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Research Article

A COMPARATIVE ANALYSIS OF PHYSICOCHEMICAL PARAMETERS OF VAIGAI RESERVOIR AND PICKUP DAM, THENI DISTRICT, TAMIL NADU, INDIA

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ABSTRACT

The present study aims at investigating the physicochemical analysis of water samples from two different sites during March - August, 2016 at Vaigai Reservoir and Pickup Dam in Theni District. Evaluation of physicochemical parameters was carried out to assess the quality of water. Each parameter was compared with the standard desirable limit prescribed by Bureau of Indian Standards (BIS). The physicochemical parameters of Vaigai Reservoir and Pickup Dam water sample was well within the limit where as Manganese, Ammonia, Nitrite and Phosphate parameters were not within the permissible limit.

INTRODUCTION

Water is one of the most important and abundant compounds of the ecosystem. It is also a crucial resource for agriculture, manufacturing sites and other human activities. It is the most essential basic component to all living beings. As most of the biochemical reactions that takes place through the metabolism and growth of living organisms required water, a vital resource required for their growth. River is the most important and vulnerable freshwater system that plays a critical role in the sustenance of all life. In urban areas, the careless disposal of industrial effluents and other wastes in rivers and lakes may contribute greatly to the poor quality of river water (Agarwal and Sexana, 2011).

Water is considered as one of the nutrients, although it yields no calories, yet it enters into structural composition of the cell and is an essential component of diet (Baloch *et al.*, 2000). WHO (2001) reported that approximately 36% of urban and 65% of rural Indians are without access to safe drinking water (Akoto and Adiyah, 2007). Fresh water is one of the most important resources for the survival of all the living organisms. It is even more important for the human beings as they depend upon it for food production, industrial and waste disposal as well as cultural requirement (Akpoveta *et al.*, 2011). It is estimated that over 70 per cent of India's food grain production comes from irrigated agriculture, in which ground water plays a major role (Gandhi and Namboodiri, 2009). In India, 6.73 hectare of land is affected by salinity and sodicity (Singh *et al.*, 2009). Groundwater contains a varying amount of different kinds of ions such as carbonate, bicarbonate, calcium, magnesium, sulphate and hardness (Choudhary and Dagankar, 2007).

The need for water quality could be determined in different ways either for drinking, other domestic uses, industrial, agricultural, irrigation or fish farming. However, the maintenance of aquatic ecosystem is totally dependent on the physicochemical properties and biological diversity (Verkatesharajlu *et al.*, 2010). The level of physicochemical parameters of water will determine the purpose with which the water could be best used for with little or no treatments. Variability in physicochemical parameters is responsible for the distribution of organisms in different freshwater habitat according to their adaptation, which allow them to survive in a specific habitat (Jeffries and Mills, 1990). Major shift in the stream bed composition and processes can alter species distribution productivity (Palmer *et al.*, 1997).

The search for good portable water has been man's utmost concern since the beginning of civilization and thus, scarcity of clean freshwater is one of the world most pressing environmental problems. Therefore, in search of domestic water which includes the water needs for families for drinking,

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cooking, sanitation, hygiene *etc*, (Bustanmante *et al.*, 2004), rural community dwellers in the river front depend on the rivers or streams as a source of water for their domestic and other uses. This could be as a result of uneasy access and high cost of harnessing underground water.

Good quality of water resources depends on a large number of physico chemical and biological characteristics. These parameters are essential to identify magnitude and source of any pollution load (Ushe and Amadi, 2005).

The protection of ground water from surface activity is very difficult to remediate but risk can be minimized by monitoring of highly pollution prone area. Monitoring program is reliable for estimation of water quality (Chowdhury *et al.*, 2017). Hence this study has been made to analyse the Physico chemical parameters of water samples from Vaigai Reservoir of Theni Districts.

MATERIALS AND METHODS

Description of the Study Site

The study has been carried out in two sampling sites such as Vaigai Reservoir and Pickup Dam in Theni District, Tamil Nadu during March - August 2016.

