CHAPTER 1
INTRODUCTION

1.1 General :-

Water is important commodities in nature but is the most misused one. Although earth is blue planet and 4/5th of its surface is covered by water, the hard fact of life is that about 97% of it is locked in the oceans, which is too saline to drink and for direct use for agricultural or industrial purposes. Of what is left, about 80% is trapped in polar ice caps and giant glaciers, from which icebergs break off and slowly melt at sea. Another 10% of it is locked in rock crevices and minerals lying as deep as 800 meters below the earth crust which is very expensive to pump out. This leaves only about 0.3% of the world water resources that man can tap for domestic, agricultural and industrial use, until economically viable technologies are developed for utilizing water from oceans and icebergs [10].

Water is mostly used for industrial and municipal purpose. In order to ensure the right quality and quantity of water for these purpose it is extremely important to monitor water supply throughout taking all the aspect into consideration the various factors which are to be considered for supply of the water for any purpose are,

a) The quantity of the water available
b) Seasonal variation in quantity as well as quality
c) Analysis of water taking in to consideration its chemical, physical, micro-scopial and bacteriological characteristics
d) Influence of industrial wastes, sewages etc. on the quality of water.
e) Cost involved in getting continuous supply of required quality and quantity of water [2, 3].

1.2 Sources of Water:-

Water is required for agricultural, municipal and industrial purposes. For industrial purpose, natural water may be broadly divided in to the following categories [11].

1) Surface Waters:-
   a) Flowing waters e.g. Streams and rivers (moorland surface drainage)
   b) Still water e.g. Pond, lakes and reservoirs (lowland surface drainage)

2) Underground Supplies :-
a) Water from shallow and deep spring and wells  
b) Water from lower measures of coal mines

3) **Rain Water** :-  
4) **Estuarine and Sea water** :-

From the point of view of industrial applications, it is not usually feasible to use rain water and sea water. Rain water is irregular in supply and generally expensive to collect. Estuarine and sea water are too saline for most industrial uses except cooling. The three major sources of water for industrial use are:

a) Moorland surface drainage
b) Lowland surface drainage
c) Deep well water

a) **Moorland Surface Drainage**:- Water from this source is fairly constant in composition. It is generally clear and colored brown. It is slightly acidic due of the presence of dissolved carbon dioxide and of weak organic acids, which renders it corrosive. Although its hardness is low, it can cause scale formation in boilers unless it is suitable treated before use. It contains some strains of iron bacteria which must be removed by chlorination to prevent deposition in the pipe lines. It possesses a tendency to dissolve lead and copper. This fact should be considered if the water is used for drinking purposes [15].

b) **Lowland Surface Drainage**:- Water from this sources vary widely in composition from place to place. It is not generally colored but may contain fine mud in suspension, which does not easily settle unless with the help of coagulants. Its hardness is usually high and hence can cause serious scale formation in boilers, economizers and coolers, unless the water is properly treated before use, when the water is heated in boilers the CO₂ produced from the bicarbonate ions passes off with the steam and dissolves in the condensate, forming carbonic acid which is corrosive to the mild steel. River and canal water’s may get contaminated by sewage and industrial wastes, which may require preliminary treatment prior to softening [20].

c) **Deep Well Water**:- This type of water is fairly constant in composition, unless contaminated by other waters percolating through faults in the surrounding strata. When freshly drawn, this is usually colourless clear and finely divided suspended matter and
hence sparkling. This type of water may develop a brown opalescence on exposure to air due the presence of small amounts of ferrous iron, which gets converted into hydrolyzed ferric oxide. Traces of manganese as well as H₂S may also be present.

In many deep well waters the concentration of the bicarbonate is more than equivalent to the combined concentrations of Ca⁺⁺, Mg⁺⁺ ions so that Na₂CO₃ may be considered to be presents.

The hardness is then entirely alkaline hardness. The sulphate content is often very low. Water from shallow wells posses a composition similar to that of low-land surface drainage waters. The concentration of bicarbonate ions is less than the combined concentration of Ca⁺⁺ and Mg⁺⁺ ions. Hence water contains non-alkaline hardness [20].

Some deep well waters contain considerable amounts of free CO₂. Because of the hardness present and because of the carbonates ions produced due to thermal decomposition of bicarbonates ions, deep well waters, like low-land waters, give rise to severe scale formation in boiler, The high silica content also contributes to the formation of hard scales in boilers, CO₂ formed by the decomposition of bicarbonate ions. Similar to lowland waters, also result in the production of acid condensate leading to corrosion [34, 35].

1.3 Types of Impurities Present in Water:-

The impurities present in natural water may be broadly classified as follows.

1.3.1 Dissolved impurities

a) Inorganic salts e.g.

1) Cat ions :- Ca⁺⁺, Mg⁺⁺, Na⁺, K⁺, Fe⁺⁺, Al³⁺ and sometimes Zn²⁺ and Cu²⁺

2) Anions :- Cl⁻, SO₄⁻², NO₃⁻, HCO₃⁻ and sometimes F⁻ and NO₂⁻

b) Gases e.g. CO₂, O₂, N₂, oxides of N₂ and sometimes NH₃, H₂S

c) Organic salts [62].

1.3.2 Suspended Impurities:

a) Inorganic e.g. clay and sand

b) Organic e.g. Oil globules, vegetables and animal matter, finely divided clay and silica, aluminum hydroxides, ferric hydroxide, organic waste products, humus acids, colouring matter, complex protein, amino acids, which are generally classified as albumin ammonia [63].
1.3.3 **Bacterial Impurities:**

Bacteria are other micro organism and other forms of animal and vegetable life [34].

1.4 **Effects of Impurities in Natural Waters :-**

The various types of impurities present in natural waters impart some properties on the waters. Effect of the impurities on the water quality are discussed below [35, 36].

1.4.1 **Colour:** - Colour is found mostly in surface water, although water from some shallow wells, springs and deep well may also occasionally coloured. The colour of natural waters range from pale straw through yellowish brown to dark brown. The colours and the materials which cause it are often objectionable in which the water and the manufactured product come into contact e.g. dyeing scouring and laundering [51].

The colour of natural waters is mainly due to the presence of dissolved or colloid ally dispersed organic matter the measurement of colour is usually made with a Tinto meter matter and the result is expressed in “Hazen units” or “standard units of colour”. In Determining the colour of water, it is the true colour as expressed in the standard units, that is of interest and not the apparent colour [59].

1.4.2 **Taste and Odours:**

Most of the odour in natural waters with the exception of H$_2$S are organic in nature. The odours and taste observed in chlorinated waters are due to compounds formed by the reaction of chlorine on traces of organic matter present in the water. These organic tastes and odours are usually confined to surface waters and are either very low or totally absent in deep wells waters. Some deep well waters contains H$_2$S which has a repulsive odour of rotten eggs while others have a taste described as inky, astringent or metallic, generally due to the iron present in them [44].

Disagreeable odours and taste are objectionable for various industrial processes such as beverages, food products paper pulp and textiles. Organic taste and odours may be removed by means of activated carbons, aeration or aeration followed by activated carbon treatment. The removed of inorganic odours and taste due to H$_2$S or iron will have to be removed by chemical method like oxidation, chlorination or precipitation [28].
1.4.2 Turbidity and Sediments:

“Turbidity” is imparted to natural water due to the presence of finely divided insoluble impurities which remains suspended in water and reduce its clarity. These suspended impurities may be inorganic in nature (e.g., clay, slit, silica, ferric oxide, calcium carbonate, sulphur etc) or organic (e.g., finely divided vegetable or animal matter, oils, fats, greases, microorganisms etc.) with respect to size. These suspended impurities may range from colloidal particles to coarse sandy material which remains suspended only by rapid and turbulent flow. Material which is so coarse that it rapidly tends to drop out of suspension is called sediment.

Turbidity is usually determined on the basis of silica scale. The unit of turbidity is by 1ppm of silica (diatomaceous earth or fuller earth) in distilled water. However, the actual standards of turbidity are determined from the depth of liquid in a standard Jackson candle turbidity meter in which the flame of candle disappears when viewed length wise through the tube [19].

1.4.3 Micro-Organisms:

Micro-organisms are more abundant in surface waters, whenever in deep well waters, the bacterial count is often low or even absent. The growth of these organism in water used for industrial purposes may pose serious problems and hence effective measures have to be taken to prevent the growth of these organism. Organic growths generally take place most readily in water at temperatures ranging from 10°C-35°C many of them form coating in pipe lines, thus reducing their carrying capacity considerably. These coatings frequently break loose in large masses which may completely block the flow through valves, pumps, nozzles and other parts of the water distribution systems. In filter and water softener employing granular media. The granules may become matted together by such organic growth thus impairing their operations by lowering their flow rates and also resulting in channeling and overturning of the beds [11, 12]

1.4.4 Dissolved Mineral Matters:

For most of the uses of water, following mineral constituents are usually determined. Ca, Mg, Na, K, bicarbonate, carbonate, hydroxide, chloride, sulphate, nitrate, fluoride, silica, Fe, Mn and mineral acid. The most important manifestations of the
dissolved minerals matter from the pt. of industrial application include hardness and alkalinity [15, 17].

1.5 Hardness :-

Hardness was originally defined as the soap consuming capacity of a water sample soap generally consists of the sodium salts of long chain fatly acids such as oleic acid, palmatic acid and steric acid the soap consuming capacity of water is mainly due to the presence of calcium and magnesium ions. These ions reacts with the sodium salts of long chain fatty acids present in the soap to form insoluble scum’s of calcium and magnesium soap which do not possess any detergent value.

Other metal ions like Fe^{2+}, Mn^{2+} and Al^{3+} also react with the soap in the same fashion, thus contributing to hardness but generally, these are present in natural waters only in traces. Further acids such as carbonic acid can also cause free fatty acid to separate from soap solution and thus contribute to hardness, however in practice the hardness of water sample is usually taken as a measure or it’s Ca^{2+}&,Mg^{2+} content [20].

