Chapter I

INTRODUCTION

Water plays an important role in the ecological relationship of aquatic plants and animals. The richness in the productivity of aquatic ecosystem is due to the presence of organic nutrients and the water resources play a vital role in the socio-economic development of any region (Michael, 1969). The estimates suggest that the earth’s hydrosphere contains a huge amount of water, but 97.5 percent of this is saline water and only 2.5 percent is fresh water. Out of it 68.7 percent is in the form of ice and permanent snow cover in polar and high mountain ranges. Fresh water comprises 29.9 percent of water resources for all living organisms including man. Only 0.26 percent of total amount of fresh water in the earth is concentrated in lakes, reservoirs and rivers (Shiklomanov, 2000). Water is the most important and limited resource needed for extensive irrigation in the production of food grain and ever increasing demand of energy. So the development and protection of water resources required very essential.

Lakes are inland depression standing water and are socio economically and bio aesthetically important aquatic eco system (Verma and Agarwal, 2000). Water is one of the most precious gifts of nature, without which no life could survive on the earth. Freshwater present on the earth surface is put to multifarious uses and it gets polluted with organic and inorganic chemicals, pathogens and non pathogenic organisms. Among these, the metals may react with Biological system to cause adverse effects. These elements enter Human body through food chain. Monitoring and assessment of water has become environmental concern due to contamination by Mankind. One of the most important crisis of 21st century is the availability of drinking water, a resource basic to our survival and growth. Ever increasing demands for water exceeding its availability due to population explosion, industrial revolution etc, have lead to several other problems. Besides drinking, water is used for aquaculture, irrigation etc., The quality of water is subjected to major physical, chemical and biological changes due to the influx of sediments and
dissolved substances from the catchment area with which the water comes to contact with rocks, soils and vegetation during runoff. Since the quality of water affects aquatic lives in many ways so it must be of good quality for healthy survival of organisms. Assessment of water quality in a region is an important aspect for any developmental activity of the region (Jain and Seethapathi, 1996).

Water is the prime resource of man’s food supply and most important household and industrial tool. But most important is the fact that water is a major constituent of all living matter comprising up to two-thirds of human body. Lake is not only a habitat for a number of flora and fauna, is a source of migratory population and also a source of drinking water supply. The changes in the physicochemical properties of the water of an eco-system tend to change the living condition especially on the number and diversity of biota of that ecosystem (Bharat et al, 2008) and (Harinath, 2009). The causative factors responsible for degradation of water quality need to be evaluated so as to take proper steps before situation becomes worse and uncountable (Khatavkar et al, 1989).

The dissolved and suspended solids contained in the lake water are derived from all materials with which the water comes in contact including the atmosphere vegetation, soil and rock. Detergents enter the fresh water system through washing of a variety of materials. They normally contain a high level of phosphates and its influx into lentic water bodies removes the limiting effect of nutrients which leads to a change in the biological characteristics of the receiving water body. Compounds of nitrogen, phosphorus and silicon are most important substances found dissolved in fresh water. Ammonium salts in excess have a lethal effect on the fauna. The main sources of phosphates in natural water are the geochemical reactions and decomposition activities of microbes. The increasing use of detergents and chemical fertilizers in agriculture fields are also serves as a main source of phosphate. (Gupta and Raghubanshi, 2002).

Surface water is an invaluable commodity available in very limited quantities to man and other living beings. The usefulness of surface water to a greater extent depends on its quality (Jain, 1999). The physical and chemical analysis are necessary to know whether a water body is fit for domestic consumption or not.
(Pandey and Soni, 1993). Water quality can have a great influence on the ability of growth of aquatic plants and animals in a stream, pond or lake (Paka and NarsingRao, 1997).

All Water bodies contain both organic and inorganic dissolved solids. The inorganic solids consist of carbonates, chlorides, sulphates, nitrates etc. The concentrations of magnesium, sodium, potassium are undergoing minor fluctuation within the freshwater body. The ionic composition of water has an important role to play in the metabolism of various aquatic organisms and it is the index of productivity. The concentration of calcium, inorganic carbon and sulphate are influenced by microbial metabolism. JanardhanRao (1982) observed that there is direct relationship between calcium, magnesium, chloride and sulphate with metabolism. Temporary hardness in water is mainly due to the presence of bicarbonates of calcium and magnesium. High calcium content is an indication of eutrophic water (Sahai and Sinha, 1969).

Fresh water ecosystem harbour an extraordinary concentration of species, approximately 300 new fresh water species are described each year. World Wild Life Fund-US has identified 53 freshwater eco regions around the world as priority areas for conservation, based on their unique assemblage of species, habitats and ecological or evolutionary phenomena, while the WCMC has identified 136 areas of high fresh water bio diversity around the World (John Ruby and Murugesan, 2004). Water quality assessment generally involves in analysis of physico-chemical, biological and microbiological parameters and reflects on abiotic and biotic status of the eco system.

