

# Study of Physiochemical and Microbial Characteristics of Polluted and Non-polluted Water Bodies in Jodhpur

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## ABSTRACT

It has been noticed that, the human population is increasing so rapidly, hence the demand of water for various uses are also increasing enormously, which has led to the deterioration of water quality (WQ) in nature. Water quality parameters (WQP) are an essential tool, which enable us to judge the suitability of water for its designated uses and to ameliorate existing conditions. In order to assess the optimum development and effective management for the multifarious beneficial uses, the current information is required which is obtained by different WQP. The water availability is not uniform on the surface of the earth and with the passage of time its availability is dwindling like anything. In present scenario, the availability of freshwater is the cause of grave concern in term of water quantity as well as quality. The numerous studies have been conducted to assess the WQ of different water bodies' viz. lakes and ponds in India.

Water quality studies in Jodhpur highlight a stark contrast between protected, treated reservoirs and heavily contaminated local urban water bodies like the Jojari River, Padamsar Talab, Ranisar Talab, Jhalamand Pond, Fatehsagar lake etc. These water bodies show optimal pH levels (ranging from 7.0 to 7.8) and moderate dissolved oxygen (DO) levels conducive to aquatic life and bathing. Trophic state indices (TSI) classify them as mesotrophic, reflecting moderate nutrient enrichment. Water from these reservoirs is generally safe but requires full treatment before human consumption, as they occasionally exhibit high Biological Oxygen Demand (BOD) due to vegetation and urban runoff.

**Key words :** Water quality, dissolved oxygen, trophic state indices, oxygen demand.

## INTRODUCTION

“Water is the best of all things”, said the eminent Greek philosopher Pinder. Water is one of the most important and abundant compounds of the ecosystem. All living organisms on the earth need water for their survival and growth. As of now water covers 71% of the earth's surface, and is vital for all known forms of life. On earth, 96.5% of the planet's water is found in seas and oceans, 1.7% in groundwater, 1.7% in glaciers and the ice caps of Antarctica and Greenland, a small fraction in other large water bodies, and 0.001% in the air as vapour, clouds (formed of solid and liquid water particles suspended in air), and precipitation. Only 2.5% of the earth's water exists as fresh water, and 98.8% of that is in ice and groundwater form. Less than 0.3% of available freshwater is in rivers, lakes, and the atmosphere, and an even smaller amount as earth's freshwater (0.003%) is contained within biological systems and manufactured products. But due to increase in population, industrialization, use of fertilizers in the agriculture and man-made activity, it is highly polluted with different harmful contaminants. Therefore it is necessary that the quality of drinking water should be checked at regular intervals, because due to use of contaminated drinking water, human population suffers from variety of water borne diseases. It is difficult to understand the biological phenomenon fully because the Chemistry of water reveals much about the metabolism of the ecosystem and explains the general hydro – biological relationship. Still one has to accept that access to safe drinking water has improved over the last few decades in almost every part of the world. But still approximately one billion people lack access to safe water and over 2.5 billion lack access to adequate sanitation. Thus, there is a clear correlation between access to safe water and GDP

per capita. Some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. As a focus on available potable water and scarcity of water in Kota industrial area, an attempt has been made to systematically study groundwater issues of region with focus on sustainable development in the Kota region. Safe and adequate drinking water is the prime requirement. Pollution of water has been reported to cause 80% of human diseases and 20% of infant mortality. It is therefore important to monitor the quality of ground water pollution in various parts of our country.

It is the fundamental right of every individual to be able to breathe fresh and pure air and drink pure water. In case we are unable to enjoy these basic rights, it is our own fault individually as well as collectively. Progress in agriculture and Industry resulted into unlimited exploitation of every bit of natural resource. Such activities of man had adverse effect on all forms of living Organisms in the biosphere. Unlimited exploitation of nature by man disturbed the delicate ecological balance between living and non-living components of the biosphere. The unfavourable conditions created by man himself threatened the survival not only of man himself but also of other living organisms. The number of species likely to become rare, threatened, endangered or near extinction in the Red Data Book of the IUCN is increasing with time. It is very common to find warnings at public places, reading as 'air unfit for breathing', 'water unfit for drinking', 'do not eat fish caught here' and so on. India today is one of the first ten industrialized countries of the world. Today we have a good industrial infrastructure in core industries like metals, chemicals, fertilizers, petroleum, food etc. What has come out of these? Pesticides, detergents, plastics, solvents, fuels, paints, dyes, food additives etc. are some examples. Due to progress in atomic energy, there has also been an increase in radioactivity in the biosphere. Besides these, there are number of industrial effluents and emissions particularly poisonous gases in the atmosphere. Mining activities also added to this problem particularly as solid waste (Verma V., 2009).

