Introduction

Water can be certified as the most important limited natural resource for mankind. Ever since the dawn of time humans have built their lives around this precious resource. Great civilizations like Harappa, Egypt and Mesopotamia have stood around water sources and crumbled in its absence. Though water can be found at many places in the universe, it exists in all three states (solid liquid and gas) on earth. This unique property and availability laid the foundation for the evolution and sustenance of life on our planet. Life is not possible on this planet without water as it acts as a media for both chemical and biochemical reactions and also as an internal and external medium for several organisms.

Water of good drinking quality is of basic importance to human physiology and man’s continued existence depends very much on its availability (Lamikanra, 1999; FAO, 1997). Due to the immense importance of water, the UN General Assembly, on July-2011, declared safe and clean drinking water and sanitation a human right essential to the full enjoyment of life and all other human rights (WHO, 2011). The UN has earmarked March 22nd of every year as the ‘World Water Day’ and has declared the period between 2005 and 2015 as international decade for action on proper utilisation of water (water for life).

Though there is ample water on the Earth (71% of the earth is covered with water), the available usable water, with respect to humans, is very meagre (0.014% of the total global water) resulting in frequent water famines/crises and water wars. India has only 4 per cent of the global waters to meet its 1.25 billion populations. Because water is a shared and community resource, it often leads to disputes between different states and also with the neighbouring countries and that adds to the problems of water resource management. Water being considered a limited resource demands adequate management measures to meet our ever increasing demand. The future of water quality at local, regional, and global scales depends on investments of individuals, communities, and governments at all political levels to ensure that water resources are protected and managed in a sustainable manner. One of the key aspect that forms the backbone of water management is a regular and periodic study of water for various parameters, to test its suitability, safety and the hydrogeological cycle.
Unsafe water, improper sanitation and hygiene kill about 2 million people every year mostly due to diarrhoeal diseases and most of them are children less than 5 years of age (UNICEF). UN says unsanitary water is responsible for 80 per cent of all illness and is world’s number one killer. An estimated 1.3 billion people living in per capita low income countries do not have access to safe drinking water (UNDP-HDR 2006). In 1996, the World Health Organization estimated that in every eight seconds a child dies from water related disease and each year more than five million people died from illness linked to unsafe drinking water or inadequate sanitation (Anon 1983).

In India, about 80% of the diseases are believed to be water related and the World Health Organization has reported that nearly five million human deaths occur every year from polluted drinking water (Singh, 2004). In a UN survey, scoring -1.31 water quality indictor value India occupied 120th rank out of total 180 countries surveyed for water quality (UN 2003). According to the official records of Ministry of Health and Family welfare, Government of India in 11th five year plan, the state of Andhra Pradesh prevailed in the first place with 17846 Hepatitis cases, 1,35,550 Typhoid cases, and prevailed in second place with 12,15,659 Diarrhoeal cases among the states of the nation regarding water sanitation.

Anthropogenic activities are the determining ecological factors in cities and industrial regions (Birke and Rauch 2000). All man-made changes disturb the natural balance of ecosystems that has been formed evolutionarily over a long period of time. These changes most often lead to a degradation of the natural human environment (Kabata-Pendias and Pendias 2001). Urbanisation being motivated by rural push than urban pull creates further problems in departments of hygiene, housing and sustainability. The impact of anthropogenic activities on water bodies has been so extensive that they have lost their self-purification capacity to a large extent. (Sood et al., 2008). Domestic Sewage, Industrial effluent and Agricultural runoff are the major anthropogenic factors causing water pollution. Lack of appropriate infrastructure to manage these wastes is a major contributor in deterioration of water quality across our country. According to an estimate only 20% of the waste water generated in big towns and 2% generated in small towns is being properly treated (Parikh et al. 2000). According to CPCB (1995) only 4989 of the 8432 Large and Medium scale industries have waste water treatment units and among them 1233 units are not adequate. Apart from that most of the, 2million odd and increasing, Small scale industries do not have any waste water treatment plants in place.
Groundwater refers to water that occurs in the zone of saturation below the water-table; the water-table being the surface that divides rocks in which the pores are completely filled with water from those that are partially filled with air (Drever 1997). Ground water is a major source of fresh water and fulfills about 97% of fresh water requirements (Hussain et al., 2003). In many parts of the world today ground water is the only source of fresh water where surface waters are either absent or polluted (Haniffa et al., 1993). The importance of ground water quality has been significantly growing since last two decades in India because of uncertainties of surface water resources, population growth and industrial development (Saboo 2003). In 1960, there were less than one lakh groundwater wells but by 2006 the figure had risen to nearly 12 million. (Sakthivadivel.R. 2007). In Punjab groundwater levels have dropped 10 meters since 1979 and rate of depletion is accelerating. (UpmanuLall., 2009). The feature that makes it a valuable water resource is its chemical quality; it has few suspended solids, low concentrations of bacteria and viruses and often only minimal concentrations of dissolved mineral salts (Schwartz and Zhang 2003). Water utilization projections for 2020 put the ground water usage at more than 50% of total water utilized.