Vaigai Reservoir originates in the Periyar Plateau of the Western Ghats range, and flows to Northeast through the Cambam Valley, which lies between the Palni Hills to the north and Varushanad Hills to the South. The Vaigai is 258 kilometers (160m) long, with a drainage basin of 7,031 square kilometers (2,715 sq m) large. It falls within the coordinates of Latitude at $7^0$2100 N and Longitude $79^0$00 00 E. Vaigai Dam is built across the Vaigai Reservoir near Andipatty, in Theni district of Tamil Nadu, Southern India. The Vaigai Reservoir rarely floods. Its chief tributaries are the Suruliar, Theniar, Varaha Nadhi and it supplies water to Madurai, Sivaganga and Ramanathapuram districts.

Plate 1 Vaigai Reservoir

Plate 2 Pickup Dam

Sample Collection and Preservation

Water samples were collected in sterilized plastic bottles for every month in the early hours during March - August, 2016.

Analysis of Water Samples

Colour, Odour, pH and Temperature of the water samples were measured on the sampling spot by water analyzer kit. Total alkalinity, total hardness, magnesium, calcium and chloride contents were analyzed by titremetric methods in the laboratory following the standard methods as prescribed by APHA, (2005).

RESULTS AND DISCUSSION

The sample was slightly turbid, greenish and yellow colour was observed with a fowl smell. Water temperature ranged from 20 - 32^0C, air temperature varied between 23 and 34^0C. Highest temperature in both air and water was recorded in Pickup Dam during July. Rainfall was observed during July low in August. There is no rainfall in other months (Table 1).

Physical Parameter in Water samples from Vaigai Reservoir and Pickup Dam

Turbidity

Turbidity was high in June and it was low in March. In both the sites, high turbidity was observed in June, July and August and it was low in May. Vaigai Reservoir showed high turbidity in four months except April and May (Figure 1) when compared to Pickup Dam Similar results were also observed by Manjare *et al.* (2010).

Water turbidity, which reflects transparency, is an important criterion for assessing the quality of water. This might be due to improper disposal of sewage, surface runoff and wastewater from different domestic activities. Similar higher turbidity values are also recorded by many workers as compared to the limit set by WHO (Akan *et al.*, 2008; Joshi *et al.*, 2009; Mebrahtu and Zerabruk, 2011; Murhekar, 2011; Pal *et al.*, 2013).

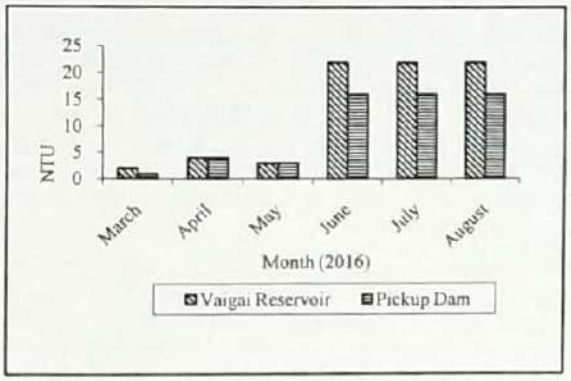

Figure 1 Turbidity of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Total Dissolved Solids

Total dissolved solids indicate the salinity of groundwater. High value of total dissolved solid was observed in June and low in March in both the sampling sites. To compare with high total dissolved solid was observed in Pickup Dam (Figure 2).

