Chapter 1

Introduction
1. INTRODUCTION

Earth, the water planet is the only one in our solar system presently characterized and shaped by abundant liquid, water - a necessity for life. Although water characterizes this planet, majority of it is saline in nature (97.2 percent) and contained in the world’s ocean (Speidel & Agnew, 1998). Only 2.8% is fresh water, including 2.05% frozen in glaciers, 0.68% as groundwater and only a tiny fraction ~0.011% of our water resources is contained in freshwater Rivers and Lakes. Water in its purest form on earth, comes from rain and snow. This water is available first in the form of surface water through Rivers and Lakes, the study of which is known as Limnology. Thus the journey of water on earth starts in the shape of surface runoff (Chapman, 1996).

Limnology can be defined as an interdisciplinary science which involves a great deal of detailed field as well as laboratory studies to understand the structural and functional aspects and problems associated with the fresh water environment, both lentic and lotic (Rajagopal et al., 2010). It is also called as fresh water biology or aquatic ecology. It covers the biological, chemical, physical, geological and other attributes of all inland waters i.e. lentic ecosystem (also called the lacustrine ecosystem or the still water ecosystem) and lotic ecosystem (also called the riverine ecosystem). A lentic ecosystem entails a body of standing water, ranging from ditches, seeps, ponds, seasonal pools, basin marshes and lakes. A lotic ecosystem can be any kind of moving water body, such as a creek, brook, river, spring, channel or stream. The water in a lotic ecosystem, from source to mouth, must have atmospheric gases, turbidity, longitudinal temperature gradation and material dissolved in it.

The River is a prime example of lotic ecosystem. It is a wide, natural stream of fresh water that flows into an ocean or other large body of water and is usually fed by smaller streams, called tributaries that enter it along its course. A river and its tributaries form a drainage basin or watershed that collects the runoff throughout the region and channels it along with erosional sediments toward the river. Rivers are described by unidirectional flow, continuous state of physical change, high degree of spatial and temporal heterogeneity including biotic (aquatic plant, organisms and plankton) as well as abiotic (physical and chemical) interactions (Fig. 1.1).
From the foregoing era, it is established that water is one of the most precious elements of nature, sustaining the mother Earth and her inhabitants in every form of life. Rivers have proved as cradles for nurturing civilization, agricultural activities and trade and commerce. Thus, the ancient civilizations have become known by the name of the rivers which flowed past them like the Sumarian Civilization, on the bank of River Nile in Egypt, Babilon Civilization on the banks of rivers Ucretis and Tygris in Central Asia, Mohanjo-dero and Harrappan Civilization on the banks of river Indus in India.

In present time too all the major cities of the world are established on the banks of the rivers or sea shores such as London on river Thames, Perison river Seine, Moscow on river Moscova and Cairo on river Nile. In India, to site few of such cities as Varanasi the oldest centre of pilgrimage is located on the banks of river Ganga, the National capital Delhi on the banks of river Yamuna, Vijayawada on the river Krishna, Ahmedabad on river Sabarmati, Surat on river Tapi and Bharuch on river Narmada.

India is bestowed with a number of rivers. The water of which are used for irrigation, potable water, cheap transportation, electricity, and the livelihoods for a large number of people all over the country. In India rivers are not mere means of

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*From the Hydrobiological and Pollution studies of Sabarmati River with reference to New River Front Development and Kharicut canal at Ahmedabad, Gujarat*
irrigation, transport, recreation, power generation or treasure house of natural resources only but also hold religious significance. The rivers in India are considered as Goddess and are worshiped among the Hindus. Some of the most prominent such rivers in India include Ganga, Yamuna, Krishna, Godavari, Narmada, Kaveri etc. Even today in India, water is the single most important tool/mode for performing daily religious rituals or social ceremonies and a primary means for purification of body and soul. Thus rivers are designated as the "Soul" of the living world. In other words, river water is an inevitable element required for existence and development of any society or civilization.