**WATER QUALITY PARAMETERS**

The word “water quality” is a widely used expression, which has a broad spectrum of meaning depending upon each individual interest of water for a specific intended use. The pollution parameters monitored for the assessment of the quality of any system gives an idea for pollution status with respect to that particular parameter (Venkata Mohan et al., 2003). In our country 70 percent of the water is seriously polluted (Ravichandran et al., 2002).
Physical properties of water in any aquatic ecosystem are largely regulated by the existing meteorological conditions and chemical properties. The effect of light and heat is an important in thermal and chemical stratifications, variations in the number and distribution of plankton and other microorganisms. Chemical properties of water not only alter the physical properties of the medium but also have a significant influence on the distribution and metabolic activities of the life forms, which in turn, tend to change the chemical quality of water in due course of the time. Therefore, to understand the fresh water systems from the holistic point of view, it is essential that due stress to be given on chemical features of the system. (Adoniet al., 1985).

Hydrogen ion concentration (pH) one of the vital environmental characteristics decides the survival, metabolism, physiology and growth of aquatic organisms. Ramanathan et al. (2005) recommended the optimum range of pH is 6.8-8.7 for maximum growth and production of shrimp and carp.

Salinity is the dynamic indicator of the nature of the exchange system. Oxygen solubility decreases slightly as salinity increases, but oxygen solubility decreases more as temperature goes up regardless of salinity. Dissolved oxygen (DO) affects the solubility of and availability of nutrients.

Alkalinity of a water body is a measure of its capacity to neutralize acids to a designated pH. It is an indirect measure of the concentration of anions in water. Total suspended and dissolved solids affect metabolism and physiology of fish and other aquatic organisms.

2. WATER QUALITY INDEX (WQI)

The concept was first proposed by Horton (1965). It indicates the quality of water in terms of index number which represents overall quality of water for any intended use. It is defined as a rating reflecting the composite influence of different water quality parameters on the overall quality of water. The indices are among the most effective ways to communicate the information on water quality trends to the general public or to the policy makers and in water quality management (Musaddiq and Fokmare 2002).
3. AQUA CULTURE

Aquaculture is the rearing of aquatic organisms for human welfare. It is considered as one of the most important sources of animal protein production. It has low saturated fat, sufficient fatty acids, omega-3, calcium, zinc and iron which are to support good health. (Chand et al., 1999). In the past three decades, aquaculture has become the fastest growing food producing sector. It is also a major source of exports and foreign exchange earnings. Domestic demand for fish in India in 2005 was 135 lakh tonnes per year and India was the 11th country in the 45 billion tonnes global market. The production from fresh water aquaculture is 5 million tonnes and India is in third ranking the world.

Rearing of aquatic organisms in lakes is called lake culture. They are natural formations. India has an area of about 0.75 million hectare lakes. In lakes, Indian major carps and cat fishes are reared. India has 2.09 Million Hectare of area in lakes and reservoirs for aquaculture. Fish and fish products are exported to Japan, USA, Singapore, Australia, Kuwait and Netherlands. Central Institute of Fresh water Aquaculture (CIFA) is involving in the development of freshwater aquaculture. The Food and Agricultural Organisation (FAO) predicted that world’s total fisheries production will increase by 10 to 13 percent by the year 2010 above the present levels. By the year 2025, Aquaculture will provide more than 50 percent. Fish Farmers Development Agency (FFDA) is a state government organization found in 1973. They promote fish culture in inland waters and provide training on fish farming. Food plays a significant role in the economic development of all countries and it is the major contributor to the improvement of social, political and economic conditions worldwide. Industrialization and technological developments while making a nation on the path of progress and at the same time impose much stress on people and environment. Advent of intense animal and agricultural production systems to meet the present demand of growing population it is highly necessary to identify the substances that occurs which are not naturally present and unable to metabolize biologically and finally accumulating in the food chain. The widespread indiscriminate use of pesticides, chemicals, metals, drugs, inorganic fertilizers and untreated effluents from industries pollute the environment and end up as residues in food, water and air.
4. HEAVY METALS

Metals for which there is no nutritional requirements may react with biological system to cause adverse effects and excessive doses of nutritionally essential metals can also cause adverse effects. The pollution of the aquatic environment with heavy metals has become a worldwide problem during recent years, because they are undestructible and most of them have toxic effects on organisms. MacFarlane, G.B. Burchett, M.D. (2000). Vierh Aquatic Botanic, (68:45-49). Fishes have been reported to assimilate these heavy metals through ingestion of suspended particulates, food materials and or by constants ion exchange process of dissolved metals across the lipophilic membranes such as the gills, absorption of dissolved metals on tissue and membrane surfaces. As a result metal bioaccumulation is a major route, through which increased levels of the pollutants are transferred across food chain and web creating public health problems. Fishes have been widely used as bio indicators of pollution by metals. Muscle tissue of fish is the most frequently used for metals analysis. Bio accumulation measurements refer to studies or methods monitoring the uptake and retention of pollutants like metals or biocides by organisms such as fish. (Roux1991, Nussey et al., (2000). The accumulation of metals in an organism’s body can take place, if the uptake by the organism exceeds the rate of elimination. (Oronsaye, 1987 Oguzie, 2003).