Table 1 Physical Parameters in Water samples from Vaigai Reservoir and Pickup Dam during March-August, 2016

Month	Site	Appearance	Colour	Odour	Air Temp (°C)	Water Temp (°C)	Rainfall (Mm)
March	Reservoir	Slightly Turbid	Greenish in colour	Slight Fowl Smell	23	20	0
	Pickup Dam	slightly Turbid	Clear and Colourless	Fowl Smell	26	24	0
April	Reservoir	Slightly Turbid	Greenish	Fowl Smell	24	22	0
	Pickup Dam	slightly Turbid	Greenish in colour	Fowl Smell	27	25	0
May	Reservoir	Slightly Turbid	Greenish in colour	Fowl Smell	26	23	0
	Pickup Dam	slightly Turbid	Greenish in colour	Fowl Smell	29	27	0
June	Reservoir	Slightly Turbid	Greenish in colour	Fowl Smell	27	22	0
	Pickup Dam	slightly Turbid	Greenish Yellow	Slight Fowl smell	34	32	0
July	Reservoir	Slightly Turbid	Yellow in colour	Fowl Smell	26	20	59
	Pickup Dam	slightly Turbid	Clear and Colourless	Fowl Smell	37	29	59
August	Reservoir	Slightly Turbid	Greenish Yellow	Fowl Smell	26	20	4
	Pickup Dam	slightly Turbid	Greenish Yellow	Slightly Fowl smell	34	32	4

Total dissolved solids in two samples were below the permissible limit, whereas in the study of Kanase *et al.* (2016) showed higher values of total dissolved solids. The value of the present study agrees with the result of Giorgis *et al.* (2010) and Alemayehu (2008). In Dhamola River total dissolved solids were within the permissible limit in all the sampling sites (Dinkar, 2016). Water containing more than 500 mg/l of total dissolved solid is not considered desirable for drinking water supplies, but in unavoidable cases 1500 mg/l is also allowed (Shrinivasa and Venkateswaralu 2000).

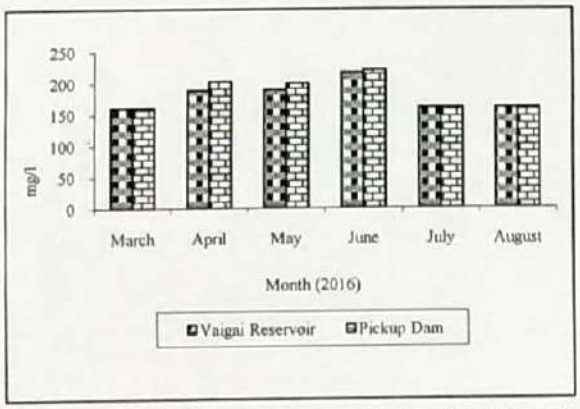

Figure 2 Total Dissolved Solids of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Electrical Conductivity [EC]

Electrical Conductivity was high in June and low in March. When combine the two sites the Pickup Dam showed high electrical conductivity and Vaigai Reservoir showed low electrical conductivity in all the months. Hence EC was high in Pickup Dam than in Vaigai Reservoir (Figure 3). Jayalakshmi *et al.* (2011) reported that electrical conductivity values of Elala River were within standard permissible unit which are similar to our present findings. Increase in electrical conductivity indicates the presence of higher concentration of ions (Deepali *et al.*, 2009).

The higher levels of electrical conductivity alter the chelating properties of receiving systems, which favour free metal availability to flora and fauna (Nagajyothi *et al.*, 2009).

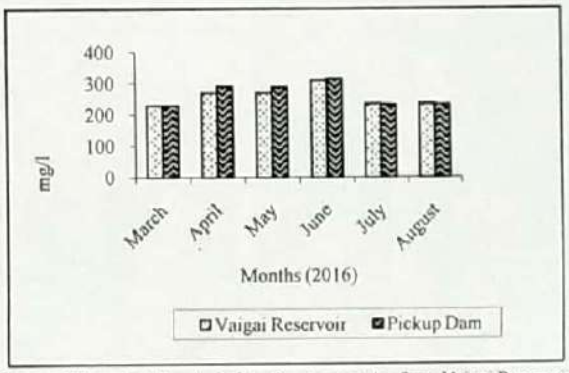

Figure 3 Electrical Conductivity of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Navneeth Kumar *et al.* (2010) suggested that the underground drinking water quality of study area can be checked effectively by controlling conductivity of water and this may also be applied to the management of water quality.