On the other hand, since the dawn of civilization, many water bodies have also been used for the purpose of disposal of sewage and other wastes. They can assimilate wastes to a certain degree and restore its quality before becoming polluted. However, with the advent of industrialization, urbanization and increased human interference, its self-purification power is diminished, leading to water pollution, a problem of great biological, technological and sociological complexity. Water pollution is one of the most serious environmental problems in India. Since the middle of 20th century, the influences of human activities on river ecosystem have been intensifying. These activities, such as agriculture, urbanization, tourism etc. have great influence on river ecosystem exceeding the self-cleaning capacity of river ecosystem (Eziz et al., 2008). Untreated industrial effluents, especially the waste water from electroplating chemical, electrical and electronics, textiles metal-based and other heavy engineering industries release high amounts of undesirable metals as pollutants into the water stream. Runoff waters from major cities with a variety of ions and other substances being carried out into the streams or rivers in higher concentrations may lead to pollution (Girija et al., 2007).

There are 14 major rivers, 44 medium rivers and 53 small rivers in India. Major rivers have been proved to be the seat for the setup of big cities and their educational, political and regional developments. The state of Gujarat has been profusely endowed with number of perennial rivers such as Narmada, Tapi, Mahi and Sabarmati (Fig.1.2). This river are being used by people as a source of water and as a sink to dispose the sewage and industrial effluents which has led inevitably to alterations in the quality and ecology of water bodies and this brings new challenges to both water resource managers and aquatic ecologists (Abida Begum & Harikrishna, 2008).

Hydrobiological and Pollution studies of Sabarmati River with reference to New River Front Development and Kharicut canal at Ahmedabad, Gujarat
The state of Gujarat is well known as one of the leading largest industrial states of the country. Traditionally it is known for textile industries and its ancillary engineering units. These industries in the state are the leading producers of chemicals, fertilizers, dyes, fibers, polymers, drugs, catalysts etc. but unwillingly are contributors to the problem of air and water pollution. Urbanization goes hand in hand with industrialization in the race of polluting water bodies. In past few years, cities located on river banks have shown significant negative impacts on water quality because of extensive urbanization as a consequence of which the rivers are getting deteriorated day by day. The structural interventions in the natural water bodies through canalization or damming of rivers, diversion of water within or among drainage basins, construction of river front, over-pumping of aquifer etc. are usually undertaken with a beneficial objective in mind. Though, the resulting long-term

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environmental degradation often outweighs these benefits (Table 1.1) (Chapman, 1996).

Table 1.1: Ecological impacts of direct or indirect modification of the river bed

<table>
<thead>
<tr>
<th>Activity/Modification</th>
<th>Effects</th>
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<tbody>
<tr>
<td>Construction of barrage or retention wall</td>
<td>Enhancement of Eutrophication, hampered species migration, lift up silt sedimentation, Enhancement of water density, blocks sunlight penetration</td>
</tr>
<tr>
<td>Damming</td>
<td>Enhancement of Eutrophication (bottom anoxia, high organic matter in surface waters etc.) complete storage of sediments resulting in potential fish kills (high ammonia, BOD and TSS)</td>
</tr>
<tr>
<td>Dredging</td>
<td>Continuous high levels of TSS and resultant silting of gravel spawning areas in downstream reaches, regressive erosion upstream of dredging areas may prevent fish migration</td>
</tr>
<tr>
<td>Flood plain reclamation and river bed channelization</td>
<td>Loss of ecological diversity, including specific spawning areas, loss of biological habitats especially for fish.</td>
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Sabarmati River:

The river Sabarmati originates in the Aravali hills of Udaipur district at Rajasthan and flows through three Districts of Gujarat - Sabarkantha, Ahmedabad and Kheda. The river is approximately 371 km in length with an average width of 325 to 500 m. The main tributaries of the Sabarmati river are Wakal, Harnay, Hathmati, Vatrak, Meshwo, Sei and Khari river, which also flow south-westwards in courses generally parallel to the Sabarmati river, upto their confluence with the River in Gujarat and finally it empties into the Gulf of Cambay of Arabian Sea.