1.5.1 Temporary and Permanent Hardness :-

When natural water is boiled, the bicarbonate ions present are decomposed to form carbonate ions and carbon dioxide is set free. The Ca^{2+} and Mg^{2+} ions readily combine with the carbonate ions to form CaCO_3 and MgCO_3 precipitates. The hardness so precipitated was formally referred to as “temporary hardness”, but this term is now referred to all the hardness associated with the bicarbonate content of the water (i.e., that determinable by titration with acid). This is due to the fact that CaCO_3 and more particularly MgCO_3 have appreciable though slight, solubility in water [51].

The difference between the temporary and total hardness is referred as “permanent hardness”. Since this is not removed by boiling by water. The permanent hardness is regarded as comprising of the dissolved chlorides, sulphates and nitrates of calcium and magnesium [51, 59].

1.5.2 Alkaline and Non-Alkaline Hardness :-

The term temporary and permanent hardness, are gradually being replaced by the preferred terms of alkaline and non alkaline hardness.

“Alkaline hardness” is defined as the hardness due to the bicarbonates carbonates and hydroxides of the hardness-producing metals. It is also called carbonate hardness. In a raw
water, the alkaline hardness is almost always the hardness associated with the bicarbonates. However a treated or boiler water may also contain hardness due to small quantities of CaCO₃ and Mg (OH)₂ in solution. The alkalinity is equal to the sum of the concentrations of bicarbonates, carbonate and hydroxide expressed in equivalent. If this alkalinity is less than the total hardness also expressed in equivalents, then the alkaline hardness is equal to the alkalinity. Conversely when the alkalinity to methyl orange is equal to or greater than the total hardness. The alkaline hardness is equal to the total hardness. The non-alkaline hardness is obtained by subtracting the “alkaline hardness” from the “total hardness” This is also known as “non-carbonate hardness” [59].

1.6 **Alkalinity :-**

Alkalinity of water means the total content of those substance in water that cause an increased concentration of OH⁻ ions upon dissociation or due to hydrolysis. The alkalinity of natural waters is generally due to the presence in them of HCO₃⁻, SiO₃²⁻, and sometimes CO₃²⁻ ions and also due to the presence of salts of some weak organic acids known as amides, that bind H⁺ ions as a result of hydrolysis thereby increasing the concentration of OH⁻ ions. In addition to the above, the alkalinity of boiler water is also conditioned by the presence of PO₄³⁻ and OH⁻ ions. Also the presence of salts of weak acids such as silicates and borates induces buffer capacity in water and resists the lowering of pH. Surface water containing algae and also water treated by lime soda process may contain considerable quantities of alkalinity due to CO₃²⁻ and OH⁻ [51]. Depending on the anion that is present in water (HCO₃⁻, CO₃²⁻ or OH⁻) alkalinity is classified respectively as bicarbonate alkalinity, carbonate alkalinity or hydroxide alkalinity. Higher alkaline waters may lead to caustic embrittlement and also may cause deposition of precipitate and slugs in boiler tubes and pipes.

1.6.1 **Chlorides :-**

Chlorides are present in water generally as NaCl, MgCl₂ and CaCl₂. Although chlorides are not considered as harmful as such, their concentrations over 250 mg/l. impart peculiar taste to the water which is objectionable or unacceptable for drinking purpose for most people from aesthetic point of view. Hence the secondary standard for chlorides is 250 mg/l. further presence of unusually high concentration of
chlorides, in water generally indicates pollution from domestic sewage or from industrial waste water, presence of chlorides is also undesirable in boiler feed water salts like MgCl₂ may undergo hydrolysis under the high pressure and temperature prevailing in the boiler, generating hydrochloride acid which causes corrosion of boiler parts [28].

1.6.2 Sulphate :-

Sulphates are among the major anion present in natural water when sulphate are present in excessive amounts in drinking water, they may produce a laxative or cathartic effects on the people consuming such water. The secondary maximum contaminant level for sulphate is 250 mg/l [29].

1.6.3 Nitrate :-

Excessive concentration of nitrates is objectionable particularly for infants. The maximum contaminant level for nitrate is 10 mg/l. In agricultural region, ground water can have significant concentration of nitrates from unused fertilizers leaching in to the underlying aquifers. Surface water can be polluted by nitrates both from discharge of municipal waste water and from drainage from agricultural lands. Ingestion of excessive nitrates in drinking water by infants causes a diseases know as “methemoglobinemia” infant cyanosis or blue baby syndrome). In the intestine of infants nitrates can be reduced to nitrites, which are absorbed into the blood, oxidizing the iron present in the blood, there by resulting the iron present in the blue colour of the baby [34,35].

1.6.4 Manganese :-

Manganese is objectionable in water supplies because it imparts brownish colour to laundered goods, it also affects the table of beverages such as coffee and tea by imparting a sort of medicinal taste. the maximum contaminant level for Mn is 0.05 mg/l [19].
1.6.5 Iron :-

Iron is objectionable in water supplies because it imparts unacceptable brownish colour to laundered goods, it also affects the taste of beverages like tea and coffee, the secondary maximum contaminant level for Fe is 0.03 mg/l.

1.6.6 Dissolved gases :-

The dissolved gases occurring in various water supplies are 1) carbon dioxide (CO₂), 2) oxygen (O₂), 3) Nitrogen (N₂), 4) Hydrogen sulphide (H₂S) and 5) Methane (CH₄).

**Carbon dioxide:** In the lake water the CO₂ concentration in the surface samples range from 0 to 2 ppm and its increases with the depth. This is due to the fact that CO₂ is generated at the bottom of the lake due to the decay of organic matter [17].

**Oxygen:** The solubility of pure oxygen at 32°F and atmospheric pressure is 48.89 ml per liter, while under the same conditions the solubility of nitrogen is 23.54 ml per liter. Consequently, when air is dissolved in water, the two main components namely N₂ and O₂ exist in different proportion in solution then that existing in the atmosphere. The solubility of a gas is proportional to the absolute pressure thus if pressure is increased, the amount of air or O₂ which can hold in solution at a given temperature is also increased proportionally.

Dissolved oxygen is very corrosive to metals like iron, steel, galvanized iron and brass, which are widely used for making vessels for conducting and holding water. Low pH values and elevated temperatures accelerate the rate of this corrosion [59].

1.7 Thermal Pollution of Water :-

It is mainly arises by the discharge of unutilized heat produced in various thermal power plants. The heated waters have reduced the amount of dissolved oxygen (DO) content due to which organic matter degrades faster.

The cooling water from thermal and nuclear plants is considerably warm and if such water is discharged into natural water bodies. It will result in the rise of temperature of water of such natural bodies’ . As a result there will be more demand for dissolved oxygen. Since activity of biological life is more at higher temperature. As the temperature increases, the DO (Dissolved oxygen) decreases. Thus higher temperature, less amount of oxygen will be soluble in water [10].
### 1.7.1.1 Factors Affecting Ground Water Pollution :-

The extent ground water pollution depends on the following factors.

1) Rain fall pattern,
2) Depth of water table
3) Distance from the source of contamination and
4) Soil properties such as texture, structure and filtration rate.

### 1.8 Sources of Contamination in Ground Water :-

Underground sources of drinking water, especially in outskirts of larger cities and villages are highly polluted. Ground water is threatened with pollution from the following sources.

1) Domestic wastes
2) Industrial wastes
3) Agricultural wastes
4) Run off from urban areas.
5) Soluble effluents

#### 1.8.1 Domestic Wastes :-

Domestic wastes and methods of their disposal are of primary concern in urban areas. Prime factors responsible for deteriorating the water quality include pathogenic organisms, oxygen demand, nutrients and solids from domestic wastes. Solid wastes are the potential source of contamination as they are partly burned and partly in corporate into the soil and pose serious danger to the ground water [62, 63].

#### 1.8.2 Industrial Wastes :-

Most industries generally produce wastes containing toxic heavy metals along with hazardous organic and inorganic effluents. These chemicals contaminate with the ground water and severely pollute it [15].

#### 1.8.3 Agricultural Wastes :-

Fertilizers, pesticides, insecticides, herbicides, processing wastes and animal wastes etc. are constantly added to the water. Leachiest from agricultural land containing nitrates, phosphates and potash, move down wards with percolating water and join the aquifers below posing danger to the ground water.
Throwing rubbish and other unwanted things into the water are not only the cause of water pollution, but a harmless activity such as farming could lead to something as insidious as nitrate pollution. Rising nitrate levels have raised an alarm because of the possibility of adverse effect on human and animals. Methaemoglobinaemia or blue baby disease is caused by the reaction of nitrate with hemoglobin. The oxygen carries in the blood, producing methaemoglobin which strangles the oxygen carrying capacity of the tissue [12].

1.8.4 Run off from Urban Areas :-

Effluents from urban areas contain large concentration of oils, greases, nutrients, heavy metals and detergents. The detergents being soluble can pass through the soil and pollute ground water. Raw sewage dumped in shallow soak pits and seepage from polluted lake, pond or stream also pollutes water. Rainfall could pick up substantial contaminants from dust and air and join the aquifer below. The infiltration of liquids containing toxic pollutants may cause pollution in sandy soils’ and well waters [51].

Supply of potable water has been affecting the contamination of water resources in most of the developing countries. River, lake and ground water have been polluted by industrial effluents, Pesticides, and fertilizers from agricultural runoff and urban waste. Chronic water scarcity is common in areas where ground water has been over drawn for irrigation, Industrial use or to meet the requirements of urban population. Clearing of forests which increase surface run off and reduce ground water have worsen the situation many countries are fast using up their ground water and moving from a situation of crises to disaster. Almost two thirds of the world population by the year 2025 will be subject to moderate to high water management difficulties.

1.8.5 Soluble Effluents :-

Several soluble effluents pollute the ground water critically. The extent of pollution is more in sandy soils and humid regions having high water table condition. Global withdrawals of water have grown by a factor of over 6 between 1900 and 1995 more than double rate of population growth. This is because of increasing water need for agriculture, industrialization and greater human use in urban cities. Agriculture takes about 70% of the water withdrawals. Often rising to 90% in dry tropic. Water withdrawals for irrigation purpose has increased by more than
60% which has coincided with the green revolution High yielding crop varieties require a lot of water. Now water withdrawals are so high that water bodies such as river and lakes have shrunk in size. A direct impact of this has been on the levels of ground water. Increasing use of ground water has pushed the water table lower. This can have serious effect on the flow of rivers, especially during dry periods, which is so vital for the aquatic ecosystem. Along the coasts, Increasing water withdrawals have led to the ingress of saline water into ground water.