pH

pH of the Vaigai Reservoir water samples was high in April and it was low in March. In Pickup Dam the pH value was high in May and low in June. Among the two sampling sites, the water sample from the Vaigai Reservoir showed high alkalinity (Figure 4). Similar observations made by Venkateswarlu *et al.* (2014), Tyor and Chawla, (2012); and Chaudhary *et al.* (2013). pH is more important in determining the corrosive nature of water. Lower the pH value higher is the corrosive nature of water. pH was positively correlated with electrical conductance and total alkalinity (Gupta 2009). The higher pH values observed suggested that carbon dioxide, carbonate-bicarbonate equilibrium is was affected due to change in physico-chemical condition.

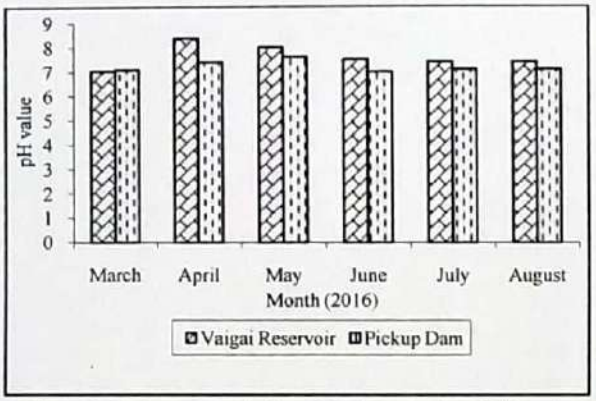

Figure 4 pH of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Total Alkalinity

Alkalinity was high in June and low in March in both the sites (Figure 5). High alkalinity was observed by Venkateswarlu *et al.* (2014); Alemayehu (2001); Sharma *et al.* (2013); Soni *et al.* (2013). Lower values of alkalinity was reported by Bhattarai *et al.* (2008); Joshi *et al.* (2009); Alani *et al.* (2014). The alkalinity of both the water samples were within the standard permissible unit of BIS.

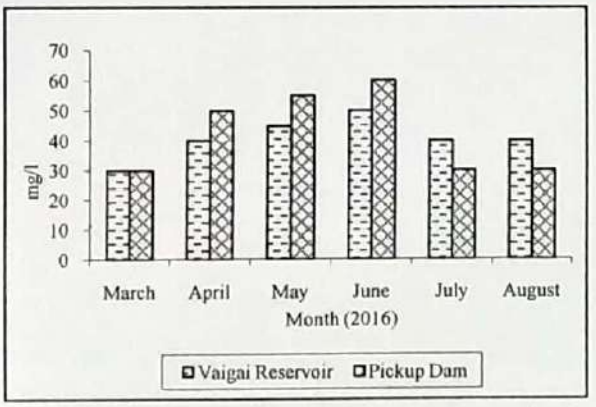

Figure 5 Total Alkalinity of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Total Hardness

Total hardness was high in April, June, July and August and it was low in March in Vaigai Reservoir. In Pickup Dam it was high in June and April and was low in March, July and August (Figure 6). The standard permissible unit of values was observed by Prasad *et al.* (2016). They pointout the concordent values of hardness. Mishra *et al.* (2014) studied the pond water quality in Rairangpur, Varanasi and found that the hardness values varied from 146 to 268mg/l.

Hardness of water is a measure of its capacity to form precipitates with soap and scales with certain anions present in the water. Water hardness arises due to the presence of cations such as calcium, magnesium and anions such as bicarbonates, chlorides and sulfides (Kumar *et al.*, 2013; Adejuwon and Adelakun, 2012). Water hardness is understood as a measure of the capacity of water to precipitate soap. The increase in the maximum level of total hardness is due to the presence of carbonate and non carbonate compounds (Ramesh *et al.*, 2013).

