DOI:10.34256/irjmtcon94
- Soceanu A., Dobrinas S., Dumitrescu C I., Manea N., Sirbu A., Popescu V and Vizitiu G. (2021). Physico-Chemical Parameters and Health Risk Analysis of Groundwater Quality. *Applied Science*. 11(11):4775. <https://doi.org/10.3390/app11114775>
- Lall Upmanu., Josset Laureline and Russo Tess. (2020). A Snapshot of the World's Groundwater Challenges. *Annual Review of Environment and Resources*. 45: 171-194 DOI:10.1146/annurev-environ-102017-025800
- Baird R and Bridgewater L. (2017). *Standard methods for the examination of water and waste water*. (23rd edition). Washington D C. American Public Health Association.
- Lamma D O A. (2020). Study on groundwater analysis for drinking purpose in Mangalagiri Mandal regions, Andhra Pradesh, India. *International Journal of Applied Research*, 6(1): 148-153. 2394-7500
- Meride Y and Ayenew B. Drinking water quality assessment and its effects on residents health in Wondo genet campus, Ethiopia. (2016). *Environmental system research* 5(1): 1-7 <https://doi.org/10.1186/s40068-016-0053-6>
- Adesakin T A., Oyewale A T., Bayero U., Mohammed A N., Aduwo I A. Ahmed P Z., Abubakar N D and Barje I B. (2020). Assessment of bacteriological quality and physico - chemical parameters of domestic water sources in Samaru community, Zaria, Northwest Nigeria. *Heliyon*. 6(8): e4773. <https://doi.org/10.1016/j.heliyon.2020.e04773>.
- Kumar Ritesh. Singh Sarnam. Kumar Rakesh and Sharma Prabhakar (2022). Groundwater Quality Characterization for Safe Drinking Water Supply in Sheikhpura District of Bihar, India: A Geospatial Approach. *Frontiers in Water* 4: 1-13 <https://doi.org/10.3389/frwa.2022.848018>
- Kandasamy Karthik., Mayildurai R., Mahalakshmi R and Karthikeyan S. (2019). Physicochemical analysis of groundwater quality of velliangadu area in Coimbatore district, Tamil Nadu, India. *Rasayan Journal of Chemistry*. 12:409-414. 0974-1496
- Memon Y I., Qureshi S S., Kandhar I A., Qureshi N A., Saeed S., Mubarak N M and Saleh T A. (2023). Statistical analysis and physicochemical characteristics of study. *International groundwater Journal quality of parameters: Environmental Chemistry*, 103(10):2270–2291. <https://doi.org/10.1080/03067319.2021.1890064>
- Hussain R A. (2022). Groundwater quality analysis and mapping for Raichur city using GIS. *Journal of*



- emerging technology and innovation research 9(9): 9- 23. 2349- 5162.
15. Chaudhry Akshay., Kumar Kamal and Alam Mohammad. (2019). Spatial distribution of physico-chemical parameters for groundwater quality evaluation in a part of Satluj River Basin, India. *Water Science and Technology WaterSupply*. 1490<https://doi.org/10.2166/ws.2019.015>
 16. Panahi G., Eskafi M H., Rahimi H., Faridhosseini A and Tang X. Physical chemical evaluation of groundwater quality in semi-arid areas: case study—Sabzevar plain, Iran. (2021). *Sustainable Water Resource Management*. 7(99): 1-15 <https://doi.org/10.1007/s40899-021-00576-y>
 17. Sivakumar D., Govindasami S., Asanammal Saral J D., Arun D and Durai Arasu T. (2018). Groundwater Quality Assessment in Ambattur Industrial Estate. *International Journal of Engineering & Technology*. 7(3.34): 428 432 <https://doi.org/10.14419/ijet.v7i3.34.19343>.