Sabarmati is one of the polluted rivers in the country although it is the lifeline of Gujarat state. The Sabarmati River flows from North to South in the center of the city and is a major source of water in every sector for the city. The intensive agricultural practices, withdrawal of water for industrial purpose and Urbanization have left the river absolutely dry after it entered the Ahmadabad city. Though, this problem was

*Hydrobiological and Pollution studies of Sabarmati River with reference to New River Front Development and Kharicut canal at Ahmedabad, Gujarat*
overcome by constructing a Vasana barrage which holds up the water in river throughout the year.

The industrial belt of Ahmedabad is mainly situated in Eastern part of the city which includes different industrial estates like Nikol, Odav, Ramol, Vastral, Naroda, and Vatva. Around 3,850 small as well as medium scale Industries comprising chemical, engineering, fabric; ceramic and printing units are located in these three industrial estates. These industries liberate huge amount of effluents into the canal which leads to the change of water quality, deterioration of soil and adverse impact on aquatic biota. Sabaramati has been categorized as “E” Class (E class: irrigation, industrial cooling, and controlled waste disposal according to designated best use classification of streams given by CPCB).

Kharicut canal is extension from Khari River which is a tributary of Sabarmati River, stretches along almost the length of Ahmedabad. Kharikat was initially built to facilitate to irrigate adjacent villages. It passes through Odhav, Nikol, Ramol and Vatva area. The different industrial units situated there started to release huge amount of effluents into the canal which leads to the change of water quality and deteriorating the soil, water and other biota of the nearby areas.

Riverfront Development Project by Sabarmati River Front Development Corporation Ltd. (SRFDCL):

The Sabarmati River Front Project is a project for environmental improvement, social upliftment and urban rejuvenation of Ahmedabad city which aims to reclaim the private river edge as a public asset and restore the city’s relationship with its river. The concept of SRFDCL was first visualized during 1961 by Mr. Bernard Kohn, a French architect residing in Ahmedabad. Later, the Ahmedabad Municipal Corporation established the Sabarmati River Front Development Corporation Ltd in 1997, though the project was inaugurated only in April 2003, and actual work on the project was started in early 2005. This project presents a great opportunity to create a public edge to the river on the eastern and western sides of Ahmedabad. By channeling the river to a constant width of 275m, riverbed land has been reclaimed to create 11.25 km of public riverfront on both the banks.
The riverfront development project includes the construction of major interceptor sewer lines on both banks of the river, capturing more than 38 sewage discharge points and routing sewage to newly-commissioned treatment plants of Vasna barrage, thereby trying to keep the river clean, which generally remains polluted as sewage falls directly into it.

Objectives of Sabarmati River Front Development Ltd (SRFDCL):

- To maximize city level benefits by the provision of ample public facility and environment improvement.
- To optimize revenue potential of land allocated for sale to finance the project. Currently work is on for reclamation of about 162 hectares of land along the riverbank.
- To make provision of housing for the people living in life threatening conditions along river bank.
- To develop public gardens, development of wide public promenades along the entire length of the river with adequate on street parking facilities.
- Allocation of service land for relocation of hundreds of households affected by the project
- Construction of STP and development of four-lane wide and 9-km long roads along the entire length on both the banks.

Work Progress:

The Sabarmati River Front Development project has been divided into two phases. The phase-I includes construction of a 2ft. thick and 40-55 ft. deep 'diaphragm' to separate the 30-ft wide promenade or walkway extending from the railway bridge near Sabarmati Ashram to Vasna barrage and a 'Retention Wall' along the promenade (10 km) on both the banks of river with an estimated expenditure of Rs.824.24 crores.
Phase- II The work on river front development includes River dredging, constructing retaining walls, providing storm water outfalls, ghats and jetties, reclaiming 162 hectares of land, providing interceptor sewers, creating gardens, designing new streets / promenades with better street lighting, diversion of sewer and housing for economically weaker sections. The estimated expenditure for of the project is Rs. 462.93 crore.

