Review of Literature
REVIEW OF LITERATURE

Water plays an array of vital roles in ecosystems across the planet Earth. It is one of our most important natural resources without which, there is no life. Given that most of the Earth is covered in water, understanding aquatic ecosystem is very important. Aquatic ecosystems perform many important environmental functions like recycling nutrients, purifying water, attenuating floods, recharging ground water and provide habitats for wildlife. It is also used for human recreation and are very important to the fisheries and tourism industries.

Beginnings of knowledge concerning freshwater life, like those of marine life, arose in the remote past, possibly before the days of Aristotle (384-322 BC). These early findings, often strange mixtures of fact and fancy, have no scientific value (Welch, 1952). As time went on and man’s knowledge of his surrounding slowly increased, he started gaining information about every aspect of nature.

Limnology, the discipline which deals with the study of all inland aquatic environments like, streams, rivers, lakes, reservoirs and wetlands have attracted many scientists. It was the efforts of Francois Alphonse Forel (1841-1912) and his early studies of Lac Leman (Lake of Geneva, Switzerland) which was recognised worldwide. The first two volumes published in 1892 and 1895 consist of the geology, physics and chemistry of the lake, while the third volume published in 1904, deals with the lake’s biology. Earlier, in 1896, Forel published a paper on the bottom fauna of Lake Geneva. In 1901 he published the first textbook on limnology. Forel, then a professor at the University of Lausanne, is justifiably considered the ‘Father of Limnology’.
Limnology continued to develop as a field of study and expanded its geographical base during the first half of the twentieth century. Limnologists of the 1920s and 1930s founded many field stations, used them to collect a wealth of information on individual lakes, and synthesized this information at the regional scale. The study of progressive limnology began the foundation of knowledge among the physical, chemical and biological characteristics of lakes which was done by Birge and Juday (Wetzel, 1996).

Several contributions are to be noted who have made achievement in the field of limnology throughout the world. Pioneer workers other than Forel are Stephen Alfred Forbes (1844-1930). Many of his insights about lake ecology were collected in a classic paper on “Lakes as Microcosms” (1877) which outlined not only the premise that a lake is an integrated system with emergent properties, but also that lake ecosystem can be studied through analysis of biogeochemical cycles, system metabolism, food webs, and physico-chemical gradients; August Friedrich Thienemam (1882-1960) and Einar Christian Leonard Naumann (1891-1934), who in 1922 formed the International Society of Limnology; Angelo Secchi (1818-1878) created Secchi disk to measure water transparency; West and West (1911) who observed the periodicity of phytoplankton in some British Lakes; Pearsall (1921) worked on the development of vegetation of English lake and considered it in relation to general evolution of glacial and rock basis; Eddy (1934) studied the limnological parameters of various lakes; Prescott (1938) recorded the objectionable algae and their control in lakes and reservoirs.

Some of the important contributors in the late decades of 20th century are, Egborge (1970) who studied the hydrology and planktons of the river Oshem, Lewis (1978) studied the dynamic and successions of phytoplankton in a tropic lake, Canoo
Mathew (1978) investigated the plankton of Govindgarh lake and its correlation with physico-chemical factors. Classification of Central Amazon lakes on the basis of their microbiological and physico-chemical characteristics was studied by Rai and Hill (1980). The importance of aquatic vegetation in controlling the nutrient enrichment in an artificial high altitude lake, Moondarra in the North-Western Queensland was studied by Finlayson et al., (1980). Adebisi (1981) studied the physico-chemical hydrology of tropical seasonal river - Upper Ogun. Hilton and Phillips (1982) observed that turbidity of a water body was influenced by algae and boat activities which also influenced the growth of macrophytic vegetation. Kimmel and Groeger (1984) investigated the factors controlling primary production in lakes and reservoirs. The study revealed that cessation of the sewage input along with regular harvest of macrophytes could assist in reducing the internal nutrient and metal load in the lake.