Pollution is another factor that is reducing water quality and there by the availability of clean water. The amounts and there by the availability of clean water .The amount and types of wastes discharged have outstripped natures ability to break down pollutants into less harmfully elements. Human health is directly related with the quality of water. As the health of ecosystem is linked with the quality and quantity of water. About 20% of the population lack access to safe drinking water. While 50% lacks access to adequate sanitation. Most of these peoples are in developing countries.

At any given time it is estimated that half the people in developing countries suffer from water or food associated diseases. And from diseases that find their source in water (eg. Malaria and dengue). Chemical contamination and heavy metals in water also cause illness such as cancer, nervous system disorders and birth defect [59].

1.9 Harmful Effects of Water Pollution :

Ground water pollution causes irreparable damage to soil, plants and animal including man [10].

1.10.1 Harmful Effect of on Man :-

i) Polluted ground water is the major causes

For the spread of epidemics and chronic diseases in man . It causes typhoid, jaundice, dysentery, diarrhea, tuberculosis and hepatitis.

ii) Water contaminated by fibers i.e. asbestos causes fatal diseases like asbestosis and lung cancer.

iii) Ground water in excessive rainfall areas contains iron in toxic amounts as 20ppm. In deep tube wells, iron exists as ferrous ion which on taking out rapidly changes to light yellow orange color due to oxidation and precipitation as ferric hydroxide.
iv) The woolen industries contribute large amounts of toxic metals such as Hg, Ni, Cu, Cr, Fe and cyanides to ground water causing skin and stomach diseases in man [51].

1.10.2 Harmful Effects on Soil:-

i) The use of polluted ground water for irrigation agricultural fields severely of damage crops and decreases grain productions.

ii) Polluted water acutely affects soil fertility by killing bacteria and soil micro-organisms.

iii) Contaminated ground water increases alkalinity in the soil.

iv) Ground water pollution affects plant metabolism severely and disturbs the whole eco system [62].

1.11 Physical properties of water:-

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1.12 Details of Parameter :-

1.12.1 Temperature: - The temperature is basically important for its effect on the chemical and biological reactions in the organism in water. A rise in temperature of the
water leads to the speeding up of the chemical reactions in water. Reduces the solubility of gases and amplifies the taste and odours, at higher temperature metabolic activity of the organism increases.

Surface water differs considerably in temperature between winter and summer. Temperature measurement is useful in detecting an unsuspected source of pollution. In calculation alkalinity and in industrial water supplies for heat transmission calculations [21].

1.12.2 Hydrogen ion concentration (pH):

The pH of a solution is measured as negative logarithm of hydrogen ion concentration pH = - \log_{10} [H^+]. At a given temperature, the intensity of the acidic or basic character of a solution is indicate by pH or hydrogen ion concentration. pH values from 0 to 7 are diminishing acidic, 7 to 14 increasingly alkaline and 7 is neutral. Measurement of pH is one of the most important and frequently uses tests, as every phase of water and waste water treatment and waste quality management is pH dependent.

The pH of natural water usually lies in the range if 4 to 9 and mostly it is slightly basic because of the presence of bicarbonate and carbonates of alkali and alkaline earth metals, pH value is governed largely by the carbon dioxide and bicarbonate/ carbonate equilibrium. It may be affected by humus substances. By changes in the carbonate equilibriums due to the bioactivity of plants and in some cases by hydrolysable salts. The effect of pH on the chemical and biological properties of liquid makes its determination very important. It is used in several calculations in analytical work and its adjustment to an appropriate value is absolutely necessary in many of analytical procedures. In dilute solution, the hydrogen ion activity is approximately equal to the concentration of hydrogen ion. Pure water is very slightly ionized and at equilibrium the ionic product is [H^+][OH^-] = k=1.0\times10^{-14} at 25°C [62].

1.12.3 Electrical Conductivity (EC):

Electrical conductivity is a measure of water’s capacity to convey electric current, its unit is micro mho/cm or micro Siemens/cm³. Conductivity of water varies directly with the temperature and is proportional to its dissolved mineral matter content. Electrical conductivity determination is very rapid. So the quantity dissolved salts in water samples
can be ascertained quickly. It is an important guide to check the purity of distilled water and is applied for evaluation of steam purity in power industry. Distilled water with conductivity more than 2 should not be used for water analysis [63].

1.12.4 Solids :-

The term solid refers to the matter that remains as residue upon evaporation. Total solids include both dissolved solids and suspended solids. Potable waters contain mineral matters in dissolved conditions whereas industrial effluents and sewage contains huge amount of undissolved matter [21].

**Suspended solids:** 500 ml. of sample is taken exactly in a volumetric flask and allowed to filter through a dried and weighed Gooch crucible containing an asbestos mat. The suspended solids retained in the crucible are washed with distilled water to remove chloride. The crucible is finally dried, cooled in a desiccators and weighed. The increase in the weight of the crucible is equivalent to the suspended impurities present. The total solid contents of 500 ml sample can also be calculated by evaporating it to dryness on a steam bath and drying at about 100-110°C in an oven for about one hour. From this, subtract dissolved solids to get the quantity of suspended solids.

**Dissolved solids:** Filter 500ml sample in a Gooch crucible to free it from suspended matter. The filtrate is collected in a beaker and evaporated to about 50ml. volume.

It should be noted that any deposit on the walls of the beaker of due to evaporation of water should not touch the flame of the burner. The 50 ml liquid is carefully transferred to a weighed platinum dish with the help of policemen and distilled water. Evaporate the solution to dryness on steam bath and dry the dish in an oven at about 100-110°C for about an hour cool it in desiccators and weigh.

1.12.5 Total Alkalinity :-

Total alkalinity means the capacity of the water to neutralize a strong acid. However, most of the waters are rich in carbonates and bicarbonates with the little concentration of other alkalinity imparting ions.

Total alkalinity, carbonates and bicarbonates can be titrating with a strong acid first to phenolphthalein as an indicator and pH between 4.2 and 5.4 with methyl orange or mixed indicator. In first case the value is called as phenolphthalein alkalinity (PA) and in the
second case, it is total alkalinity (TA) values of carbonates, bicarbonates, and hydroxyl ions can be computed from these two types of alkalinites [10].

1.12.6 Hardness :-

Hardness is generally caused by the calcium and magnesium ions present in water. Polyvalent ions of some other metals like strontium, iron, aluminum, zinc and manganese etc. [51].

1.12.6.1 Calcium:- Calcium occurs in water mainly due to the presence of lime stone, gypsum, dolomite and gypsy ferrous materials. Calcium and magnesium are the major scale forming constituents in raw waters.

The determination of calcium is usually required for potable and industrial effluents and not for polluted waters or sewages. The organic matter present in industrial waters can be destroyed by evaporation and ignition. EDTA titrimetric method and Gravimetric method are used for the determination of calcium. Titrometric method can be conducted rapidly while gravimetric method is time consuming [54].

1.12.6.2 Magnesium:- Magnesium salts occur in nature water, sea water estuary water (about 130 ppm)

Magnesium may be determined by gravimetric or photometric methods. It may also be calculated as the difference between total hardness and calcium hardness as follows:

Mg (as CaCO₃) mg/l = Total hardness – calcium hardness.

1.12.7 Chloride :-

A freshly filtered sample is used for its determination which is carried out titrometrically [62].

1.12.8 Dissolved Oxygen (DO) :-

The dissolved oxygen (DO) levels in natural as well as waste waters depends on physical, chemical and biological activities of the water body. The analysis of dissolved oxygen is very important in water pollution control as well as waste water control.

1.12.9 Biochemical Oxygen Demand :-

Biochemical oxygen demand (BOD) is the measure of the degradable organic material present in a water sample and

Excessive nutrients, such as nitrates and phosphates commonly originate in domestic sewage runoff from domestic fertilizers, waste material from animal feed lots, packing plants
etc. these nutrients are responsible for water pollution because they stimulate the growth of micro-organism which often increase the Biochemical oxygen demand.

Eutrophication is a natural process in many lakes and ponds which have a rich supply of nutrients. It also occurs as the part of aging process in lake and ponds as nutrients accumulate through natural succession. Eutrophication, however, becomes excessive because of abnormally high amounts of nutrients from sewage, fertilizers, animal wastes etc. entering into streams, lake or ponds. This causes excessive growth or bloom of micro-organisms and aquatic vegetation.

There is a close relationship between organic matter and dissolved oxygen in water. Thus water pollution is measured by biochemical oxygen demand (BOD) which is standardized measurement of the amount of oxygen required by micro-organism to cause the break down or decomposition of organic matter in water sample over a period of 5 days at 20°C. The result is called 5 day BOD and is expressed in milligrams per liter of water (mg/l) or in ppm. [63].

1.12.10 Chemical Oxygen Demand (COD) :-

Chemical oxygen demand (COD) is the measure in ppm of oxygen taken from a k$_2$Cr$_2$O$_7$ solution in two hours.

Chemical oxygen demand has been found to be more scientific than the biological oxygen demand (BOD). It should be noted that it is not necessary for the COD values to correlate with BOD values. Textile values, paper mills waste and other wastes having higher levels of cellulose have been found to have considerably higher COD values than their BOD values because of the fact that cellulose is not readily attacked in BOD test. Distillery and refinery wastes often have higher BOD values than COD values unless COD measurement is specially modified. The BOD of a given water supply decreases faster than its COD value [51].

The BOD values approximate the amount of oxidizable organic matter. So it is used to measure degree of water pollution and waste strength. COD is a poor measure of organic matter as oxygen is also consumed in the oxidation of inorganic matter (such as nitrates, sulphates, reduced metal ions etc) as well as some organic materials such as benzene, pyridine etc.

