

CHAPTER - 3

To survey the sources of eutrophication of water bodies in Goa.

3.1: INTRODUCTION

Good quality water is an essential requisite of all living organisms to carry out daily activities. Severe alterations in water quality may prove harmful, leading to the death of aquatic organisms. Because of human negligence the quality of water is gradually deteriorating (Virendra *et al.*, 2013). Industries have grown enormously throughout the world in the past few decades. As a result resources have been overexploited to fulfill the increasing demand of human civilization, resulting in pollution of water, land, and air.

About 70% of water pollution in India is due to the release of domestic waste into water bodies (Gaikwad *et al.*, 2004). Improper management of water systems has caused serious problems in the availability of drinking water (Subba, 1995). When waste from industry is discharged without proper treatment into water, the physical, chemical and biological characteristics are altered to make it unsuitable for human use (Sachidanandamurthy and Yajurvedi, 2006). Physical and chemical parameters like light, temperature, DO, nitrates and phosphates influence the levels of primary productivity, affecting trophic structure and total biomass of the aquatic food web (Wetzel, 1975). There are enormous challenges in the water resources protection and water safety management fields. Lake eutrophication has become a global environmental issue (Smith, 2003). Washing of nutrient rich soil into water bodies leads to eutrophication over a period of time (Smith, 2003). Cultural eutrophication is caused by human land use, including agriculture and industrial developments. Sewage, agriculture, and small scale industries increase nutrient input in watersheds and the amount of input varies according to the types of human activity in each watershed (Smith and Schindler, 2009). The combination of these effects causes a rapid growth of

phytoplanktons and aquatic macrophytes. Regular application of chemical fertilizers and P-laden manure has resulted in the gradual accumulation of P in soil, which enters into lakes resulting freshwater eutrophication (Bumb and Baanante, 1996).

According to literature reports, water bodies throughout the world are polluted due to urban runoff, septic tank leachete, and agricultural runoff and dumping of waste, *etc.* Many fresh water bodies in Goa are used as a source of irrigation, recreation and for drinking water. It is imperative to investigate and point out how best the water bodies from different places could be utilized for the benefit of local residents. Such studies are of great importance as they are concerned with basic sanitary and health problems of people residing in the vicinity of the water bodies. Present survey aimed in finding out if similar conditions existed in the state of Goa leading to water pollution. In this chapter, detailed observations are recorded from a survey study and an attempt to identify the sources of eutrophication of water bodies in Goa.

3.2: MATERIALS AND METHODS

Different fresh water bodies situated in the state of Goa *viz.*, Benaolim, Carmbolim, Khandola, Marcela, Keri, Madkai, Ponda, Sulabhat, Curtorim, Macasana, Shiroda, Mayem and Canacona were surveyed to assess their present status. Photographs of different sources responsible for water pollution were taken during the visits. Based on this survey study, two water bodies each from north and south Goa were chosen to evaluate their usefulness based on physico-chemical and biological properties.

3.3: OBSERVATIONS AND DISCUSSION

It was observed that in Goa there are many small scale industries in the vicinity of water bodies releasing waste water into the water bodies thereby causing pollution. Activities like boating, immersion of idols during festivals, dumping of solid waste, leachete from septic tank, washing of vehicles, bathing of domestic animals and washing of clothes, were commonly observed during the survey. These activities resulted in declining the water quality and affecting aesthetic beauty of several water bodies. Besides this industrial, agricultural, livestock, residential, urban and mining runoff from surrounding areas was also responsible for water pollution (**Plate 1**).

The degradation of urban lakes due to septic tank leachete is a common phenomenon in the state. The factors regulating the composition of aquatic microbial community is useful in predicting the persistence and behaviour of human, animal and plant pathogens in natural water (Yigal *et al.*, 1989). Water contaminated with fecal matter poses serious health risks for fish consumers and swimmers. Microbial pathogens are introduced into waters bodies in various ways, like leakage of septic tanks, sewer malfunction, contaminated storm drains, runoff from animal feedlots, human fecal discharge and other sources (Aslan- Yilmaz *et al.*, 2004). Enumeration of fecal coliforms, *Escherichia coli* and /or *Enterococcus sp.* is used to assess microbial water quality. These micro-organisms can inhabit the intestines of warm-blooded animals, (Chou *et al.*, 2004) and are responsible for intestinal infections, such as dysentery, typhoid and cholera. Thus the water becomes unfit for domestic or agricultural purposes.

Plate 1



Plate 1

Sources of Water pollution in the state

A. Growth of macrophytes at Syngenta Lake.

B. Dumping of food waste in Curtorim Lake.

C. and **D.** A film of greasy layer due to dumping of pollutants at Maitolem (Macasana) Lake.

E and **F.** Dumping of waste at Carambolim Lake.

G and **H.** Runoff from industries and agricultural sites to lakes in Kundai and Mardol area.

Agricultural activities in Goa are involving excess use of fertilizers and pesticides to enhance productivity (Alvares, 1993). This has threatened the ground and surface water on a large scale. The waters and soils continue to be polluted, when necessary precautions are not taken during usage of chemicals (Tulay, 2010). Increased use of fertilizers has also resulted in nitrate pollution in many places (Alvares, 1993). The use of water with high nitrate level for drinking purposes reduces the oxygen carrying capacity of the blood and can lead to *methemoglobinaemia* in babies (Smith *et al.*, 1971). Many agricultural activities involve use of organic materials, such as farm manures or composts that contain higher concentration of trace elements. The use of bio-solids and composts increases the total amount of Cu, Zn, Pb, Cd, Fe and Mn in soils (He *et al.*, 2005).

Human-induced pollution through excessive fertilizer use, untreated wastewater effluents, deforestation results in stripping of top soil. Besides mining activities and use of detergents has significantly increased nutrient load into lakes in Goa, accelerating eutrophication beyond natural levels (Alvares, 1993). These loads are responsible for deleterious changes in the natural ecosystem. Excessive biological productivity in water bodies has inflicted significant environmental and societal damage to fresh water systems in the state. Hypoxic conditions are known to result when plants and algae die and decompose stripping water of dissolved oxygen, leading to fish kills and degrading the aesthetic and recreational value of the lake thereby disrupting the normal food webs in lakes (Ecological Society of America, 2008).

Heavy monsoon runoff from the open cast mining carries washings of reject material into water bodies. Besides, there is widespread pollution of water systems due to percolation, pollution and disruption of water table.