Despite the importance of reservoirs, every dam obstructs natural river flow irrespective of size, shape and location and these impacts upon biodiversity. The environmental impacts of large reservoirs have been extensively documented by Goldsmith and Hidyard (1986). Barnard and Biggs (1987) noted the macro-invertebrate diversity in the catchment and streams of Lake Naivasha, Kenya. De Silva (1988) studied the fisheries of reservoirs of Sri Lanka. Rast and Ryding (1989) analysed the control of eutrophication of lakes and reservoirs in Paris. Many studies have shown that small reservoirs are quite productive ecologically when compared with large reservoirs as a result of greater area: volume ratio.

Costa-Pierce (1990) studied the multiple regression analysis of plankton and water quality relationships as affected by sewage inputs and cage aquaculture in a Eutrophic Tropical reservoir fishery of Asia. Mathew Varghese (1992) carried out the
hydrobiological studies of ponds. The environmental impact assessment of lakes and reservoirs of Japan was carried out by Tundisi (1993). Harper et al., (1993) studied the eutrophication prognosis for Lake Naivasha, Kenya. Frequent thermal instability is also a characteristic of small reservoirs, which ensure more rapid exchange of nutrients within the water column and at the water-sediment interface (Marshall and Maes, 1994). The investigators also studied about small water bodies and their fisheries in Southern Africa. Egborge (1994) investigated the water pollution, biodiversity and chemistry of Warm river in Nigeria.

Over the last decades an increasing number of studies have been conducted on the dynamics of the physical and chemical variability of reservoirs around the world in order to subsidize the management of these resources (Carpenter et al., 1995). The plankton diversity, its abundance and productivity in the Owena reservoir, South Western Nigeria was studied by Oke (1998). Use of reservoirs by birds, wildlife and fish is known to attract ornithologist, naturalists, hunters and anglers (Patten, 1998). Basis for the protection and management of tropical lakes was done by Lewis (2000). Oben (2000) did limnological assessment of the impact of agricultural and domestic effluent on three manmade lakes in Ibadan, Nigeria.

In recent years significant works in the field of limnology were carried out by Francis et al. (2002) in Eastern Rift Valley (Kenya), Akin – Oriola (2003), Ana and Maria (2003) in Eutrophic reservoirs (Portugal), Idowu and Ugwumba (2008), Oso and Fagburo (2008), Bonner et al. (2009) in Bethesda (North America), Berry and Lind (2010) in Lago Catemaco (Mexico), Argillier et al. (2012) in European Lakes, Michael et al.(2014) in High Altitude Tropical Reservoir (Mexico). Studies range from simple environmental surveys to complex analyses, such as hydrodynamic
modelling (Lindim et al., 2011) and tropic network modelling (Carpenter et al., 2008).

India, with her unique geological history, highly diverse physiography, monsoon climate with extremes of temporal and spatial variability and high biotic diversity, is endowed with equally diverse aquatic habitats. According to Rao (1975) there is a network of 14 major, 44 medium and hundreds of minor river systems in India. Since the early 19\textsuperscript{th} century, all these aquatic habitats and their biota have been extensively investigated and interest has grown rapidly in the recent years due to the rising demand for water and fish, and the need for managing the water quality. Like Europe, the history of studies of aquatic biota in India also can be traced back to the early 19\textsuperscript{th} century when during the British rule, extensive surveys of freshwater fauna were made (Hamilton, 1822; McClelland, 1839; Day, 1873, 1878). E. Haeckel had examined and published a research article on fish fauna from Kashmir valley as early as 1838 (Das and Subla, 1963). Several surveys also reported on algal flora (Braun, 1849; Dikie, 1882; Kirtikar, 1886; Turner, 1892).