The construction of diaphragm walls, retention walls and lower promenade has been completed whereas the work on upper promenade and construction of sewer line is under progress. A key feature of this project is a two-level, continuous promenade on both sides of the river. The lower promenade has an average width of 10.30 meters. It is built just above the water level to serve only pedestrians and cyclists and to provide access to the water. The upper promenade is being built to host a variety of public features: cultural and educational institutions, leisure activities, large public parks and plazas and a few areas for commercial and retail development.

This River Front Development Project will come up with following key features:

1. Overall environmental improvement
2. Creating high quality public open spaces
3. Providing adequate public access to the river
4. Rehabilitating the slums
5. Creating vibrant urban neighborhoods
6. Providing city level infrastructure
Fig. 1. 3: (A) & (B): Aerial view of Sabarmati River before and after SRFDCL Hydrobiological and Pollution studies of Sabarmati River with reference to New River Front Development and Kharicut canal at Ahmedabad, Gujarat
Hydrobiological aspects of River:

The River water bodies can be fully characterized by the three major components: Hydrology, Physico-chemistry and Biology. The complete profile of water can be revealed by carrying out different physico-chemical and biological aspects such as temperature, pH, total alkalinity, acidity, chloride, phosphate, sulphate, nitrate, sodium, potassium, coliforms and plankton. An assessment of all these parameters provides an insight towards the pollution status of aquatic ecosystem.

Virtually no water bodies are free from pollution in Gujarat and almost all the rivers have become polluted either by sewage or industrial discharges or by both. Any aquatic ecosystem can be polluted through various sources such as industrial pollution, surface run-off, sewage pollution etc. Based on sources, pollution can be categorized as point and non-point source of pollution. The point sources of pollution can be related to a single known outlet like untreated or inadequately treated sewage disposal, mines and industrial effluents etc. whereas the non-point sources cannot be ascribed to a single human activity although, they may be due to many individual point sources to a water body over a large area such as agricultural runoff, surface runoff, urban runoff from city streets and surrounding areas, pollution from open lake resource exploitation etc. (Fig 1.4)

Fig. 1.4: Sources of pollution in river water body
The time variability of pollutant release into the aquatic environment falls into three main categories. Sources can be considered as permanent or continuous, periodic (seasonal variation associated with the influx of tourist populations, or food processing wastes), occasional or accidental (e.g. tank failure, truck or train accidents, fire etc).

**Spatial variation** of water quality includes vertical and longitudinal variation at different geographical location.

The **temporal variation** of water body is minute to year variation and is of five major types: minute to minute or day to day variability, diel variability, day-to-months variability, seasonal variability and year to year trend.

Therefore, continuous monitoring and testing of urban river water quality is of prime importance in terms of having an idea regarding its pollution status along with the positive and negative impacts of the urbanization on river ecology. This includes the study of hydro-geo chemical and biological analysis in order to assess the spatial-temporal and seasonal variation as well as to find the degree of point and non-point sources of pollution.

**Hydro- Chemical aspects:**

**pH** is a measure of the acidity or alkalinity of a solution. Many physico-chemical processes and reactions in water are affected by pH. The dissolution of heavy metals are also dependent on pH. Therefore, it is one of the important water quality parameter in pollution studies.

**Acidity** as applied to natural water and wastewater is the capacity of the water to neutralize OH⁻; it is analogous to alkalinity, the capacity to neutralize H⁺, from the pollution standpoint, strong acids are the most important contributors to acidity. However, in natural unpolluted fresh waters, the acidity is mostly due to the presence of free CO₂ in the form of carbonic acid.

**Total alkalinity** of water is due to the presence of bicarbonates, carbonates, OH⁻ ions, borates, silicates and phosphates. Highly alkaline water often has a high pH and generally contains elevated levels of dissolved solids. Aquatic biota is sensitive to
extremes of pH. Alkalinity is used as criteria for determining the nutrient status of water.