Pollutants enter fish through a number of routes via, gills, oral consumption of water, food and non-food particles. On absorption, pollutants are transported in the blood stream to either a storage point (bone) or to liver for transformation and or to storage, (Nussey et al., 2006). If transported in the liver, pollutants either stored there or excreted in bile or passed back to the blood for possible excretion via gills or kidneys or stored in fat. (Heath, 1991). These dynamic processes, which take simultaneously with in the body of the fish, eventually determine the concentrations of the pollutants in the fish. As fish constitute an important link in food chain, its contaminations by toxic metals causes a direct threat, not only to the entire aquatic environment, but also to human that utilize it as food.
Excessive pollution of surface waters could lead to health hazards in man, either through drinking of water and or consumption of fish (Mathis and Cummings, 1973). Fish has also been extensively used in the study of physiological behaviour of heavy metals in body organs (Suzuki et al, 1973; Goldberg, 1976, Oronsaye, 1989). Adeyeye et al. (1996) showed that the concentration of metals was a function of species and accumulate more in some fish tissues than in others. The environmental factors such as pH, salinity, DO and temperature as well as other factors such as sex, size and feed habit plays significant roles in heavy metals accumulation in aquatic organisms. (A.Turkmen, M.Turkmen and M.Can, 2003).

Heavy metals pollution in air, soil, water and plant systems is of major environmental concern on a world scale with a rapid development of the industry. Besides their natural occurrence, it may enter the ecological system through anthropogenic activities such as sewage sludge disposal, application of pesticides and in organic fertilizers as well as atmospheric deposition (Haiyan and Stuanes, 2003). Sediments are important sinks for various pollutants like pesticides and heavy metals and play a significant role in the remobilization of contaminants in aquatic systems under favourable conditions and in interactions between water and sediments. The release of trace metals from sediments in to water body and consequently to fish will depend on the speciation.

5. MICROBIAL STUDY

The domestic and industrial sewage enters the lake and causes the microbial pollution. The domestic sewage composed of the human wastes, fungi, protozoa, algae, bacteria and virus. Raw sewage may contain millions of bacteria per millilitre. The industrial wastes contains both organic and inorganic compounds. Organic matter is discharged from sugar factory and slaughter houses. The inorganic matter is discharged from metal industries. Bacteria are the main type of microbes spoiling the fish. Microcystis, anabena, oscillatoria, algal bloom forms due to organic wastes accumulation. Some are release toxic substances and kills fishes and birds. The contamination of drinking water is chiefly done by human and animal excreta which contain various kinds of bacteria and other micro-organisms. The degree of water pollution is assessed by the presence of Escherichia coli. Waterborne infection is the
common problem of India and other developing countries. Eighty percent of the diseases in these countries are linked with contaminated water.

6. PESTICIDES

Extensive and indiscriminate use of biocides made them an integral part of the biological, geological and chemical cycles of the earth. Today they are present throughout the ecosystem. Measurable amounts of DDT residues can be found in the air, soil and water thousands of kilometres from where it was applied originally. The BHC, PCB, DDT are chlorinated hydrocarbons are being long lasting under natural conditions they cannot easily be degraded by micro-organisms and physical forces in the environment. Their concentration, therefore, goes on increasing in soil and water with successive applications.

Pesticides are primarily of agricultural origin. The agriculture return flow and drainage constitute the main pathways of transport of pesticides from arable to the soil to lakes environment. The fate of pesticides degrade in to non-toxic byproduct by microbes and chemical action or it persists in solution or gets absorbed to particulate matter for extended period or gets deposited in sediments or concentrated in certain organisms and gets propagated through trophic food chain. Which accumulate a very high concentration of this chemical in their body fat. On fat breakdown during respiration it is released in the blood stream and may cause toxic effects.

In Tamil Nadu DDT, Lindane, Endosulfan, Heptachlor were found in higher values in Parangipet and in the Chennai sediments. (Srinivasalu, 2005) However their concentration was observed below the permissible level. According to the BIS Guide lines value the maximum permissible value of pesticide is 0.001 mg/l, when it exceeds this value, it affects the central nervous system of organisms.