Towards the end of 19\textsuperscript{th} century and in the early 20\textsuperscript{th} century, many investigators started to survey areas beyond British India under the leadership of Annandale who became the first Director of the Zoological Survey of India in 1916. By the late 1920s, S.L. Hora carried out investigation on the biogeography, evolution, ecology, physiology and general biology of fishes and thus, laid the foundation of Indian fishery science (Hora, 1921, 1923, 1930, 1933, 1934, 1935a, b). Hora was also concerned about the impact of dams on fisheries (Hora, 1940). Among other worker were Das (1927), Pearse (1932) and Khan (1924, 1934) for their studies on fish ecology. By the early 1940s a momentum was gained in the hydrobiological studies in our country. Ganapathi (1941, 1943) investigated seasonal changes in the physico-
chemical characteristics of water, zooplankton, and aquatic vegetation in fishponds and tanks in Madras and also reported on controlling aquatic vegetation (Ganapathi, 1947).

The contributors to the field of limnology in the succeeding decades include those of Gonzalves and Joshi (1946) who worked on the seasonal succession of algae in a tank at Bandra, Bombay. The distribution of algae in a group of six small ponds was investigated by Rao (1953). Work on fresh water diatoms of Pratabgarh, Rajasthan was carried on by Gandhi (1955). Singh (1960) recorded the phytoplankton ecology of inland water of Uttar Pradesh. Govind (1963) carried out preliminary studies on plankton of the Tungabhadra reservoir, Khan and Quajjium (1966) studied the ionic composition of tropic freshwater pond of Uttar Pradesh. Ray (1969) studied the hydrology of Vanivillas Sagar reservoir. Odum (1971) studied the producer components of aquatic systems and found that Diatoms are good indicators of water quality.


The significance of the dynamic changes in aquatic ecosystems attracted the attention of environmentalists in the advent of 21st century. Works on limnology during the last decade was done by many workers. Nandan et al., (2001) studied the Hartala lake of Jalroan district of Maharastra. The study revealed that the occurrence of blue-green algae was found to be greater as compared to other groups of algae and its abundance was due to the higher concentration of dissolved oxygen, carbonates, total alkalinity, phosphate and chloride. Das (2002) studied the production potential in Peninsular reservoir, Joshi and Sakhare, (2002) carried out studies on Ecology and Icthyofauna of Bori reservoir in Maharashta, Dwivedi and Sonar (2004) evaluated the physico-chemical and biological characteristics of water samples of reservoirs around Rono Hills (Arunachal Pradesh), Dwivedi et al., (2005) carried out Limnological studies in Solapur Dam and Ratan Sagar reservoir (UP), Pazhanisamy (2005) studied the Limnological aspects of Lower Anaicut reservoir (TN), Rani

Srivastava et al., (2009) carried out investigations in Lakes around Jaipur. Abhas and Singh (2013) studied limnological investigation in Anasagar Lake in Ajmer and noted the poor water quality of the lake. Abdar (2013) studied the physico-chemical characteristics and phytoplanktons of Morna lake, Shirala (MS). The chemical analysis of the lake water exhibited richness in nitrogen and orthophosphate which favoured the growth of phytoplankton. The water was found to be moderately polluted and showed a trend of increasing eutrophication. Khwaja Salahuddin et al., (2013) carried out the limnological studies of Narsinh Mehta lake of Junagadh district in Gujarat. The results of the analysis of different physico-chemical parameters indicated that the lake was getting polluted due to continuous discharge of certain junk materials, debris of construction works and human interference affecting the quality of aquatic life. Indresha and Patra (2014) studied the seasonal variations in the physico-chemical parameters of Kanjia Lake (Odisha). The study was carried out for a period of two years. The study revealed seasonal variation in different physical and chemical parameters and all the parameters were within the desirable limits.