**Temperature** is a critical factor influencing several aspects of the estuarine ecosystem. Water temperature influences the rate of photosynthesis, the metabolic rates of aquatic organisms and the sensitivity of organisms to toxic wastes, parasites and diseases (US EPA, 1997). The changes in water temperature also regulate the physiological processes such as timing of important processes like reproduction and migration of many species.

**Dissolved oxygen** is one of the most important water quality parameter. The DO level in natural water depends on the physical, chemical and biological activities in the water body. It is the characteristic of any aquatic ecosystem under typical hydrology, hydrographic, waste loading and environmental conditions. The oxygen depleting substances reduce the available DO. During summer months, the rate of biological oxidation increases while the DO concentration is at its minimum due to higher temperature (Maiti, 2003a).

**Free Carbon Dioxide** in the water accumulates due to microbial activity and respiration of organisms. Surface waters normally contain less than 10 mg free CO₂ per litre. This imparts the acidity to the water because of the formation of carbonic acid (CO₂ + H₂O = H₂CO₃). The CO₂ content of water may contribute significantly to corrosion.

**Chlorides** occur naturally in water and in the absence of any pollution its concentration remains low. The most important source of chlorides is discharge of domestic sewage and addition of human or animal wastes in natural waters.

**Hardness** in most fresh waters is mainly imparted by the calcium and magnesium ions, which apart from Sulphate, Chloride and Nitrate are found in combination with carbonates and bicarbonates. The water hardness can cause undesirable build-up of scale in heating devices, plumbing parts, medical equipment and irrigation systems. This scaling develops when calcium (Ca) and/or magnesium (Mg) ions combine with the carbonates (CO₃) dissolved in the water.

**Total Solids** (TS) are sum total of suspended solids plus dissolved solids present in the water. They are mostly of natural origin containing clay, slit, sand of bottom and planktons. Anthropogenic discharges add a variety of solids into the rivers depending upon the source. Water with high dissolved solids are of inferior
palatability. In less turbulent parts of river, sedimentation takes place, smothering life of the riverbed.

Nitrogen and phosphorus have been considered to be the main nutrients required for growth of biotic organisms in any water body. The concentrations of these three major elements are typically greater in the waters contaminated with sewage and agricultural runoff (Sharma et al., 2008).

**Nitrate** ($\text{NO}_3^-$) is a naturally occurring form of nitrogen found in aquatic ecosystem. The most important source of the nitrogen is biological oxidation of organic nitrogenous substances, constitutes sewage and industrial waste or is produced indigenously in the water. Variation in nitrate and its reduced inorganic compounds are predominantly the result of biologically activated reactions. Nitrate has a significant role in influencing the growth of biotic organisms especially phytoplankton in an aquatic ecosystem (Chen and Liu, 2010).

**Sulphate** forms salts with a variety of elements including barium, calcium, magnesium, potassium and sodium. The main sources of sulphate into water are decaying plant and animal matter, numerous chemical products including ammonium sulphate fertilizers that contain sulphate in a variety of forms and sulphate may be leached from the soil into water by agricultural runoff.

The **phosphorus** component in natural waters, total phosphorus (TP), is made up of phosphorus in particulate and soluble forms. The soluble reactive phosphorus is usually considered as bioavailable and is also known as orthophosphate ($\text{H}_3\text{PO}_4$), which is a key nutrient of any aquatic ecosystem. (Jo-Anne Howell, 2010).

**Chemical Oxygen Demand (COD)** is a measure of oxygen equivalent to the organic matter content of the water susceptible to oxidation by a strong chemical oxidant and thus is an index of organic pollution in the river (Khaiwal et al., 2003). The COD test is helpful in indicating toxic conditions and the presence of biologically resistant organic substances.