### **Physiochemical and Microbial Characteristics of Water**

The quality of water may be described according to their physicochemical characteristics. Freshwater ecosystems are one of the most common and stable habitats of biosphere and have their own physical, chemical and biological characteristics which are molded by local conditions and physiographic features (Goel, 1997). It is considered to be the elixir of life and is consumed in the greatest quantity throughout the world and play in socioeconomic development of human population (Park, 1997). The quality of water is getting vastly deteriorated due to unscientific waste disposal, improper water management and carelessness towards the environment; this has led to scarcity of potable water affecting the human health. Recent reviews indicate that land degradation, forest loss, biodiversity and habitat degradation, scarcity and pollution of fresh water are increasing hence this limnological study is important.

The word Limnology is derived from Greek limne-marsh, pond and evaluates how physical, chemical and biological environment regulates these relationships. The type of life which is supported by lentic communities will depend greatly on biotic components of the fresh water ecosystems. Phytoplankton's are microscopic plants which obtain their energy via photosynthesis. They are important to the ecosystem because they are part of the primary producing community and assist in recycling of elements such are carbon and sulphur. A biotic factors are essentially non living components that affect the living organisms of fresh water communities. Most biological assessments have dealt with conditions arising out of organic pollution since chemical conditions are rather difficult to monitor. Therefore both biological and chemical parameters are essential to monitor pollution. Curiosity prompted researchers to ascertain facts regarding limnology and hence publications on the ecology of freshwater biota have occurred quite occasionally.

Various physico-chemical parameters like alkalinity, salinity, dissolved oxygen, biological oxygen demand, total hardness; dissolved solids, calcium hardness, magnesium hardness, nitrate, sulphate and phosphate have a significant role in determining the portability of water quality (Adoni *et al.*, 1985). The growth of population and industry has resulted in an increase, both in the total volume of the sewage and the degree of toxicity of industrial effluents in which the share of obnoxious matter has markedly increased resulting in eutrophication of water bodies and in turn leading to the invasion of harmful vegetative species (Gaitonde, 1995; Murugesan *et al.*, 2002). Hydrobiological investigations on Man made impoundments in India was represented by many workers including the work of (Surendrakumar

and Sharma, 1991; Pandey and Soni, 1993; Bahura, 1998; Sreenivasa Rao *et al.*, 1999; Thorat *et al.*, 2000; Kumar and Gupta, 2002).

River pollution in India has now reached to a point of crisis due to unplanned urbanization and rapid growth of industrialization. The entire array of life in water is affected due to pollution in water. The problem of water quality deterioration is mainly due to human activities such as disposal of dead bodies, discharge of industrial and sewage wastes and agricultural runoff which are major cause of ecological damage and pose serious health hazards (Meitei *et al.* 2004a). The degree of pollution is generally assessed by studying physical and chemical characteristics of the water bodies (Duran and Suicnz, 2007). Studies related to water pollution of rivers like Godavari, Krishna and Tungbhadra (Mitra, 1982), Cauvery (Somashekar, 1985; Batcha, 1998), Jhelum (Raina *et al.*, 1984), Ganga (Pandey, 1985; Rao *et al.*, 2000), Godavari (Rafeeq and Khan, 2002) and Yamuna (Anand *et al.*, 2006) have received greater attention from time to time and during recent years. Rivers are an important part of Kerala's landscape and the flowing water of the rivers is the most characteristic feature of the State. Yet almost all these rivers are either dead or are on the verge of death. Accelerating denudation of catchment area's vegetation cover, construction of large dams across the rivers, exploitive and indiscriminate sand mining from the river bed, pollution of river water, destruction of riparian vegetation, encroachment of river banks, and intrusion of salinity into the far inland areas of the rivers etc, have resulted in a shocking imbalance in the river basin environment of Kerala (Varghese Latha M., 2012).

In Kasaragod district all the important rivers like Chandragiri, Kumbala, Bakel etc are polluted with effluents discharged from industries located on the banks, dumping of municipality wastes, cleaning of dresses and bathing cattle. Quality of surface and ground water sources is continuously changing and ecology is threatened. In order to protect and manage the water resources, efforts are being made to continuously monitor, predict and assess the pollution load in the water bodies. All programmes to reduce pollution or to improve the quality of water used for human consumption depend on reliable analytical measurements. A large variety of analytical methods have been developed to determine important physico-chemical parameters and microbial determinants, and some biological survey methods have evolved to estimate the quantity of surface water. Several of the analytical methods used in the assessment of pollution are not concerned with the concentration of specific substances but measure a general property of the water.

A pollutant may thus include any chemical or geographical (dust, sediment etc.) substance, biotic component or its product, or physical factor (heat) that is released intentionally by man in to the environment in such a concentration that may have adverse harmful effects (Ciaccio L.L, 1971). While air can be accounted for globally, water is national. Next to air, water is the important natural resource. We depend on water for irrigation, industry, domestic needs, shipping and for sanitation and disposal of waste. Most of our water bodies as ponds, lakes, streams, rivers, seas have become polluted due to industrial growth, urbanization and other man-made problems. Water pollution is defined as "the addition of any substance to water or changing of water's physical and chemical characteristics in any way which interferes with its use for legitimate purposes".