BOD test is influenced by the following factors.
a) Type of micro organism
b) pH value of water
c) Presence of toxic materials
d) Nitrification process
e) Reduced mineral matter [2,3]

1.13 Relevant Literature Review

Alam, J.B., et al. (2007), have studied water quality parameters along rivers, The water samples have been collected from a part of suma river along different points and analyzed for various water quality parameters during dry and monsoon periods. Effect of industrial wastes, municipal sewage and agriculture runoff in river water quality have been investigated. The study was conducted within Chattak to Sunamganj portion of suma river, which is significant due to the presence of two major industries, a paper mill and a cement factory. The other significant feature is the conveyors that travel from India to Chattak.

This study involves determination of physical, biological and chemical parameters of surface water at different points. The river was found to be highly turbid in the monsoon season, but BOD and fecal coliform concentration was found higher in the dry season. The water was found slightly acidic. The mean values of parameters were conductivity 84-805 µs, DO, dry - 5.52 mg/l., monsoon – 5.72 mg/l., BOD dry – 1 mg/l. monsoon 0.878 mg/l. Total solids dry 149 mg/l. monsoon 145.7 mg/l.[1].

Arabi S.A. et al. (2011), studied Physico-chemical study of subsurface water from part of Taraba state, Nigeria.

This study of Physico-chemical analysis of ground water utilizes a total of eleven ground water samples collected from boreholes and hand dug wells in and around mika in Taraba state north eastern Nigeria in order to appraise it’s quality for house hold and irrigation purposes samples points were generated using spatial analysis and decision assistant soft ware. The area sampled falls within latitude 08° 48’ to 98° 08’ and longitude 11° 27’ to 11° 50’. Total dissolved solids (TDS) ranges from 191 to 308 mg/l. The samples studied had medium salinity hazard which indicates that for farming purposes, the water will have detrimental effect on crops that are sensitive to salinity. The dissimilarity in chemical composition of the studied ground water samples in the study area may be due to leakage of earthly salts, wide spread use of chemical fertilizers and ion exchange between ground water and the reservoir rocks. The results obtained
also indicates that most of the ground water from the study area is under saturated in calcite and aragonite with exception of sample OW1 which was slightly saturated in calcite with mineral saturation values of 0.09249 while the determined major anion and cat ions fall within World Health Organization and Nigerian standard for drinking water values. The studied ground water quality is generally suitable for household and farming purpose [4].


Bhagat, P.R. et.al (2008), study of Physico-chemical characteristics of the accumulated water ponds of Lohara, Yavatmal (M.S.) The duration of study was March-2006 to February 2007. Three sampling points were selected for the study. The parameters studied were total alkalinity, TDS, Chloride, Sulphate, pH, temp, hardness and metals like Fe, Ni, Zn, Cu. The concentration of the parameters like total hardness, chloride, sulphate, Zn were found in excessive amounts.

The concentration of chloride, Total hardness TDS Ca and Mg and metals like Cu, Fe were found beyond minimum tolerance limit. Most of the constituents showed maximum concentration in samples S4, S5, S6 due to mixing of rainy water from the surrounding region in the pond. The data showed brutal contamination of pond water probably due to dumping of domestic sewage, garbage and use of determents by the washer-women’s [7].

Bheshdadia, B.M. et.al (2012), studied Physico-chemical analysis such as temperature, salinity, alkalinity, total hardness, phosphate, sulphate, nitrate, pH, electrical conductivity, T.D.S., turbidity, dissolved oxygen, fluoride, chloride of bore well water was carried out from twenty five sampling stations of morbid-malia territory during may-2010 (before monsoon) and Oct.- 2010 (after monsoon) in order to assess water quality. In the present study temp in may-2010 ranged form 29.6°C to 32.6°C and Oct 2010 ranged from 29.1°C to 31.8°C. Dissolved oxygen ranged in both season out of range i.e. minimum tolerance range 4.0 ppm for drinking water. In this study pH in May-2010 ranged 7.10 to 8.90 and Oct 2010 ranged 7.62 to 9.02 i.e. some sampling stations shows pH higher than the prescribed range.

Turbidity of all sampling stations have shown lower NTU values than the prescribed range. TDS also shows in some sampling stations higher than prescribed limit.
Phosphate in May-2010 ranged from 13-41 mg/l and in Oct. 2010, 10-39 mg/l. This is higher than the prescribed value. The higher value of phosphate due to the use of fertilizers and pesticides by the people residing in this area. If phosphate is consumed in excess, phosphine gas is produced in gastro-intestinal tract on reaction with gastric. Nitrate in May-2010 ranged from 85 to 445 mg/l and in Oct 2010 ranged 92 to 423 mg/l. The tolerance range for nitrate is 20-45 mg/l. If the nitrite reduces to nitrate then it causes methaemoglobinemia in infants and also diarrhea.

Total hardness in May-2010 ranged 110 to 960 ppm and in Oct 2010, 85 to 920 ppm i.e. higher in some sampling stations than tolerance limit. Chloride also in this study is higher than the prescribed limit of chloride.

The study has shown that the essential elements in water like TDS, salinity, phosphate, nitrate, pH, total hardness, chloride are higher than tolerance range. Therefore bore well water in this territory is not suitable for drinking purpose [8].

**Borul, S.B. et. al. (2012)**, The study of Physico-chemical analysis of ground water for. In drinking from selected sample points around the Banmeru science college, Lonar Buldhana district of Maharashtra the present study, the ground water samples were collected from selected sampling stations around the late Ku. Durga K. Banmeru science college, Lonar dist. Buldhana and analyzed for its various analytical parameters related to quality of drinking water prescribed by WHO, ICMR, ISI etc. In this study Mg, dissolved oxygen, chloride, nitrate, phosphate, copper, iron were analyzed. From the results selected points are of poor quality and they require higher degree of treatment before consumption and hence some following treatment methods are suggested in this study.

1) An adequate filter system before the use which will remove suspended solids and colloidal particles.
2) Proper aeration by keeping the water in atmosphere and addition of KMnO₄ after pumping the water from bore well.
3) Addition of coagulant like alum to water.
4) Hot soda-lime solution should be used for the precipitation of metallic salts [9].

**De Sanhita et.al. (2007)**, studies of water pollution in the thermal power station effluents of Sarni, Betual (M.P.). In this study sampling were done from five sites namely s₁ which is attached area of thermal power station, s₂ in ash dam, s₃ in ash dam away approximately 1.5 Km.
from $s_2$ and $s_4$ in pumping water collection station, $s_5$ in satpura dam in the month of Feb 2006 and pH, TSS, total hardness, calcium hardness, chloride were analyzed and compared it with each other from that analysis results shows that effluents of TPS, Sarni, has revealed that most of the parameters exceed the permissible limits prescribed by Indian Standards [13].

Devi, S. et.al.(2012), Physico-chemical analysis of ground water samples near industrial area, cuddalore district, Tamilnadu, India.

Cuddalore is situated at northern region of Tamilnadu state lying between latitude $11^0 43'$ north and longitude $79^0 49'$ east. Bore well water is generally using for drinking and irrigation purpose in this district. The salinity intrusion and industrial pollution of ground water are the two key reasons for water deterioration of water quality. The study was carried out to assess the impacts of industrial activities on the ground water quality in and around SIPCOT industrial complex in Cuddalore district. The quality was assessed in terms of Physico-chemical parameters. Ground water and Municipal water samples were collected from seven villages in Cuddaloretaluka during Dec 2010-Feb 2011. The Physico-chemical parameters such as pH, electrical conductivity (E.C.), Total dissolved solids, turbidity, dissolved oxygen, total alkalinity, total hardness, calcium, magnesium, sodium, potassium, chloride, nitrate, sulphate were analyzed to know the present status of the ground water quality. The results were compared with standards prescribed by ISI 10500-91. It was found that the underground water was contaminated at few sampling sites. The remaining sampling sites show physico-chemical parameters within the water quality standards and the quality of water is good and it is fit for drinking purpose [14].

Gasim, M.B. et.al. (2007), This study results showed that the pH and DO value were very low, indicating the water was not potable the daily flow of the Bebar river is $5 \times 10^5$ m$^3$ therefore it is considered a teeming river. Recently however, various activities such as illegal logging, agricultural production and unsuitable development have been taking place in the surrounding areas. The impact of these activities could result in environmental damage to the adjustment peat swamp by changing the hydrological characteristics which in the long term could lead to deterioration in the quality of the peat swamp forest ecosystem [16].

Gupta, N. et.al. (2011), physico-chemical assessment of water quality of river Chambal in kota city area of Rajasthan state (India).

Geo morphologically kota city situated in northern part of malwa plateau. The only perennial river. Chambal originating from the hills of western Madhya Pradesh passes through
the district. The overall water quality of river Chambal was observed moderately polluted in city kota area in premonsoon periods [18].

Jemi, R. J. et al. (2011), studies on two permanent temple ponds designated as A (Padmanapapuram temple pond) and B (Parvathipuram temple pond) from kanyakumari district kalkulam taluka were selected the present study.

Deterioration of water quality and eutrophication are due to casual attitude of people. Human activities include bathing, washing of clothes, vehicles and household utensils etc. even though nature has got its own mechanisms to take care of the wastes when they are in limited quantities all physico-chemical parameters showed higher values in summer. Thus it can be concluded that these characteristics of water bodies are influenced by seasonal variations. it is recommended that the proper maintenance of the water bodies is necessary. Proper sanitation measured and environmental education to public care essential to keep these water bodies clean and safe [22].

John, E. (2009), physico-chemical studies of river pumba and distribution of prawn, micro brachium rosenbergii.

Physico-Chemical factors of river pumba, kerala has been analyzed to understand its relationship with the distribution of giant river prawn macro brachium rosenbergii in the water body. Water samples were taken from two sites on the basis of presence and absence of juveniles [23].

Kalra, N. et al. (2012), Physico –chemical analysis of ground water taken from five blocks (Udwanntnagar, Tarari,Charpokhar,Piro,Sahar) of southern Bojpur (Bihar).