According to Palaniappan et al., (2010) most water assessments emphasize water quantity, while water quality is also critical for satisfying basic human and environmental needs. The quality of the world’s water is under increasing threat as a result of population growth, expanding industrial and agricultural activities and
climate change. Poor water quality threatens human and ecosystem health, increases
water treatment costs and reduces the availability of safe water for drinking and other
uses. Mohar (2011) carried out limnological study of fresh water reservoir Tighra,
Gwalior (M.P). The reservoir water is used for fish culture, irrigation, domestic and
drinking purpose. The author reported that the physico-chemical parameters were
within the permissible limit by WHO, ICMR and ISI and indicated better water
quality of the reservoir. Hulyal and Kaliwal (2011) investigated the seasonal
variations in physico-chemical characteristics of Almatti reservoir of Bijapur District,
Karnataka and results revealed that there exist seasonal fluctuations of the physico-
chemical factors. However, it is obvious that the absence of significant difference
between sampling stations for all the parameters in the reservoir indicated fairly
homogenous conditions and the water quality was also found to be homogeneous. The
study also indicated that the water is quite suitable for irrigation and pisciculture.

Medudhula *et al.*, (2012) recorded limnological studies pertaining to Manair
reservoir of Andra Pradesh and noted that physico-chemical parameters of the water
were within the permissible limits and can be used for domestic, irrigation and
pisciculture. Patel and Patel (2013) compared the physico-chemical parameters of two
lakes at Lodra and Nardipur which is under biotic stress. Their results indicate the
pollution conditions of both the lakes. Purshuramkar *et al.*, (2012) carried out a
preliminary study on water quality of Chulbandh reservoir, Murdoli of Gondia district
(Maharashtra) and came to a conclusion that the different physico-chemical
parameters studied were within the acceptable range. Pramod and Shejule (2012)
studied the physico-chemical properties of Kasura dam from Jalna district (MS). The
dam received large amount of fertilizers and domestic wastes which were directly
released into the dam. The results revealed that the different parameters studied were
having a seasonal fluctuation in the values. Pandey et al., (2012) done a case study of highly polluted Laharpur reservoir, Bhopal (M.P). Limnological status of Khanapur freshwater reservoir of Ajara Tahsil has been done by Sachinkumar et al., (2013). The study concluded that the reservoir water is suitable for drinking and fishing purposes.

Hydrobiology of Barna reservoir with special reference to seasonal flux in certain physico-chemical parameters was studied by Arunkumar et al., (2013). The study revealed that the reservoir is perfectly nature designed with balanced trophic status to use the resource for various aquaculture practices as its potential is ultimate. A case study of Gangapur Dam at Nashil District in India was done by Bharathi et al., (2014) using correlation analysis of physico-chemical parameters. The study revealed the normal limits of all parameters and the water was found to be suitable for irrigation as well as different purposes. Pawale (2014) carried out studies on scientific aspects of water quality with physico-chemical and biological factors of Vishnupuri reservoir in Nanded district (MS). The study carried out for one year period revealed that the water quality of the reservoir is quite suitable for aquaculture, agriculture and industrial purposes. Sagar et al., (2014) carried out limnological studies of Coka dam, Papara, Satna (MP) with special reference to phytoplankton.

Works on rivers and ponds were carried out by various investigators. Munavar (1970) carried out limnological studies on freshwater ponds of Hyderabad, Shaji and Patel (1994) highlighted phytoplankton ecology of polluted pond at Anand, Gujarat. Begum and Hadi (1994) worked on comparative abundance of phytoplankton, periphyton, pelagic algae and some related physico-chemical parameters in two shrimp cultivated ponds. The seasonal variations of physico-chemical parameters like dissolved oxygen, chlorides, salinity and planktonic composition of Kurichi ponds were studied by Arivazhagan et al., (1997). Baruah and

Sulabha and Prakasam (2006) investigated the limnological features of Thirumullavaram temple pond of Kollam municipality (Kerala). From the correlation study, the authors inferred that several characteristics of water, sediment and primary productivity were interrelated. The results also revealed that the pond water was mainly contaminated with Coliform bacteria and the physico-chemical characteristics indicated that it could be used as a potential water source for drinking, swimming and for secondary production after proper treatment.