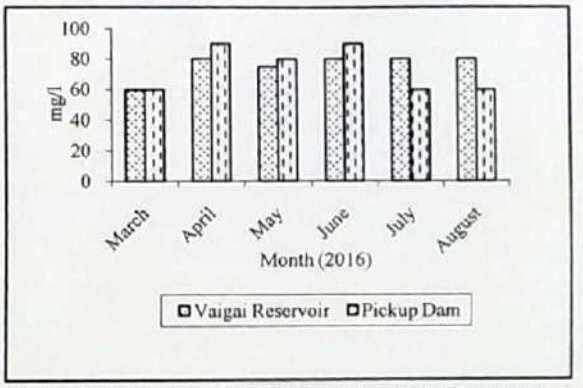

Figure 6 Total Hardness of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Calcium

Calcium was high in May and it was low in March in both the sampling sites. Comparatively high calcium was present in Pickup Dam (Figure 7) the present study coincides with the study of Vanitha and Shunmugavelu, (2012) and Kumar *et al.* (2004).

Calcium is directly related to hardness. Calcium may dissolve readily from carbonate rocks and lime stones (Chari and Lavanya, 1994). Calcium concentration ranged between 12 mg/l to 172 mg/l and found below the permissible limit of ISI. Calcium ions usually increase the hardness content in the river water (Prasad, 2016).

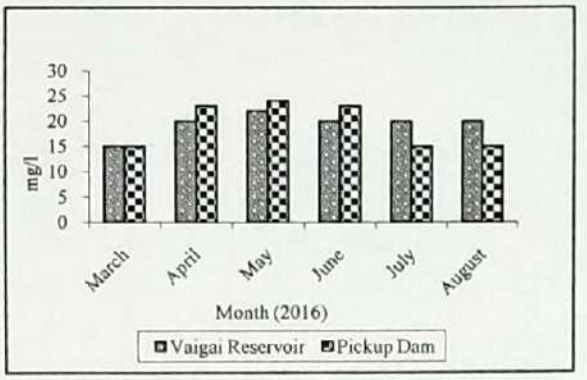

Figure 7 Calcium of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Magnesium

In Vaigai Reservoir, magnesium content was high in April, June, July and August and it was low in March and May. When comparing the two sampling sites, magnesium was observed high in Pickup Dam than Vaigai Reservoir. The magnesium content was within the permissible limit in both the sampling sites (Figure 8). The reports of Balamurugan (2015) and Chittora *et al.* (2017) do not fall in line with the present investigation. Vanitha (2012) has reported that the results, which reveal that magnesium concentration, lie within the permissible limit at Kunnur and Vaigai dam Sample units. Magnesium is one of the important sources for chlorophyll

development and it acts as a restrictive factor for the growth of phytoplankton (Dagaonkar and Saksena, 1992).

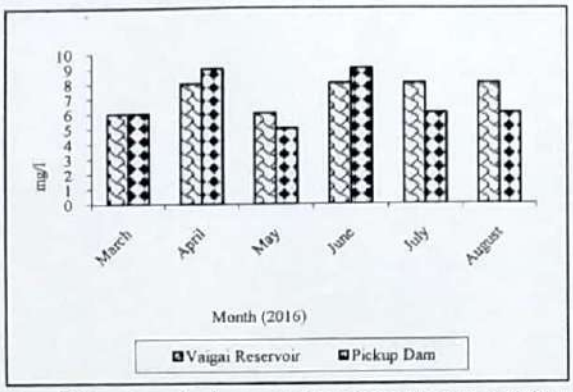

Figure 8 Magnesium of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Ammonia

Ammonia was high in June and it was low in May, July and August in both the sampling sites. To compare the two samples, high ammonia was observed in Pickup Dam than Vaigai Reservoir (Figure 9). The ammonia was above the desirable limits of BIS standard. Similar result was reported by Seyoum, (2007). Ammonia is frequently present in groundwater sources where there is no oxygen present. Ammonia ions play a key part in water treatment because they need to be removed before breakpoint chlorination can be achieved. Chittora *et al.* (2017) reported 0.03-150mg/l of ammonia in the drinking water sample Udaipur.