The study area comprises of Bhojpur district of Bihar State. Bhojpur is one of the thirty eighty district of Bihar state and their administrative head quieters are located in ara town. It is a part of patna division. Bhojpur district (plate 1) falls within 25° 00’ to 25° 30’ N and 84° 15’ to 84° 45’ E, the area is bounded by river son in the east, Darmawati –Gangi rivers in east and river Ganga in the North. Its area spread over a total geographical area of 3395 sq/km. The district has three subdivisions of Arasadar, jagdishpur and piro . The block of the district include Arasadar, udwanntnagar, jagdishpur, Koliwan, Sahar, Barhara, Sandesh, shahpur, Charpokhari, Piro, Tarari, Bihia, Agiawon and Garhami. In the present research Physico-Chemical analysis was carried out for the five blocks of Southern Bhojpur.
In the Physico-chemical analysis, various quality parameters are measured including pH, turbidity, electrical conductivity, total dissolved solids, total hardness, content of calcium, magnesium, chloride, sulphate, Iron, DO, COD, BOD, total alkalinity and Nitrate concentration present in ground water. Also all the parameters were compared with ICMR standards of water quality. Also in the present research paper classification of water samples of five blocks was investigated on the basis of TDS and TH.

The study shows that ground water is the only source for people in the study area and the results of the chemical analyses of ground water indicate considerable variation. Most of the water samples do not comply with ICMR standards for drinking purposes. The water quality in the investigated area is found to be suitable for drinking only in few locations while as out prior treatment. It must be noted that a regular chemical analysis must be done to insure that the quality of water in this area is not contaminated, in addition to research for new walls in the area in order to get additional water for the resident people [24].

Khan, R.M. et.al. (2012), physico chemical analysis of Triveni lake water of Amravati district in (M.S)India. In the present investigation involves the analysis of water quality in relation to physico-chemical parameters, Triveni lake of Amravati district of Maharashtra was selected for physico-chemical analysis of water. The lake is source of drinking and irrigation water for 15 villages under the canal irrigation. Now a days lake water was polluted due to domestic waste and agricultural discharge. physico-chemical parameters of Triveni lake water were studied and analyzed for the period of one year i.e December 2010 to Nov.2011. In order to understand the water quality of Triveni lake various physico-chemical parameters such as water temperature, air temp, pH, humidity conductivity total hardness CaCO$_3$, Ca$^{++}$ Mg$^{++}$ were studied. The result revealed there was significant seasonal variation in some physico-chemical parameters and most of the parameters were in normal range and indicate better quality of lake water, It has been found that the water is best for drinking purposes in winter and summer seasons [26].

Khound,N.J. et.al. (2012), Physico-chemical studies on surface water quality in the JiaBharali river basin, North Brahmaputra plain, India.

The JiaBharali river catchment area is bounded by longitudes 92$^\circ$00’-93$^\circ$25’ E and latitudes 26$^\circ$39’ - 28$^\circ$ 00’ N. The JiaBharali, one of the major tributaries of the river Brahmaputra, flows down from the lower Himalayas in Arunachal Pradesh in the north eastern India and runs through the middle of sonitpur district of Assam. The river known kemeng in Arunachal Pradesh
flows orthogonal to the Himalayan thrust pattern and deflects along the tipi thrust in north and foothills fault in the south respectively, before debouching into the foreland at Bhalukpong where it takes the name of Jia Bharali. The region has extensive tea-plantations and paddy fields. The northern portion is made up of reserve forests and sparsely populated forest villages.

The lower catchment of Jia Bharali river basin and adjoining areas defined by the Arunachal Himalayas towards north, Brahmaputra river towards south Jia Gabharuriver and Ghiladhari river towards west and east respectively, is characterized by a network of foothills fed river and numerous static water bodies linked to fluvial activities. The surface water regime is primarily monsoon dependent although the trunk channels receive significant contribution from ground water during lean season. This study presents a comprehensive assessment of surface water quality of the area based on analysis of six data sets representing thirty five points sources and three consecutive years (2008-2010). The physico–chemical parameters show variable spatial and temporal relationship. The major ion contents show the trend Ca>Na>Mg>K while anion composition follows the trend HCO₃>Cl>SO₄>Po₄>NO₃ in both the wet and the dry season. with respect to the physico–chemical parameters the surface water sources of the Jia-Bharali catchment and adjoining area are found to be suitable for domestic, agricultural and Industrial use. spatio – temporal variability of the physico – chemical parameters from this study may be used as future baseline data to monitor and manage any changes with changing land use [27].

**Mohabansi, N.P.et.al. (2011)**, Physico–chemical and microbiological analysis of textile industry effluent of wardha region.

Wardha is important and historical city of India. The present work is an attempt to examine the textile industrial effluents of wardha district. The paper is an attempt to analyze the water quality of the effluents from the textile mill. In this investigation Physico-chemical parameters such as colour, odour, temp. density, sulphate COD, BOD, Pathogen had been analyzed from the effluent collected from the textile industry of wardha region, sodium and potassium elements were analyzed flame photometrically. In conclusion it can be stated that the different studied. Physico-chemical parameters such as colours, odour, temperature, density, surface tension, viscosity, alkalinity, acidity, chloride, hardness, total dissolved solids, total suspended solid, pH conductivity, sulphate, COD, BOD, pathogen are within the permissible limit. BOD exceeds WHO acceptable limit. This high level of BOD is an indication of the contamination and
improper drainage system of the dyeing units. The present investigation has let us to conclude that the quality of water samples subjected to study was acceptable from majority of Physico-chemical parameters while as per bacteriological standards the water needs to be treated before using it for domestic applications. Thus as per as sample water is concerned the potential risk of getting infected by water borne diseases is always there if used without proper disinfections [30].

Mahananda, M.R. et.al. (2010). Physico-chemical analysis of surface and ground water of Bargarh dist. Orissa, India. Bargarh town is situated between $21^036'1''$E longitude and $176.362$ mts. above sea level. It is situated on the bank of Jira river. The town is on the national highway no. 6 and 37 miles to west Sambalpur district. It is also served by the south eastern railway. The population of Bargarh town is about 80,000 and there is floating population of another 25,000 people every day because it is a trading town. It gets around 1527 mm rainfall per year. There is a big cement factory at Khaliapali village which is 3 km away from the Bargarh town.

The present investigation is concerned with the limnological studies of 3 community ponds as well as dug wells and bore wells of 10 wards of Bargarh town of western Orissa. Attempts were made to study and analyze the physico-chemical characteristic of the water various parameters like temp, pH, Total dissolved solids, Total suspended solids, Alkalinity, Dissolved oxygen, Chemical oxygen demand, Nitrate, Chloride, Sodium, Potassium, Phosphate, Fluoride, Total coli forms, (pond water) etc. give a picture of quality parameter in both dug well and bore well water as well as pond water of the town.

In this investigation, it was found that the max. Parameters were not at the level of pollution except few parameters like nitrate for ground water so both type of ground water satisfy the requirement for the use in various purposes. But the study of pond water indicated that the community ponds are highly polluted and unsafe for human use. Temple pond is comparatively less polluted than small community pond and large community pond.

By observing the results it can be concluded that the parameters which were taken for the study the water quality are below the pollution level for ground water which satisfy the requirement for the use of various purpose like domestic, agricultural, industrial etc, But in case of surface water, the water quality of small community ponds are above the permissible limit [31].

Makwana, S.A. et.al.(2012), Physico-chemical analysis of drinking water of Gandhinagar district.
Water samples from fifteen different areas located in and around Gandhinagar territory were collected in brown glass bottles with necessary precautions. The water quality parameters considered for the examination in this study are Temperature, pH, Dissolved oxygen, TDS, Total alkalinity, Calcium, Magnesium, Hardness, Sulphate, phosphate and nitrate content measured by water analysis kit and manual methods.

The physico-chemical data of the bore well water sample collected in June 2011 to Nov. 2011 are recorded. The results of the samples vary with different places because of the different nature of the soil contamination.

In the present study TDS ranged from 250 to 1470 mg/l. According to WHO and Indian standards TDS value should less than 500 mg/l for drinking purpose. DO range from 4.4 to 8.4 mg/l. in the present study, Total alkalinity content in the samples is in between 160 to 784 mg/l. Calcium hardness ranged from 8.02 to 88.70 mg/l. Magnesium hardness ranged from 7.88 to 155.42 mg/l. Phosphate ranged from 7.0 to 55 mg/l. The evaluated values of phosphate in the present study are higher than the prescribed values. The higher values of the phosphate are mainly due to the use of fertilizers and pesticides by the people residing in this area. If phosphate is consumed in excess, phosphine gas is produced in gastro-intestinal tract on reaction with gastric juice.

Nitrate ranged from 75 to 450 mg/l. The tolerable limit of nitrate is 20-45 mg/l. In Nitrate nitrogen is one of the major constituents of organism along with carbon and hydrogen as amino acids, proteins and organic compounds in the bore well water. If the nitrite reduces to nitrate, then it causes methaemoglobinemia in infants and also diarrhea [32].

Mathur P. et al. (2008), Assessment of Physico-chemical characteristics and suggested restoration measures for pushkar lake, Ajmer Rajasthan (India). Pushkar is situated 12 km north-west of Ajmer, which is centrally situated city of Rajasthan. It is located at latitude 26°29’ 14’’ N and longitude 74° 31’ 18’’ E at an elevation of 530 m above the mean sea level. The total catchment area of pushkar lake is 36.71 sq.km. In this area Physico-chemical and Bio-chemical weathering is predominate. Climate feature of pushkar are characterized by dry climate uncertain rainfall pattern and great variation in temperature during different seasons of the year. Humidity in low even in rainy season. The area under investigation represent different soil types ranging from sandy loom to sandy clay and yellowish brown to dark in colour.
The study shows that pushkar lake water exhibit low DO, high COD, BOD, turbidity, hardness chloride, phosphate, nitrate etc. Higher pH value indicates that slightly alkaline nature of water. The remarkable point is that the pollution load is significantly high during pushkar fair, especially on the kartikpoornima due to excess of religious activities of Hindu community on that day. The analysis shows that turbidity COD, BOD, hardness, chloride, phosphate, nitrate were above the permissible limits. It is observed that situation in one of the key causes responsible for the degradation of the lake.