Recently changing ecological behaviour of ponds has been studied by many workers (Mahananda et al., 2005 ; Gupta et al., 2008 ; Banerjee and Mandal, 2009). Most of our demands for water are fulfilled by rain water that gets deposited in surface and groundwater sources. The quantity of this utilisable water is very much limited on the earth. Though water is continuously purified by evaporation and precipitation, pollution of water has emerged as one of the most significant environmental problem (Agarwal, 2005 and Shinde et al., 2011).

Effect of poultry droppings on water quality parameters in Indian major Carp ponds were studied by Ahmed et al., (2013). Limnological studies of temple ponds in Cachar District (Assam) of north East India was carried out by Devi et al., (2013) and
found that amongst all the environmental variables, rainfall, conductivity, water temperature and free carbon dioxide bring highest variability to the plankton communities of the temple pond.

The succeeding contributions to the field of freshwater bodies have been given by Munendra and Singh (2007) in bibliography of environmental studies in natural characteristics and anthropogenic influences on the Ganga river. The study gives a good account of the investigations carried out in the river in various aspects such as physico-chemical characteristics, hydro-geochemistry, organic geochemistry, faecal contamination, arsenic contamination and biomonitoring.


Arti Sharma and Saxena (2012) carried out limnological studies of Neem river with special reference to phytoplankton diversity. Bhandarkar and Bhandarkar (2013) carried on a study on seasonal variations of physico-chemical properties in some freshwater lotic ecosystems in Gadchiroli district, Maharashtra. The study disclosed that all the ecosystems under investigation were mildly polluted. Harney et al.,(2013) carried out an investigation in the seasonal variation of the physico-chemical parameters of Pindavani pond of Central India. The study showed that there was a
cyclical variations among the different parameters studied. The slight high value of conductivity, total alkalinity, chloride, phosphate and nitrate in the pond indicate towards its slight polluted nature and it exhibits a slightly polluted status. Smitha and Shivashankar (2013) carried on physico-chemical analysis of the freshwater at river Kapila, Nanjangudu Industrial area, Mysore.

Investigations of other water bodies like canals, wetlands and estuaries were also studied by many workers like Bijoy Nandan (1991) in Kerala, Sreenivas and Rana (1994) studied the ecology and trophic status of Gomti tank, Gujarat, pointing out that the tank was on the verge of attaining eutrophic state. Ebanasar et al., (2000) in water bodies formed by limestone in and around Ariyalur (TN), Patil and Dongare (2006) carried out studies on physico-chemical characteristics of the water bodies of Aundh of Southern Maharashtra with reference to the stress of human activities. Prasanna and Rajan (2010) in Dhamra estuary, Bharathi et al., (2013) in Anekere water body (Karnataka).

Seasonal variations in physico-chemical characteristics of Mughal canal flowing through Karnal in Haryana was studied by Sharma et al., (2011). The results showed the relationship of various parameters to productivity and capacity to support vegetation. Amita and Bhavna (2013) assessed the variations in physico-chemical characteristics of water quality of the wetlands in Manipuri district (U.P). The results indicate fluctuation in levels of different parameters, throughout the study period. Shib Abir (2014) studied seasonal variations in physico-chemical characteristics of Rudrasagar wetland, a Ramsar site in Tripura. The study revealed that the water quality is rich in TDS, phosphate and nitrate content which indicates that the wetland is moderately eutrophicated.
Life in aquatic environment is largely governed by physico-chemical characteristics and their stability. Fresh and pure water is limited in quantity which indicates the need for comprehensive water management (WHO, 1992). Most of the forms exist only within narrow range of conditions. The changes in the water may be essential for the existence of some organisms while for other such changes may not be desirable. The increasing anthropogenic influences in recent years in and around aquatic system and their catchment areas have contributed to a large extent to deterioration of water quality and dwindling of water bodies leading to their accelerated eutrophication (Bhatt et al., 1999).