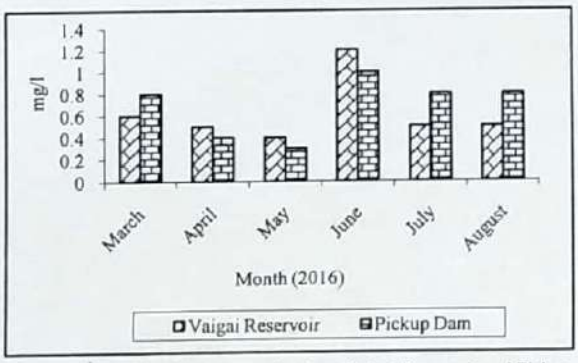

Figure 9 Ammonia of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Nitrite

Nitrite was high in June and low in May, July and August in Reservoir. In Pickup Dam high nitrate content was observed in June and it was low April, May, July and August (Figure 10) similar results were observed by Drissi (2016); Sivamanikandan and Ahmed John, (2016). Nitrite exists normally in very low concentration and even in waste treatment plant, effluent levels are relatively low, principally because the nitrogen will tend to exist in the more reduced (ammonia) or more oxidized (nitrate) forms. Nitrite is an intermediate in the oxidation of ammonia to nitrate, such oxidation can proceed in soil, and because sewage is a rich source of ammonia, waters which show any appreciable amounts of nitrite are regarded highly poor in quality. Levels in unpolluted waters are normally low, that is below 0.03 mg/dm^3 NO_2. Values greater than this indicate sewage pollution WHO 1993.

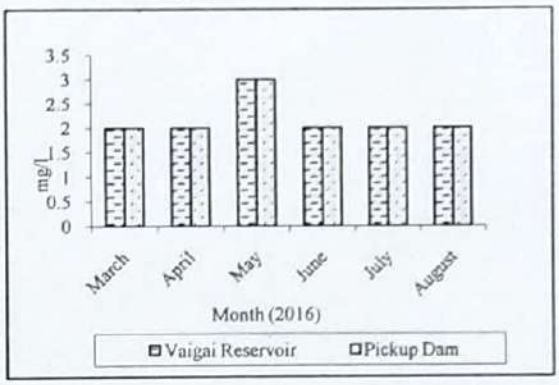

Figure 10 Nitrate of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Nitrate

Nitrate content was high in May and July and it was low in March, April June and August in both the sampling sites (Figure 11). Concordant values were recorded by Alam (2017). Nitrate represents the final product of biochemical oxidation of ammonia (Mahananda *et al.*, 2010). Similar results were recorded in Sivamanikandan and Ahmed john, (2016). Nitrate is the most important nutrient in an ecosystem. Generally water bodies polluted by organic matter exhibit higher values of nitrate. Moreover nitrogen is an essential nutrient that is required by all plants and animals for the formation of amino acids. In its molecular form, nitrogen cannot be used by most aquatic plants, therefore it must be converted to another form. One such form is ammonia.

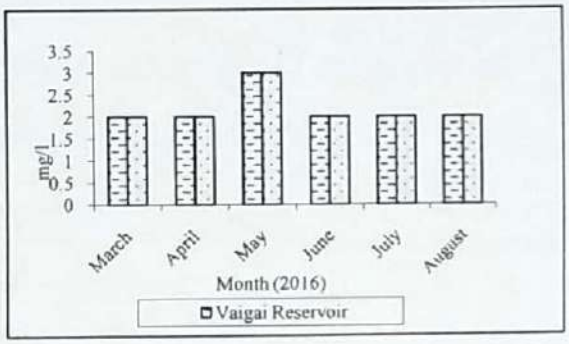

Figure 11 Nitrate of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Chloride

Chloride content was high in June and it was low in on other months in the Vaigai Reservoir. In Pickup Dam it was high in June was low in March April July and August (Figure 12). Permissible limit of chloride according to BIS is 250 -1000 mg/l and it is within the limit. Similar results were reported by Swarnalatha and Narsingrao, (1998) and Manjare *et al,* (2010) where the higher value was observed by Mallika (2017).