**Biochemical Oxygen Demand (BOD)** is defined as the amount of oxygen required by microorganisms while stabilizing biologically decomposable organic matter in a waste under aerobic conditions. The BOD test is widely used to determine the pollution load of waste water, the degree of pollution in lakes and streams at any time and their self-purification capacity and efficiency of wastewater treatment methods.
A bacteriological assessment, particularly for coliforms—the indicators of contamination by fecal matter, is a necessary parameter to be carried out to ascertain the quality and potability of water to ensure prevention of further dissemination of pathogens through agency of water under investigation (Venkatesheraju et al., 2010).

Heavy metals are added to an aquatic system by natural and man-made sources during their transport and are distributed between different compartments of aquatic ecosystems, such as water, sediment and biota (Singh & Upadhyay, 2012). Heavy metals are getting importance for their non-degradable nature and often accumulate through trophic level causing deleterious biological effects (Kar et al., 2008).

Geo-chemical aspects:

River sediments, as biotic components of our environment, provide foodstuffs for living organisms. They also serve as a sink and reservoir for a variety of environmental contaminants. It has been recognized that aquatic sediments absorb persistent and toxic chemicals to a level many times higher than the water column concentration (Milenkovic et al., 2005). Depending on the river morphology and hydrological conditions, suspended particles with associated contaminants can settle along the watercourse and become part of the bottom sediments, often many kilometers downstream from the chemical sources (Vigano et al., 2003). Sediments bind a wide variety of chemical species and are sites of many chemical and biochemical processes.

The organic carbon content of sediment is the sum of particulate organic carbon and dissolved organic carbon and it is a measure of the total amount of oxidisable organic material. Decaying detritus particulate organic matter is distributed amongst mineral and amorphous particles in sediments and is site for bacterial activity. The amount of sediment organic carbon depends on soil texture, climate, vegetation and historical and current land use management.

The chlorine in soil occurs as soluble chloride ions. Chloride is not strongly associated with either soil minerals or organic matter and therefore exists primarily in a dissolved form as the soil solution. Chloride salt tends to get accumulated in
sediments of river, estuaries and oceans. Measurement of Chloride in sediment provides information on salinity problems.

**Sulphate** is added to the sediments from animal manures, fertilizers, plant residue and other organic matter. Sulphate is anionic in nature and it can be easily leached from surface soil. It easily precipitates and settles to the bottom sediment of the river. It is one of the important nutrients required for living biota in river ecosystem.

Storm events are mainly responsible for transporting high percentages of catchment pollutant loads e.g. soil-derived salts, sediment, nitrogen, sulphate and phosphorus. Excess loadings of such pollutants may contribute to common water quality problems such as eutrophication and algal blooms and are likely to reduce the habitat quality of stream water. *(Smith et al., 2005)*.

**Nitrogen** is one of the critical limiting factors to algal growth and Eutrophication in many water bodies. The fertility and biodiversity in an aquatic system is greatly influenced by nitrogen concentration of the sediment.

The bioavailability of **phosphate** in sediments is a central issue in the study of eutrophication of aquatic systems. Phosphates are known to be deposited in a wide range of depositional environments like very shallow or low energy environments. Phosphorus accumulation occurs from atmospheric precipitation, dust, glacial run-off, cosmic activity, underground hydrothermal volcanic activity and deposition of organic material.

**The pH** of pore water influence the behavior of the biogeochemical species. In addition, the fate of metals released from sediments is affected by overlying water conditions, in particular the pH, dissolved oxygen concentration and amount of suspended solids *(Atkinson, 2007)*.

**Sodium** and **Potassium** are major constituents of crustal minerals, sediments and water. These elements are brought to water by surface runoff and tend to remain accumulated in the sediment. They found in higher concentration in estuarine and ocean waters.
Plankton:

Plankton are any drifting micro-organisms (animals, plants or bacteria) that inhabit the oceans, sea or bodies of fresh water. They are vital components of the marine and freshwater aquatic food chains. Plankton constitutes the basis of trophic structure of an ecosystem. Phytoplankton and zooplankton, both are very sensitive to the environment they live and any alteration in the environment leads to the change in the plankton communities in terms of tolerance, abundance, diversity and dominance in the habitat. Therefore, plankton (phyto and zooplankton) population observation may be used as a reliable tool for biomonitoring studies to assess the pollution status of aquatic bodies (Mathivanan, 2007).