Factors that influence the sustainability of water resources are temperature, transparency, salinity, biogenic salts, dissolved gases etc. (Munawar, 1970; Misra and Yadav, 1978). Fresh water habitats occupy a relatively small portion of the earth’s surface as compared to marine and terrestrial habitats, but their importance to man is far greater than their areas. As a consequence of population growth, agriculture and industrial development, building construction, the demand for water is also increasing and has forced environmentalists to determine the resources (Regina and Nabi, 2003).

The magnitude and dynamics of phytoplankton population becomes an essential tool to assess the general health of an aquatic ecosystem (Govindasamy et al., 2000). Aquatic environment depicts ecological features that lead to the establishment of a very dynamic system in which the plankton communities play an important role (Sharma and Sarang, 2004). Phytoplankton is a fundamental component of aquatic ecosystem as they are the major source of biologically important and labile organic carbon, located at the base of food chain.
Various workers reported the seasonal cycles of the phytoplankton assemblages (Roy, 1949, 1955; Chako and Ganapati, 1949; Iyengar and Venkataraman, 1951; Dutta et al., 1954; Laxminarayana, 1965 in Ganga river; Rai, 1962, 1974 in Yamuna river, Ray et al., 1966, Chakrabarthy et al., 1959; Tasneem Fatima, 1990; Das et al., 1993; Mishra and Trivedy, 1993; Sugunan, 1995; Sahu et al., 1995; Habib et al., 1998; Koshly and Nayar, 2000; Biswas and Konar, 2001; Sankaran, 2005; Sanap et al., 2008; Ayoade, 2009; Jhindal and Thakur, 2013; Abdar, 2013; Minukumari et al., 2014; Sumithra and Ebanasar, 2013c; Sagar et al., 2014) and Zooplankton assemblages (Chakrabarthy et al., 1959; Edmondson, 1965; Rai, 1974; Arunachalam et al., 1982; Sharma and Pant, 1984; Yousuf, 1989; Dezwart, 1991; Bhattish, 1992; Subla et al., 1992; Agarkar et al., 1994; Sugunan, 1995; Scottrup, 2000; Kumar et al., 2001; Taylor et al., 2002; Suontama, 2004; Kudari et al., 2005; Wanganeo and Wanganeo, 2006; Mathivanan et al., 2007; Redmond, 2008; Kumar et al., 2010; Dheenadayalamoorthy and Mazher Sultana, 2011; Annalakshmi and Amsath, 2012; Rajni Raina et al., 2013; Sharma et al., 2013; Umadevi, 2013; Deepali et al., 2013; Michael et al., 2014).

The primary role of phytoplankton is to fix solar energy by photosynthesis and make it available to other organisms. Brylinsky and Mann (1973) carried out an analysis of factors governing productivity in lakes and reservoirs. Data was collected as part of the International Biological Program from 43 lakes and 12 reservoirs, distributed from the tropics to the arctic. In ecosystem analysis, productivity is of great importance as it integrates the cumulative effects of many physiological processes, which occurs simultaneously within the ecosystem (Jordan, 1985). Primary productivity of aquatic ecosystems is essential for a proper assessment of the biological potential of that habitat. In any rational formulation and deciding of water
resource an adequate parameter magnitude and source of any pollution load must be known, for which monitoring of physico-chemical parameters and pollution is essential (Reddy et al., 1994). Planktons are highly sensitive to the environment where they live and are essential links in the food chain in an aquatic system. Any change in the environment leads to the variation in the plankton population with reference to their tolerance, dominance and diversity (Singhal et al., 1986). Hence, both phytoplankton and zooplankton population may be used as reliable tools for bio monitoring studies to evaluate the pollution status of any aquatic ecosystem.

The production, consumption and decomposition are the three important eco-regulatory and balancing processes in an aquatic habitat, the interplay between which determine and regulate the output levels. Natural eutrophication is a slow process of enrichment and is part of aging phenomenon. It is also a beneficial process which in turn enhances productivity in the water mass (Rodhe, 1969). This invariably results in deterioration of water quality, which in many cases results in significant economic loss. Zutshi and Wanganeo (1984) studied the phytoplankton and primary productivity of a high altitude subtropical lake.