Chloride is one of the common anions found in water and sewage. Chloride is highly soluble with most of the naturally occurring cations and do not precipitate with sediments and cannot be removed biologically in the treatment of waste. The

of organic matter and limited flow of water in low holding environment due to high temperature.

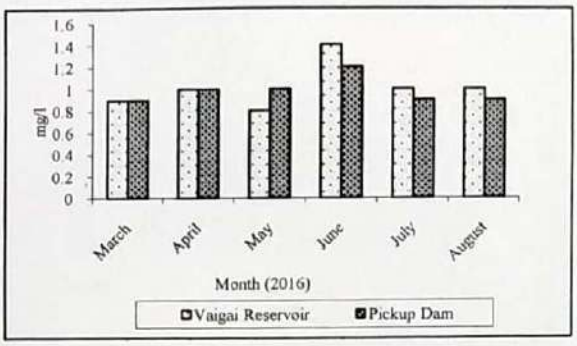

Figure 16 Dissolved oxygen of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

CONCLUSION

The major intention of physicochemical analysis is to prevent physical changes as well as chemical contamination of reservoir so as to protect the life of people in our society. In this study, two samples were collected from two different locations of Theni District. The physicochemical analysis of Vaigai Reservoir and Pickup Dam water was analysed by desirable, permissible and acceptance limit of the water sample. The parameters of turbidity, pH, electrical conductivity and fluoride are within the desirable and permissible limits. Total alkalinity, total hardness, calcium, magnesium and nitrite are below the permissible limit, phosphate, ammonia and chloride are above the permissible and desirable limit. Therefore, it is recommended in this study, to create awareness among the residents of the studied area about the need to utilize Vaigai Reservoir and Pickup Dam water for irrigation and domestic purposes.

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concentration of Chloride in natural waters varies from a few milligrams to several thousand milligrams per litter.

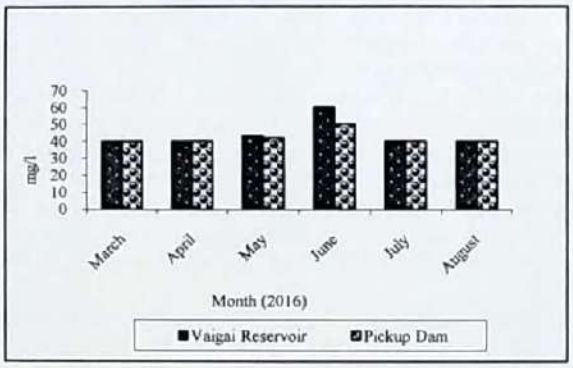

Figure 12 Chloride of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Fluoride

Fluoride was high in June and low in May in the Vaigai Reservoir, whereas in Pickup Dam, it was high in April and June and it was low in March, July and August (Figure 13). The concentration of fluoride was within the standard permissible limit as in the study of Kumar and Kumar (2013); Kumar and Jain (2016). Fluoride occurs as fluorspar (fluorite), rock phosphate, triphite, phosphorite crystals etc. in nature. Among factors which control the concentration of fluoride are the climate of the area and the presence of accessory minerals in the rock mineral assemblage through which the ground water is circulating (Handa, 1985).

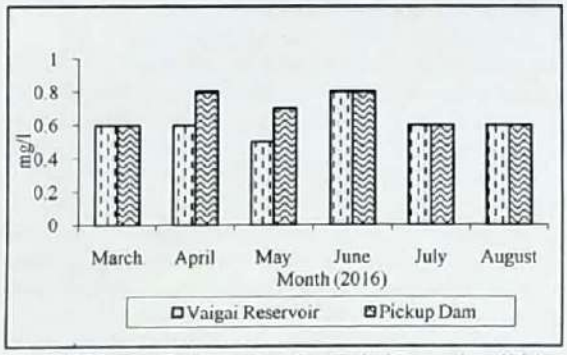

Figure 13 Fluoride of water samples from Vaigai Reservoir and Pickup dam during March-July, 2016

Sulphate

The presence of sulphate concentration was maximum in May and it was minimum in March and June in the Vaigai Reservoir. In Pickup Dam, it was high in June and low in except all the months (Figure 14). The sulphate content was below the permissible limit. The concordant values were observed by Lakshmi, (2017) in the sulphate content.