Phytoplankton:

Phytoplankton community comprises of a heterogeneous tiny plants adapted to various aquatic environment (Harilal, 2005). The quality and quantity of phytoplankton and their seasonal patterns have been successfully utilized to assess the quality of water and its capacity to sustain heterotrophic communities. It forms a major source of fish diet and as an indicator of pollution and the trophic status of the water body (Hulyal and Kaliwal, 2009). They are one of the most rapid detectors of environmental changes due to their quick response to toxins and other chemicals. Chemical stress reduces the number of algal species but increases the number of individuals. Eutrophication or organic pollution of aquatic ecosystem results in replacement of algal groups. It has been observed that many species are sensitive to the nutritional loading but equally good numbers are pollution tolerant (Desai et al., 2008). Phytoplankton encountered in the water body reflects the average ecological condition and therefore, they may be used as indicator of water quality (Jafari & Gunale, 2006).
Zooplankton:

Zooplankton are microscopic invertebrate animals that swim or drift in water. They are at the base of the food chain, feeding upon microscopic plants and being fed upon by aquatic insects, fish and salamanders. Investigation on the structure of the zooplanktonic community and abundance of organisms coupled with analyses of chemical and physical parameters of the water, are important to obtain basic knowledge on the species diversity of a given water body as well as its underlying dynamics (Ahmet et al., 2009). The structure of the zooplankton community is especially influenced by climatic, physical and chemical parameters, biogeographical factors and biotic interactions, therefore, some species could be found in a wide range of environmental conditions, while, others are limited by many physical and chemical factors including pollution. Zooplankton plays an integral role and serves as bio-indicators as well as a well suited tool for understanding water pollution status (Rajagopal et al., 2010).

Hence, the river pollution study takes into account the hydro-chemical, geo-chemical and biological (plankton) aspects of water and sediment both. However, due to the complexity of factors determining water quality, large variations are found between rivers and lakes of different continents or in different hydro-climatic zones. Similarly, the response to anthropogenic impacts is also highly variable. As a consequence, there are no universally applicable standards which can define the baseline chemical or biological quality of water. The effect of this urbanization can be evaluated by regular monitoring of hydro-chemical and Geo-chemical parameters along with biotic components as the physico-chemical analysis of water provides a considerable insight into the health of rivers. It also provides a clear understanding of the limits of a water body’s ability to assimilate some level of pollution without harming the water system, its aquatic biota and humans.
Therefore, in order to assess the pre and post impacts of SRFDCL project on river water quality, the present study on “Hydrobiological and Pollution studies of the Sabarmati River with reference to New River Front development and Kharikat canal at Ahmedabad, Gujarat” has been carried out in two study areas viz; Sabarmati river and Kharikat canal from July-2009 to June-2011 at five selected sites with following objectives.

- To find out the degree of point and non-point sources of pollution by regular monthly assessment of physico-chemical parameters like pH, Temperature, Total alkalinity, Acidity, Dissolved Oxygen, Total solids, Free CO₂, Phosphate, Nitrate, Sulphate, Chloride, Hardness, Chemical Oxygen Demand (COD) and Bio-chemical Oxygen Demand (BOD) of water samples.

- To evaluate the magnitude of nutrient budget and recycling of nutrients by analyzing bottom sediments for pH, Chloride, Available Phosphate, Sulphate, Nitrate, Potassium, Organic Carbon and Organic matter on monthly basis.

- To explore microbial analysis: Total coliform and Faecal coliform by Most Probable Number (MPN).

- To determine the enormity of planktons as indicators and markers of pollution, periodic changes of phytoplankton and zooplanktons for one year i.e. 2010-11.

- To carry out analysis of Heavy metals from water and sediment.