Seasonal variations on occurrence of phytoplankton and primary productivity of some selected lakes in Maharashtra was studied by Leela Bhosale (2010). The results revealed that there is considerable variation in species of phytoplankton in the different districts and seasonal variation is also distinct. Studies on the primary productivity of the river Pandu, Kanpur was done by Sunita et al., (2011). The study was carried out to monitor potential and ambient pollution load. The results indicated an unhealthy polluted condition of the river due to anthropogenic waste discharge into it. The investigators came to a conclusion that special need to save the river from further pollution and initiate corrective measures to depollute or alleviate pollution
load on it in order to save the river was needed as the river is an important tributary of the river Ganga. Diurnal variation of physico-chemical properties and primary productivity of phytoplankton in Bheema river was studied by Vasanthkumar and Vijaykumar (2011). The study was conducted to provide information on the seasonal abundance and distribution of phytoplankton as well as the water quality of the river. The results revealed variation in all the physico-chemical parameters and the rate of photosynthesis was greater in the early hours of the day light and the trophic status of the water body indicates the oligotrophic nature of the river. Physico-chemical status and primary productivity of Ana Sagar lake, Ajmer (Rajasthan) was carried out by Vijay and Madhur (2011). The study revealed that the physico-chemical and primary productivity of the lake were found high, mainly due to sewage discharge, industrial effluents and agricultural runoff by surrounding city population showing the eutrophic condition of the lake. Primary productivity of Bay of Bengal at Digha in West Bengal was carried out by Puspalata and Patra (2013). Ecology of two riverine wetlands of Goalpara district (Assam) in relation to plankton productivity was investigated by Sarma et al., (2013). Primary productivity studies in Nagaram tank of Warangal district (Andhra Pradesh) was carried out by Narasimha and Banarjee (2014).

The physico-chemical characteristics of soil and water determine the type of flora and fauna supported by that ecosystem. The biodiversity of an aquatic ecosystem indicates the level of succession in that ecosystem (More and Gajjar, 1990). Several reports have appeared on the phytal fauna (fauna specifically associated with aquatic vegetation) particularly on aquatic weeds such as water hyacinth and *Salvinia* sp. (Michael, 1968; Arunachalam *et al.*, 1980; Sobhana and Nair, 1983; Sarma and Gopalaswamy, 1975; Sarma *et al.*, 1981). According to Kachroo (1956) the macrophytes communities have received little attention. These were classified according to their zonation along the water depth gradient, into submerged, free floating, floating-leaved, emergent and wet meadow types until late 1960s. Hogeweg and Brenkert (1969) who extensively surveyed the Indian vegetation in a variety of habitats, for the first time applied the growth form system proposed by Hartog and Segal (1964) with some modifications. Dawson *et al.*, (1999) studied the distribution of the morphological groups of aquatic plants for rivers in UK. Daniels *et al.*, (2006) reported the relationships between physical features of rivers and the distribution of macrophytic vegetation along the Scorff river and its tributaries in western France. In India distribution, abundance, dynamics and significance of hydrophytes have been studied by many workers (Sharma *et al.*, 1998; Devi and Sharma, 1998 and Mohini Gadhia *et al.*, 1999). Ecological productivity studies of the macrophytes in Kharungpat lake (Manipur) was investigated by Khelchandra and Manihar (2012). The authors are of the opinion that the lake is found to be markedly polluted and in a eutrophic state.

Water pollution, the world’s biggest problem is a result of urbinisation, industrialisation and modern agricultural practices. It leads to alteration in physical, chemical and biochemical properties of water bodies as well as that of the environment. It directly or indirectly affects the life process of flora and fauna of the
water body, surrounded by chemical toxicants. Every year nearly 250 million cases of water-related diseases are reported, causing death between 5 and 10 million. Diseases such as diarrhoea alone causes millions of children to be underweight, mentally and physically handicapped and vulnerable to other diseases. Many infectious diseases are still carried by insect vectors, particularly mosquitoes that breed in freshwater (Gleik et al., 2001).