The chief sources of water pollution are

- (i) Sewage and other wastes
- (ii) Industrial effluents,
- (iii) Agricultural discharges and
- (iv) Industrial Wastes from chemical industries, fossil, fuel plants (thermal power Plants) and nuclear power plants. Each of these sources of pollution carries a variety of pollution carries a variety of pollutants that enter our water bodies.

## REVIEW OF LITERATURE

Water is the essential element for tremendous uses and it has a vital role in human daily activities. However, there are many challenging conditions govern water supply-demand management, and yet water becomes a rare commodity in some cases. The recent changing climatic conditions accompanied

with population growth have become a geo-environmental issue of concern after water problem has been raised on the regional and international levels. This is well pronounced in arid and semiarid regions where water resources are rare. The last few years have witnessed about two fold increases in the use of pesticide chemicals, polythenes, drainage of water and industrial effluents in the water bodies. Much of the waste materials released in to the environment never find their target organisms and drains in to the homes of fishes (Pimental and Edwards, 1982). Effluents from pesticide industry have result a marked increase in the incidences of mass mortality, growth retardation and tissue damage in fish (Kumarguru, 1995; Sarkar, 1997; Lal and Pandey, 1999; Pandey 2000). Estimation of bacterial production, a crucial step in quantitatively the function and contribution of bacteria in material cycling within aquatic habitat (Azam *et al.*,1990). In a study of Pichhola lake, Udaipur during annual cycles of 2005-06 and 2006-07 the water remained moderately alkaline (pH 7.5) while electrical conductance (0.3958 ms/cm), TDS (237.5mg/l), chloride (176mg/l), hardness (174.33mg/l) and alkalinity (207.16mg/l) showed low mean values. Average dissolved oxygen levels were at 5.75mg/l while average nitrate and phosphate levels were 3.70mg/l and 2.79mg/l respectively. On the basis of water quality parameters in general, lake Pichhola was found to be eutrophic. A high rate of primary production (302.085 mgc/m<sup>2</sup>/hr), diversity of phytoplankton (58 forms), zooplankton (104 forms) and fish (15 species) were also observed during the study period. Therefore, lake Pichhola has rich number of species and biodiversity of aquatic animals (Sharma *et.al.* 2010).

A limnological study of Ramgarh Lake of eastern Uttarpradesh showed significant seasonal and spatial variation in four species of zooplankton Cladocera 41%, Copepoda 24%, Rotifera 27% and Protozoa 18% as a result lake is undergoing eutrophication. Shrivastava, S. K. and Gupta, V. K. *et. al.* (2008) statistically analysed to determine the correlation between physico-chemical water quality parameters in pond water in Bilaspur, Chattisgarh. Sankhya Sagar Lake, Shivpuri, M.P. is a polluted fresh water body due to continuous discharge of municipal sewage and run off.

The pollution of lake becomes noticeable in the form of visible changes of the lake environment as well as water quality tests (Mishra and Mathur *et.al.*, 2007). Patra and Santra, *et.al* (2010) revealed the poor water quality due to contamination of water from sewage effluents in Santragachi jheel and the Joypur jheel in West Bengal, India. In other physical, chemical and microbiological comparative study of Ganga, Alaknanda, Bhagirathi, Yamuna, and Mandakini , water sample analyzed from 9 monitoring stations: Devprayag, Gangotri, Haridwar, Rudraprayag, Dakpathar and Yamunotri showed positive for *E. Coli* which indicates fecal pollution in water and Brahamkund in Haridwar a famous tourist place found most polluted (Ashok and Bisht (2010). A study on physico-chemical analysis of surface and ground water of Bargarh district, Orissa, India has showed that the parameters which were taken for the study of water quality were below the pollution level for ground water which satisfy the requirement for the use of domestic, industrial and agriculture but in case of surface water the water quality of small community pond are above the permissible limit (Mahananda., *et.al.*, 2010). Changes in nutritive value with pollution of *Channa punctatus* has also been reported (Srivastava and Srivastava, 2008). Sachidanandmurthy and Yajurvedi (2006) found physico-chemical factors were higher than the desirable limits in Bilikere lake, Mysore city, Karnataka due to the entry of runoff and occasional flow of sewage in to the lake therefore it is suggested that control of nutrient load that enters in lake occasionally, might help lake to continue its mesotrophic status.