Based on the aforesaid, some suggestion are being proposed for consideration which might be helpful in restoration of this lake.

1) Canalization of streams, which carry run-off, is needed so that the flow is diverted towards the lake. further to minimize the seepage and leakage of run-off, part of streams need complete lining.

2) Construction of check dams at appropriate location and regular clearance of the accumulated materials to far off location, which will not returning the streams.

3) A forestation in the catchment area and measures for stabilization of active and dunes should be taken up [33].

Pandey, S.K. et.al.(2009), Physico-chemical analysis of ground water of selected area of Gazipur City- A case study.

The experiment was conducted at dept. of environmental science P.G.CollegeGazipur, This is suburban area and district head quarter, located in the eastern gang tic plain of the Indian sub continent at $25^0 19'$ and $25^0 54'$ N latitude, $83^0 4'$ and $83^0 58'$ E longitude and 65.70 mts. above the sea level. The coldest months here are Dec-Jan and the hottest months are May-June. The temperature varies from $5^\circ C$ to $17^\circ C$ centigrade in winter and $30^\circ C$ to $42^\circ C$ in summer, but some-times winter temperature decreases to $3^\circ C$ and summer temperature shoots up to $45^\circ C$. In the summer which begins from March and last till mid June the temp. starts rising and sometimes it reaches $45^\circ C$. The study was conducted to monitor the ground water quality of selected sites of Ghazipur city by examining the various Physico-chemical parameters like pH, TDS, DO and CO$_2$ etc. A Comparison with ICMR standard shows that the water is nearly suitable for drinking purposes, the DHP’s (Disinfection by Products) analysis is required to corroborate the present study [37].
Parihar, S.S. et al. (2012), Physico-chemical and Microbiological analysis of underground water in and around Gwalior City, M.P. (India)

Total 16 water samples were collected in (July-2009) from different locations (Rairu, Jaura, Noorabad, Madhavpura, Banmore, GolekaMandir, Thatipur, C.P. Colony, Oil Industry, Birla Nagar, Shinde Ki Chawani, Railway Station, MaharajPura, Pintooka Park and GudaGudika Naka) in Gwalior, Madhyapradesh. Electrical conductivity, Total dissolved solids, Total aerobic Microbial count and most probable number were max. in S3 sample pH, hardness and DO were observed higher in S6, S8, S10 samples. Enteric pathogen E-coli and enterobactor were found in samples viz. S5, S11 and S1-4, S12-13, respectively, No coli forms were observed in samples S6-9 and S14-16. The Physico-chemical and microbiological characteristics of different water samples showed that maximum samples were not suitable for drinking purpose.

The observation of study strongly suggest that water of Gwalior region is of very high TDS and needs to be lowered down within prescribed limits before arising using it for drinking purposes. Also the water samples were showing microbial content beyond the pot ability range, which needs to be disinfected before consumption to avoid water-borne diseases. Although, the present investigation is essentially a primary work and needs to be further investigated to arrive at specified conclusion with respect to clinical implications [38].

Raut, P.D. et al. (2011), Study of physico-chemical and biological characteristics of lakes from shivaji university campus, Kolhapur (M.S.) Shivaji university is situated between the latitude 16°40’ 31.81’’ and longitude 74° 15’ 12.10’’, pollution of water bodies is one of the areas of major concern to environmentalists. For the present study, water samples were collected from three different lakes from shivaji university campus, Kolhapur monthly changes in physical and chemical parameters such as temperature, transparency, turbidity, Total dissolved solids, pH, Dissolved oxygen, free carbon dioxide, Total hardness, chlorides, alkalinity, phosphates, nitrates, and MPN were analysed for a period from Sept. 2010 to Feb. 2011.

The main objective of the study was to know physico-chemical and biological characteristics of lakes from the university campus. Sample were collected and analyzed for different physico-chemical and biological parameters reveals that Rajaram lake is polluted due to domestic sewage discharge, washing, bathing and microbiological decomposition of organic matters where as in remaining two lakes these anthropogenic activities were strictly prohibited. The present study reveals that some of the parameters were above the permissible limits of
surface water standard. The parameter like pH, alkalinity, acidity, DO, nitrate, chloride, hardness, turbidity are all well within limits whereas DO is high in Rajaram lake and Music department lake. Fecal contamination is observed during the study indicates that this water is not suitable for drinking purpose directly without proper treatment, seasonal variation in some parameters was also observed for temperature, pH, alkalinity, acidity, BOD, chloride in all three lakes during the study careful precautions should be taken before using this water for drinking purpose [39].

**Patil, S.G. et.al. (2012),** Impact of physico-chemical characteristics of Shivaji university lakes on phytoplankton communities, Kolhapur India, Kolhapur city is a prominent city of south western Maharashtra, is rapidly emerging as a leading industrial and commercial centre. The development of city created directly or indirectly a number of water quality problems. The city once supposed to have 40 small and large lakes in presently left with only few lakes in the shivaji university campus are the sole source of water for gardening laboratory use for various departments and hostels from the campus and these lakes has potential to sustain variety of biota. As the water from these lakes is used for drinking purpose there is need to study the physico-chemical and biological parameters.

The study deals with Physico-chemical properties of shivaji university lakes of Kolhapur city and its impact on phytoplankton population. Several limnological parameters were evaluated during the period from sept. 2010 to Feb. 2011 from seven sampling stations sited along lakes of shivaji university campus, Music department lake, Bhashabhavan lake, Rajaram lake, The physico-chemical parameters included were temperature, turbidity, pH, alkalinity, dissolved oxygen, total hardness and nitrate, phosphate, sulphate. A total 19 species were observed during the study period max. number of species observed in Rajaram Lake. There were 9 species were observed from the class chlorophyceae, 4 species of the class cynophyceae, 3 of class Bacillariophyceae, 3 of the class euglenophyceae. The microcystis species was observed in Rajaram Lake Indicates that the sign of eutrophication of lake, while species like desmidium observed from music department and Bhashabhavanlake were the indicator of good water quality. The physico-chemical parameters such as nitrate, phosphate, temperature and alkalinity are favourable for the growth of phytoplankton, maximum spices of the class chlorophyceae were observed during study period [40].
Pathak, H. et al. (2012), Assessment of physico-chemical quality of ground water in rural area nearby Sagar city, M.P. (India)

Baheria and Gambhiria, village area nearby Sagar city was chosen as study area. 15 locations of 2 villages were selected based on domestic, agriculture and industrial activities.

Physico-chemical parameters were carried out during different months of the pre monsoon, monsoon and post monsoon season in June 2007-July 2010. The statistical analysis of the collected samples yielded the range of the variation, mean, standard deviation and coefficient of variation. The multiple regression analysis and regression equation indicated that the degraded water quality of Gambhira and Baheria is caused by anthropogenic activities and in appropriate rural water management action plan.

Physico-chemical analysis of water samples of Gambhira and Baheria villages of Sagar city. Physico-chemical parameters are out of the highest desirable limit or maximum permissible limit. Hence these sample water cannot be absolutely fit for directly drinking. Some essential treatment needed to convert in drinking water. In conclusion from the results of the present study it may be said the people in these rural areas are therefore at higher potential risk of contacting water-borne and or sanitation related diseases. Both villages water is not absolutely fit for directly drinking purpose need treatment to minimize the contamination. It is recommended that water analysis showed be carried out from time to time to monitor the rate and kind of contamination. It is need to human to explain awareness among the people to maintain the cleanliness of their highest quality and purity levels to achieve a healthy life [41].

Puri, P.J. et al. (2010), Study and interpretation of physico-chemical characteristics of lake water quality in Nagpur city, the climate in the study area is continental, winter months are cold and rainy and summer is hot and dry. To characterized water quality throughout the main basin of lake, four permanent stations for monthly sampling were established and marked within the inflow (S1), out flow (S2), mid Lake Region (S3) and corner (S4). The sampling pts were selected on the basis of their importance.

This paper is intended to be a study concerning lake water pollution in Nagpur city. Regional and seasonal variation of some physico-chemical parameters such as nutrients salts, total nitrogen and total phosphorous, in addition, temp, pH, conductivity, dissolved oxygen, chemical oxygen demand, biological oxygen demand and suspended solids were determined for the estimation of pollution load during the period for January to December 2008. The sampling
points were selected on the basis of their importance. A Monitoring network was net as representative site in the whole studied area and water samples were taken on a regular basis for laboratory analysis. Important variations have occurred in the investigated area as a result of human activity and discharge of waste water. During present study, Ambazari, Gandhinagar and Futala Lake water showed significant pollution as compared to Gorewadalaake. This is attributable to pollution due to human activities such as immersion of idols of Gods and Goddess during festival season, surface runoff resulting from rainfall, washing activities and sewage (poor) around lake. All the calculated water quality parameters in studied lakes shows that fair water quality rating a autumn season which then change to medium in rainy season and higher during summer season. The situation is alarming and degradation is in continuous process, therefore immediate action is required for its better management [42].

**Krishan, R. et.al. (2007),** A comparative study on the physico-chemical and bacterial analysis of drinking borewell and sewage water in the three different places of sivakasi,

The drinking, borewell and sewage water in the sanmugasiKamaniNadar (SN) street, NaivatiNadar (N,N) Street and Thiruthanagai area of sivakasi has been studied. The various constituents monitored include the physico-chemical characters like pH, total solids, chemical parameters like total alkalinity, acidity, free CO₂, dissolved oxygen, total hardness, calcium, magnesium, chloride salinity and bacterial parameters like standard plate count (SPC), total coliform count (TCC), facealstreptococeal count (FSC) Most of the physico-chemical characters of drinking and borewell water were within the ISI permissible level. However in water samples from all the sites bacterial count exceeded the recommended permissible level of WHO introduction of sewage into the drinking and bore well water was the main reason for the bacterial contamination. The boiling of water is therefore advisable before consumption. The physico-chemical and bacterial characters of the sewage water were unworthy, the sewage water recycling was necessary to minimize the water born diseases.