The natural concentration of sulphate in most surface water is within the range of 2 to 80 mg/l (Manivasakam, 2005). Sulphate is widely distributed in nature and may be present in natural waters. The main source of sulphur is the rocks present near the water bodies and biochemical action of anaerobic bacteria (Sharma *et al.*, 2011). Anbarasu and Anbuselvan, (2017) reported by higher values of sulphate content in Musiri Taluk unlike this study area.

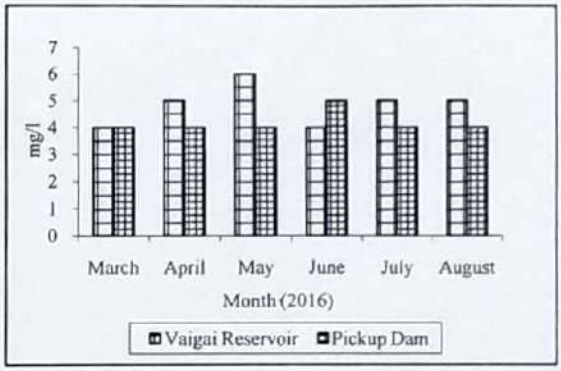

Figure 14 Sulphate of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Phosphate

Phosphate was high in June and low in April and May in Vaigai Reservoir. In Pickup Dam, it was high in March and low in April and March (Figure 15). Phosphate content was present in above the permissible limit. This finding is in agreement with that of Udaipur lakes (Ranu 2001, Christy 2002 and Medudhula *et al.*, 2012). It is one of the most important nutrients and a limiting factor in the maintenance of reservoir fertility. Phosphate may occur in ground water as a result of domestic sewage, detergents, agricultural with fertilizers and industrial waste water. The phosphate content in the Vuyyuru, Andra Pradesh was found in the range of 0.31 mg/l to 0.66 mg/l and it was within the limit (Janardhana *et al.*, 2013).

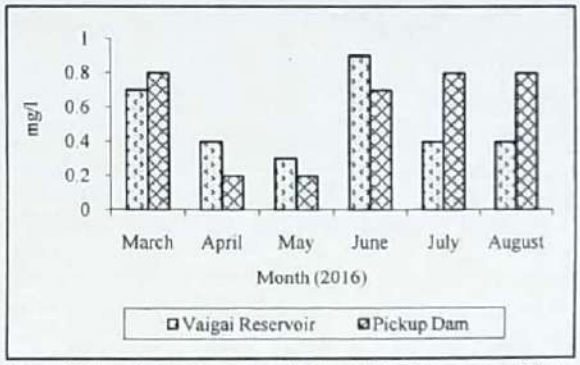

Figure 15 Phosphate of water samples from Vaigai Reservoir and Pickup dam during March-August, 2016

Dissolved Oxygen

Dissolved oxygen was high in June and low in May in the Vaigai Reservoir. In Pickup Dam also it was high in June and low in March, July and August (Figure 16). Similar results of dissolved oxygen were observed in Medudhula, (2012). Dissolved Oxygen is one of the most important parameter. Its correlation with water body gives direct and indirect information e.g. bacterial activity, photosynthesis, availability of nutrients, stratification etc. (Vikal, 2009). Dissolved oxygen is an important aquatic parameter, whose presence is vital to aquatic fauna. It plays crucial role in life processes of animals. Rani *et al.* (2004) also reported lower values of dissolved oxygen in summer season due to higher rate of decomposition

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