Fertilizer industry effluent induced some biochemical changes in freshwater teleost (Yadav *et al.*, 2007). Garg, (2007) found the effect of oral administration of l-thyroxine as growth performance digestibility and nutrient retention in *Channa punctatus* (Bloch) and *Heteropneustes fossilis*. Studies on bacteriological aspects of the water bodies have been performed by Sharma and Mall (1988), Ramasubramanian *et al.*, (1992), Shuangjiang *et.al.*,(1993), Hodgkiss (1994), Khatavkar and Trivedy (1994), Thomas *et.al.* (2001), Parihar *et.al.* (2007). The coliform bacterium is the primary bacterial indicator for fecal population in water. A comparative limnological and microbiological study has been made by Sharma and Sharma (2008) in lake Pichhola, Swaroop sagar, Udaisagar and Fatehsagar in which all the parameters were found to fall in a far higher range than laid for fresh water by Central pollution control board (CPCB).

Abiotic factors are essentially non-living components that affect the living organisms of the fresh water community. When an ecosystem is barren and unoccupied, new organisms colonizing the environment

rely on favourable environmental conditions in the area to allow them to successfully live and reproduce. When a variety of species are present in an ecosystem, the consequent action of these species can affect the lives of fellow species in the area, and these factors are deemed biotic factors. The angle of incidence at which sun light strikes the surface of water, the cloud cover, season and location are all important and this sort of variance greatly affects what type of organisms would occupy fresh water ecosystems.

Limnological studies is carried in the various parts of the world. The Multivariate analysis of phytoplankton . Rotifers And crustacean abundance consistently review the three factor of variation. Ionic composition of water 2. Nutrient content 3. Water residence time of reservoir. (J.L.Viera,et al 1992). Studies and analyse variations in land and riparian characteristic along small Danish stream help to determine the effect of channelization of physical habitat. The results are useful to water managers, who seek to identify natural and impacted physical condition in large river system.( Morten Lauge Pedersen,2009).No clear PH depression was seen during the study with exceptionally thin snow cover. In contrast when of clear episodic decline in surface water PH was measured. In contrast to many Arctic lakes.

## Objectives of the study

The objectives of the present study are:-

1. To measure physical parameters as temperature, pH, total hardness, TDS in the water of Thar Desert.
2. To determine chemical parameters as dissolved Oxygen, BOD, COD, Alkalinity, Chloride, Fluoride etc in the water of some area of Thar Desert.
3. To find out microbiological parameters such as bacteria in the water of the lakes, ponds, wells etc. of Thar Desert.
4. To ascertain the application and significance of limnological and bacteriological parameters in drinking water, Irrigation and fishery purpose.

## HYPOTHESIS

The purpose of the study may be useful for providing a sustainable solution with reference to potable water. The conservation of water resources is of prime importance for Nature and whole world.

The quality of the water is a broader issue which can be described in terms of:

- Water quality,
- The composition and state of the biological life present in the water body,
- The nature of the particulate matter present, and
- The physical description of the water body (hydrology, dimensions, nature of lake bottom or river bed, etc.).

## Methods and Methodology

The proposed research work will be carried out in 2015-16 with the help of following methodologies: During the study, water samples will be collected at seasonal interval from 4 different places in the lake and mix them to make a composite sample. The samples were analysed using standard methods of analyses to assess various physicochemical parameters according to APHA & WHO norms. Some parameters like temperature, colour, pH were measured on site. Water sample were analysed by standard

methods for physicochemical parameters like water temperature( 0C), TDS, Conductivity, Turbidity, Odour, Nitrate, Sulphate, Phosphate, Dissolved Oxygen, Hardness, Chlorides, Fluorides, Nitrate, Sodium, Potassium and Chemical Oxygen Demand(COD), Biological Oxygen Demand(BOD), Alkalinity, Free NH<sub>4</sub>, Coli form Organism, Heavy Metals like Fe<sup>+2</sup>, As, Cu, Zn. The Physico-chemical analysis of groundwater samples were carried out by instrument and non-instrumental methods. Temperature, pH, conductivity and TDS were determined by using water analysis Kit. Hardness, DO, Chloride, CO<sub>2</sub> and all such parameters were analysed by standard procedure mentioned in APHA. The elemental analysis was carried out by digital Flame Photometer. All the reagents used for the analysis were AR grade. Double distilled water was used for preparation of solutions.

## CONCLUSION

Hence, it can be concluded that consumption of ground water in the area of study needs to be redressed by proper treatment before it is consumed by living beings as well as for irrigation purpose. An exhaustive study may be useful for providing a sustainable solution with reference to potable water. The conservation of water resources is of prime importance as water ceases to be a resource if its quality in relation to its use deteriorates. It is extremely important that not only quality of natural water bodies have to be kept within specified standards of acceptance, but regular quality up gradation programs have to be undertaken for those water bodies which are in perpetual danger of getting contaminated. There shall be a regular program of continuous monitoring of water bodies for their health and ecology, so that control measures can be adopted in time.

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