Most of the physico-chemical parameters were found to be suitable for domestic uses even though, the bacterial parameters such as SPC, TCC, FCC and FSC exceeded the standard limit. Therefore boiling of water is essential before consumption of water by the people living in the S.N. Street and N.N. Street and Thiruthangal. The sewage water must be pretreated and then disposed of into the environment for avoiding health hazards [43].
Rajiv, P. et.al (2012), Physico-Chemical and microbiological analysis of different river water in western Tamilnadu, India.

The environmental quality is greatly focused on water because of its importance in maintaining the human health and health of the ecosystem. Many parts of the world are facing water scarcity problem due to limitation of water resources coincided with increasing population. River are vital fresh water system that are critical for the sustenance of life. In the present study river water samples were collected in the period between Jan-March 2012 from different parts of western Tamilnadu and various physico-chemical and microbial analysis were performed based on standard methods. The comparative results shows the pH (7.5 to 10), DO (8-16 mg/l), BOD (2.5 – 7.5 mg/l), COD (14.5 – 15 mg/l), total hardness (100-520 mg/l), Calcium (80-200 mg/l), Magnesium (20-320 mg/l), Number of fungal colonies (30-45 CFU).

Physico-chemical and microbial analysis was performed on five river water samples collected from various districts in Western Tamilnadu, India by standard methods. These rivers used as such as for drinking, fishing, irrigation and other domestic purposes. This study would help the water quality monitoring and management in order to improve the quality of water with maintaining better sustainable management. Results obtained showed slight variations between water qualities of the river. The comparative analysis suggest the district nature of different river water and it depends on geographical location time zone and geological foundation. Comparatively shanmuga river was more polluted that other four rivers. This study would help to create and develop awareness among the people to maintain the quality of the river water [44].

Reza, R. et.al.(2009), Physico-Chemical analysis of ground water in Angul-Talcher region of Orissa, India.

The Angul-Talcher area lies between latitudes $20^\circ$ 37’ N to $21^\circ$ 10’ N and longitudes $84^\circ$ 53’ E to $85^\circ$ 28’ E and situated at an average height of 139 mts. above mean sea level, vast mineral deposits availability of water and good infrastructure conductive for industrialization in the Brahmani river basin has resulted in heavy industrialization of the area. Many small, medium and large scale industries such as Coal mines, Super talchar, Thermal power plants, Talcher Thermal power station, Nalco smelter and its captive power plant and other iron and steel industries are situated in this region. The study area was carried out to assess the impact of industrial and mining activities on the ground water quality in Angul-Talcher region of Orrisa. The quality was assessed in terms of physico-chemical parameters. Ground water samples were
collected from thirteen (13) open well at various locations in study area during pre and post monsoon season. The Physico-chemical parameters such as pH, Electrical conductivity, TDS, Total Hardness, Ca$^{++}$, Mg$^{++}$, Chloride, COD were analysed to know the present status of the ground water quality. Drinking water quality of pre-monsoon was better than post monsoon season. In general water quality of Angul-Talcher region is not harmful to human beings except few instances where some parameters such as COD at Blinda, Danara and Takua village, well water and turbidity at Blinda village well water were crossed prescribed limits of drinking water the reason behind this may be due to industrial and mining activities, weathering and erosion of bed rocks most of parameters showed analogous trend in post monsoon, It indicates that the extent of pollution occurred due to mining industrial discharge, utilization and other anthropogenic activities increased human interventions in the ground water quality correlation studies have also indicated the contribution of charges in land use, industrial discharge and runoff during post-monsoon season. [45].

Sahani, K. et.al.(2012), Seasonal variation in physico-chemical parameters of Bharawas pond, Rewari Haryana.

Not much information is available on physico-chemical parameters and aspects pertaining to village water bodies used for culture of Indian. Major and exotic carps around Rewari. Hence the present account is an attempts to study detailed information of some important physico-chemical parameters of Bharawas pond in district Rewari, Haryana.

The present paper deal with the seasonal variations in some important physico-chemical parameters of Bharawas pond, district Rewari. A total of 17 parameters were recorded during the study period. Most of the parameters i.e. temperature, transparency, EC, free CO$_2$, DO, Chloride, Carbonate, Bi-Carbonate, Alkalinity, Hardness, Calcium, Magnesium, Salinity, total dissolved solids and phosphate were badly affected while only pH, and nirate were found within range. It was observed that the pollutant receiving water body appears as an aquatic desert which is most unsuitable for aquatic biota and for aquaculture. The finding clearly indicate that the pond is highly polluted due to discharge of uncontrolled dairy effluents leading to eutrophication. The all over impact on the pond has resulted in the deterioration of water quality, accumulation of toxic chemicals and sediment shrinkage of pond area. In order to improve the quality of pond water, continuous monitoring of the pollution level is an urgent need of the day to promote fishery [47].
Borah, M. et.al. (2011), Study of some physico-chemical parameters and river water with reference to correlation study, Lumiding is a railway division town which lies between 25° 45’ to 26° 45’ in north latitude and 91° 50’ to 93° 20’ in east longitude.

The area is highly dry and so water scarcity is common phenomenon of the locality. Their own supply water covers some of the railway area. So the local people adjoining the local town use pond and river water for their domestic purposes. Again this fresh water is contaminated by sewage and sewerage, run of materials, industrial waste, biological contamination, toxic metal ions, biodegradable, non biodegradable pollutants.

Surface water sample were taken and collected from pond and river samples in and around of lumding town of Assam and analyzed for temperature, pH, conductance, TS, TDS, TSS, Turbidity, hardness, total alkalinity, DO, COD, NO₃, HCO₃, Cl, SO₄, Na⁺, K⁺, Ca²⁺, Mg²⁺ and Fe. The result were considered for correlation analysis and it was observed that many of the parameters bear a good positive correlation and some bear negative correlation [48].


In the present study bore wells water from twenty different area located in and around Kathalal territory were collected in brown glass bottles with necessary precautions.

Physico-chemical analysis such as temperature, pH, dissolved oxygen, total dissolved solids, chloride, total alkalinity, Calcium and Magnesium hardness, Sulphate, Phosphate, Nitrate of bore well water was carried out from twenty sampling stations of Kathalal territory area during the Feb-2011 in order to assess water quality index.

Physico-chemical analysis such as temp, pH, dissolved oxygen, total dissolved solids, chlorids, total alkalinity, calcium and magnesium hardness, sulphate, phosphate, nitrate of bore wells water was carried out, TDS value should be less than 500 mg/l for drinking water. All the sample station except sample station no 14 higher ranged as prescribed by WHO and Indian standards. It can affect human being and plants from the data of drinking water we should know properties of bore well drinking water which is used to prevent out plant growth [49].

Shaikh, A.M. et.al (2009), Seasonal study of Physico-chemical parameters of drinking water in Khed (Lote) industrial area.

Many water samples were collected from ten different places of Lote (Khed) industrial area, sample number 1 to 4 from four different rivers, sample no. 7 from general drinking water
tank, sample no. 8,9,10 from three different wells. Samples were collected in the clean polythene bottles (2 lit. capacity) collection and analysis was carried out at peak of each season i.e. July 25 to August 05, 2008 (Monsoon), Nov. 25 to Dec 05, 2008 (winter) and March to April 05, 2009 (Summer) as per standard procedure.

It can be concluded that certain parameters like pH, temperature, EC and chloride (except sample no. 9 in Summer) was found to under permissible limit in all ten different water samples. parameters like TDS, DO, COD, BOD and hardness was found to beyond permissible limit in well water samples (no 8,9 and 10) while in bore well water samples (1-4), River water samples (5-6) and water supply for drinking (no. 7) found under permissible limit i.e. satisfactory, suitable for drinking. In the present study concerned to seasonal change in parameter, there was no remarkable change of parameter as per season was found except electrical conductivity, temperature and quite chloride [50].

**Smitha, P.G. et.al.(2007)**, Physico-chemical characteristics of water samples of Bantwal Taluka, South western Karnataka, India.

Bantwal is one of the five talukas of dakshinkannad district. It is situated between 12° 40' N and 13° 5' N latitude and 74° 55' E and 75° 15'E longitude. The total geographical area of Bantwaltaluka is 735 km². There are 40 inhabited villages in taluka. According to 1991 census report, the population was 3,23,005. The population density is 439/km², Agriculture and related labour are the main occupation of the rural people. The taluka has wet monsoon type climate. The annual average rainfall received is 3819 mm with around 124 rainy days.

In the present study the analysis of water samples from different sources like open wells, bore wells, farm ponds and streams/rivers of twenty villages of Bantwaltaluka of DakshinKannad district. Physico-chemical characteristics of this water samples showed that it is suitable for irrigation and agricultural purpose.

In the present work, Physico-chemical parameters like pH, Sodium, Calcium, Mangnesium, Chloride and nitrates of the water samples analyzed from bore wells, open wells, ponds and streams/rivers were well within the permissible limit for drinking water recommended by BIS (1991) and WHO (1984). These water sources were also found suitable for irrigation without further treatment, However the authors are investigating the effect of the Physico-chemical parameters of the water from the study area on the pathogen, which will be published separately [53].
Sharma, R. et.al. (2012), Physico-chemical and microbiological studies of drinking water of Pali district, Rajasthan.

Pali is a town in Rajasthan state of Western India, located in the Marwar region. It is situated on the bank of Bandi river and in 72 km south east of Jodhpur city. It is known as the industrial city, Pali city lies between north latitude 25° 77' and east longitude 73° 33' covering the area of approximately 12387 km². It is at height of about 935 mts. above the mean sea level. The main purpose of study was to analyze the quality of ground water. Total dissolved solids, total hardness, fluoride, nitrate values were maximum on all the sites. The values of pH, conductivity, hardness, Calcium, dissolved oxygen and biological oxygen demand was high. These parameters were assessing to evaluate the quality of ground water. This investigation shows that only pH and nitrates value lies within the permissible limit and rest of the parameters are beyond the permissible limit except few, which indicates that ground water of this region is highly contaminated and thus it is necessary to test the water quality at regular and definite time interval. So it is concluded that ground water of Pali region is highly contaminated and thus a regular and periodical monitoring of water is suggested [54].