Though ground water is considered relatively safe, recent studies reveal that even this is being polluted by various anthropogenic and natural factors. Groundwater pollution (or groundwater contamination) is defined as an undesirable change in groundwater quality resulting from human activities. Contamination of ground water may occur by percolation of pollutants through the soil (Sargaonkar et al., 2003). Hydrological connectivity between groundwater and the land surface provides the opportunity for the contamination of groundwater and a subsequent reduction in water quality (Stamatis et al. 2001). Qualitative changes of ground water are due to pollution, indiscriminate disposal of industrial, domestic and agricultural wastes which pose great threat to the quality of ground water in many regions (Rengaraj, 1996; Poonam, 2000). Ground water pollution is occurring widely as a result of both the indiscriminate disposal of liquid effluents and solid wastes from urban development with inadequate sanitation arrangements, and of uncontrolled effluent disposal and leakage of stored chemicals into the ground from industrial activity (IRC, 1998).
The groundwater in a drinking-water well may contain a wide variety of microbes without presenting a public health risk. However, groundwater in some areas becomes contaminated by the fecal material of humans and other animals. This is a cause for concern because fecal material may contain pathogenic (disease-causing) microbes that can infect the intestinal tract of humans. Fecal pathogens may be bacterial, viral, or protozoan. Water containing fecal material may seep into the groundwater from the land surface or from underground sources of contamination. Major surface sources include:

- Wastewater and biosolids from sewage treatment facilities that have been applied to land as a soil conditioner;
- Seepage from shallow artificial ponds (lagoons) used for processing sewage;
- Seepage from contaminated lakes and other surface-water bodies;
- Urban runoff;
- Feces from cattle and other livestock operations; and
- Improperly constructed sanitary landfills where trash and garbage are disposed.

Due to the pressure of increasing population and developing economy all over the world, the present situation of water quality management is far from satisfactory and to enhance the sustainability of water quality management systems, in-depth research of the related barriers and the relevant mitigation approaches are highly desirable (Haung Xia 2000). The routine monitoring of drinking-water quality cannot prevent an outbreak but can detect that contamination has occurred, thus it plays an important role as it reveals basic water quality and the likely risk of an outbreak (WHO, 2001). Therefore understanding the basic processes about groundwater as well as the factors that can affect its quantity and quality is of vital importance in managing this significant resource. Monitoring provides data on groundwater quantity and quality and is an integral aspect of groundwater management. Sampling of groundwater for analysis of its chemical constituents is part of this strategy. Ideally, such sampling and analysis should be carried out on a regular basis where groundwater is being extracted for a variety of uses.

The study area Gajuwaka is an industrial area associated to the port city of Visakhapatnam lying on the east coast of India in the state of Andhra Pradesh. Easy access to Highway, seaways and railway paved way for development of major public sector industries around this area like Vishakapatnam Steel plant, Hindustan Petroleum Corporation Ltd., Bharat Heavy Plates and Vessels, Hindustan Zinc Ltd., NTPC,
Coramandel Fertilisers etc. Apart from the major industries there are various other associated industries, pharmaceuticals, sugar industries and cement industries to name a few. There are also a lot of other medium to small scale industries all around this area and more are to come up soon, especially in the pharmaceutical sector.

Due to rapid industrialisation and urbanisation the current infrastructure and housing is inadequate to meet the needs of ever-increasing population attracted by the ever-increasing industries. Apart from industrial toxins polluting the water there is a huge inflow of untreated domestic waste and sewage.

In the current study ground water analysis is carried out of various physico-chemical parameters and microbial contamination. The microbial studies help to determine the probability and the kind of disease causing microbes. The physicochemical parameters determine the quality of water and various other associated factors like toxic metal solubility, bacterial and microbial growth potential give an overall picture of the hydrological cycle concerning the aquifer. Microbial populations can shift in response to changes in ambient ground-water quality such as pH, redox state, or availability of specific ions or metals, hence the study of all the physico-chemical parameters is essential.

**Aims and Objectives of the study:**
- To determine the microbial contamination prevailing in the Ground water samples in various places in Gajuwaka.
- To determine the Physico-chemical properties of the above mentioned samples.
- To identify the interdependence of various microbes with the physico-chemical parameters in the water.
- To identify high risk areas for contamination and spread of disease.
- To determine the kind of pathogens and disease causing agents in the water samples.
- To provide a baseline study on the existing situation regarding the ground water being used in Gajuwaka.