Tepe, Y. et.al., (2005), Some physico-chemical characteristics of yarseli lake, Hatay, Turkey. Yarselilake is located in the town of Altmozin province of Hatay. Oronters river and white creek are the main water sources of the lake. The lake is constructed for irrigation purpose and was started to use for agriculture irrigation in 1991. The surface area is 3.98 km² at the mean water and the height from river bed is 37 m. The total volume of the lake is 5.4 x 10⁹ m³. The largest length of the lake is 930 m. and the flow rate when it is at full level is 888 m³/min. Water sample collected from stations. Station one was located near by the entrance of white creek station 2 was across the station 1 and close by the set.

Lakes are sometimes subjected to waste water discharges originating from different sources. Chemicals such as nitrogen, phosphorous and carbon in certain concentrations might distort and disrupt aquatic ecosystems. Eutrophication of in land bodies of water has become synonymous with the deterioration of water quality, which interferes with most of its beneficial uses. This study, purposing to determine water quality characteristics of yarseli lake, located in Antakya, Hatay, began in April 2003 and was carried out for 12 months by taking monthly water samples from two different stations, water quality parameters of pH, dissolved oxygen, temperature, salinity, chemical oxygen demand, total alkalinity and hardness, ammonia, nitrate,
nitrite, phosphate, sulphite, sulphate, chloride, potassium, sodium and silica analysis were done. Changes in water quality parameters of yarseli lake by months were determined. This study indicates that yarseli lake has not reached the eutrophic stage yet.

Soils retain sodium and potassium a greater degree than chloride or nitrate. Therefore sodium and potassium are not as useful as pollution indicators. Increase in sodium and potassium values over time can mean there are long term effect caused by pollution. Although not normally toxic themselves these compounds strongly indicate possible contamination from more damaging compounds. The primary purpose of this study is to help people understand the elements affecting lake water quality, Another goal is to show the benefits of keeping a long term record of water quality data. Such a record documents changes and helps to distinguish between a lake’s natural variability and the impact of human activity [55]

Tidame, S.K. et.al.(2012), Studies on seasonal variations in physico-chemical parameters of the temple pond. Nashik district (M.S.) India. Prayagtirth is situated two km. away from Trimbakeshwar City, which is 24 km away from Nasik district. It lies at 19° 94’ 55” N latitude and 73° 55’ 10” East longitude. The pond is stagnant perennial and hexagonal in shape. It measures about 1.5 acre, 20 meter deep and well constructed Three sites were selected of which site 1 and site 3 are in the line with human disturbances, domestic animals where as site-2, is less disturbed, The pond serves as water reservoir for agriculture, washing clothes and for drinking and washing domestic animals.

Present work focused on the seasonal variations in the Physico-Chemical parameters of the fresh water temple pond prayagtirth at Trimbakeshwar in Nashik district during summer, monsoon and winter. A total 15 parameters were analyzed and their seasonal variation is discussed. The correlation matrix of the various physico-chemical parameters are computed and analyzed.

The increase in carbon-dioxide shown decrease in GPP and chloride, dissolved oxygen shown positive correlation with phosphate and sulphate. The increase in NPP shows significant positive change in alkalinity sulphate and BOD. GPP shows positive correlation with phosphate. Increase in sulphate concentration shows increase in BOD. Hardness shows significant positive correlation with magnesium, NPP, alkalinity and BOD [56].

Tridevi,Sonal et.al. (2012),Physico-chemical studies of water quality of Shahpuralake, Bhopal (M.P.) with special reference to pollution effects on ground water of it’s fringe areas.
To study the water quality status of Shahpuralake, thirteen surface water quality monitoring stations were chosen at different points of the lake and sixteen ground water quality monitoring stations in the fringe area were finalized.

Indiscriminate and wasteful water consumption and improper waste disposal practices have led to deterioration in the water quality be it surface or ground water. Shahpura is an in land urban surface water body which is led by Bhopal city waste water and effluent from adjoining shahpura and Chunabhatti town ships there by converted into a polluted lake. This is a maiden attempt to highlight the spread of polluted surface water into the ground water aquifer which is supports the drinking water supplies to a large population of Bhopal.

In general the surface water of shahpura lake has shown lesser values of the parameters pH, total hardness, EC, TDS, in comparison to the ground water samples, However the nitrate and microorganisms (Coliformbacteria) showed very high values in lake water studies carried out in present investigation revealed that one of the most important causes of water pollution is unplanned urban development without adequate attention to suitable management of sewage and waste material. It is summerised that propagation of pollution front in ground water aquifer of the fringe area of Shahpuralake is governed by the hydraulic gradient enhancing influent seepage from Shahpura lake. The alarm bell therefore rings at the doorstep with the fear of polluting the Chunabhatti ground water sanctuary which support tens of hundreds of water tankers from the tube wells of the fringe area of shahpura lake for water supply in different parts of Bhopal city. Also the entire population of Chunabhatti town ship depends on the water supply from tube wells/ Bore wells. It is therefore, recommended that this ground water supply from tube wells showed by used as drinking water only after pre treatment. It may also not be cut out of content that all the in lets of city effluents/waste water showed be suitably treated before flowing into Shahpura lake [58].

Venkate, S. S. et.al. (2011), Evaluation of Physico-Chemical characteristics in ground water using GIS- A case study of Chinnar sub basin, Cauvery river, Tamilnadu India .

The study area falls in Dharmapuri district of TamilnaduChinnar sub-basin have been selected for the present investigation. It lies between 12° 13’ 38” and 12° 41’ 44” N latitudes and 77° 42’ 38” and 78° 04’ 13” E. longitude, covering on area of 95.07 sq. km. Chinar sub-basin is one of the major tributaries of Cauvery river. The basin come under parts of palakkodetaluka and pennagaramtaluka of Dharmapuri district in Tamilnadu state, India.
A detained GIS based study on hydrochemistry of ground water in Chinnar sub-basin, Dharmapuri district, Tamilnadu has been carried out to assess the quality of ground water for determining its suitability for drinking purpose, further the spatial variation of various ground water quality parameters over the basin has also been studied for Nov. 2010, fifty seven ground water samples were collected and analyzed for pH, Conductance, total dissolved solids, total hardness, calcium, magnesium, fluoride, iron, carbonate, bicarbonate, total alkalinity, chloride, sodium, potassium, sulphate and nitrate etc.

The aforesaid statement reveals that the chemical composition of the Chinnar basin area is hard, fresh to brackish and slightly alkaline in nature. TDS about 87% of the sample and spatially 789-32 km² areas are within the max. allowable limit for drinking (1000 mg/l). Total hardness (TH) 7.08 km² area falls in exceed the permissible limits of 500 mg/l prescribed for drinking water. Magnesium content in ground water fifty out of 57 samples and 26.18 km² area falls in exceeded the maximum allowable limit of 50 mg/l. Concentration of potassium ion in ground water ranges from 3 mg/l. Thirty nine out of 57 samples and 270.59 km² area falls in exceeded the max. allowable limit of 10 mg/l. Fluoride is (71.5 mg/l) in ground water at 5 locations and spatiality 25.15 km² area peoples affected for the dental and skeletal fluorosis in the chinnar sub-basin this classification based on WHO standard for drinking purpose [60].

Wagh, C.V et.al.(2009), Physico-chemical analysis of ground water in pravara area, District Ahmednagar, Maharashtra.

Ground water samples was collected from eighteen different locations of village in pravara area i.e. Zarekhathi, Dhadkd, Durgapur, Dhad Bk, Pratappur, Chinchpur, Golalgaon, LoniKd., Chandrapur, Sadatpur, Hasanpur, Mandapur, Rajuri, Fatyabad, Songaon, Chanegaon, Satral and Dhanore, The sampling stations are 4 to 5 km away from each other.

In the present investigation an attempt has been made to investigate the quality of ground water around pravara area. The water quality parameter i.e. pH, electrical conductivity, total dissolved solid, total hardness, total alkalinity, dissolved oxygen, chemical oxygen demand, calcium, magnesium, sodium, potassium, chloride, sulphate, phosphate and nitrate were investigated.

The various parameters studied are within the permissible limit as per WHO and ICMR norms for drinking purpose in the studied period. The finding of the present work is also
recommended ground water is suitable for irrigation and domestic use. Some of location in study area are unfit for drinking as well other domestic purpose [61].


Samples of the river Ganga water were collected at monthly interval from the selected sites in the first week of each month (from Sept. 2004 to August 2006) Triplicate samples, each of two liters’ in Polythene bottles were collected between 8 am to 10 am from each sampling sites and brought to the laboratory in ice boxes for the analysis of various physico-chemical parameters Temperature of water samples were recorded on the sampling sites immediately with the help of Celsius thermometer. Dissolve oxygen was fixed on the sampling sites with manganous sulphate and alkali iodide, azide for analysis.

Physico-chemical properties of the water of river Ganga were studied at five different sites i.e. site 1\textsuperscript{st} pattharghat site, 2\textsuperscript{nd} Bad Mahadevghat site, 3\textsuperscript{rd} Dadarighat site, 4\textsuperscript{th} Collector ghat site, 5\textsuperscript{th} chitnathghat during the September 2005 to August 2007, rin river Ganga at Ghazipur, Uttarpradesh, Depletion in the dissolved oxygen and increase in temp. total dissolved solid, Hardness, Calcium, Magnesium, Phosphate, Electrical conductance, pH, Biochemical oxygen demand, Chemical oxygen demand, Chloride, Acidity, Total alkalinity, Nitrate, Sodium, Potassium. Analysis observation reveal variation in the values of temperature ranged from a minimum of $17 \pm 0.55^\circ C$ at site-1 in Jan 2006 to a max of $33.90 \pm 0.58^\circ C$ at site- 2\textsuperscript{nd} in the month of June 2006. Seasonally the values were highest in summer season followed by rainy season and winter season.

The observation of total solids reveals that the monthly variation ranged from a min. 260 $\pm 11.5$ mg/l .at site-1 in February 2006 to a max. of 1055 $\pm 15.7$ mg/l. at site-2\textsuperscript{nd} in the month of August 2006, Seasonally the values were higher in rainy season and low in winter and the intermediate values were recorded in summer season [64].
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