Shiddamallayya and Pratima (2008) studied the impact of domestic sewage on freshwater body. The study was carried on to note the chemistry and quality of tank water in Bhalki town of Bidar (Karnataka).

Microorganisms play a major role in processing and controlling the water quality of inland waters and are crucially involved in the fate of pollution released to the environment. Studies on the Coliform bacteria in rivers and lakes have been studied by many workers. (Kaushik and Prasad, 1964; Phirke and Verma, 1972; Agarwal et al., 1976). Sivakami et al., (2012) carried out a comparative study in Coliform bacterial density and dynamics in relation to physico-chemical characteristics of two temporary ponds. The results reveals that higher bacterial population was observed during rainy season in the ponds, probably due to increased surface runoff around the areas. Seasonal changes in fungal populations of both lakes and rivers, particularly in relation to organic matter, temperature, pH and other habitats factors have been examined in several studies (Khulbe and Durgapal, 1992, 1993; Khulbe et al., 1993, 1995).

Reservoir ecology has attracted many fishery biologists throughout the world. Diversity of fish is an important index deciding the utility of any water body for aquaculture. Some of the studies outside India include Peter (1967) in Volta lake (Ghana), Rai and Hill (1980) in Amazon lakes, Lorenzen (1993) South Asian small
reservoir (UK). In India, fisheries science grew in tandem with that in Europe and North America. India led the limnological or hydrobiological studies in Asia at the turn of the 20th century. The separation between fisheries science and limnology in India started about the same time and appeared complete by the turn of the century. As an example, the Department of Limnology and Fisheries established in 1970s under the Agriculture Faculty at Udaipur (Rajasthan) was converted into the College of Fisheries in 2003. The emergence of the concept of ecosystem goods and services has brought the realisation that fish are a major but services that is linked closely with several other ecosystem services (Dugan et al., 2010).

The diversity of fish fauna in fresh water ecosystems has been studied by many workers. Fishes are most intensively investigated and much of the published information has been summarized by Jhingran (1992) who has included an extensive bibliography. (Saxena, 1963; Prem Kumar and John, 1987; Dobriyal and Singh, 1988; Rao, 1993; Ajith Kumar et al., 1999; Sakhare, 2001; Soruba, 2002; Dwivedi and Sonar, 2004; Nandan and Aher, 2005; Sheeja, 2005; Pazhanisamy, 2005; Rani Palaniswamy et al., 2006; Sarma et al., 2007; Das et al., 2008; Vinodhini and Narayanan, 2009; Saravanan et al., 2010a; Vijayakumar 2010; Vyas et al., 2012; Aparna and Utpal, 2013; Muruga et al., 2014). Kamble and Mudkhede (2013) studied the fish fauna and productivity of Loni reservoir (Maharashtra). Commercially important fishes in Yeshwant Sagar reservoir, Indore was studied by Sharma Archana (2014) and recorded 39 species of fish fauna from the reservoir.

Many south Indian reservoir were investigated in detail during the 1960s for both primary and secondary (fish) production. These results have been summarized earlier by Sreenivasan (1966, 1972), Ganapathi and Sreenivasan (1970, 1972), Ganapathi (1972) and Natarajan and Pathak (1987).
The physico-chemical parameters of various water bodies of Tamil Nadu have been studied by many workers. Sangeetha et al., (2000) carried out studies on water quality of ground water of seven villages in and around Udayarpalayam. Rani et al., (2001) studied the potability of water sources in cement industrial area, Ariyalur District. Shanti et al., (2002) carried out hydrobiological study of Singanallur Lake at Coimbatore. Evaluation of drinking water quality characteristics of five villages in Jeyankondam Panchayat Union, Ariyalur District was carried out by Rani et al., (2002a). Drinking water quality characteristics of five rural places in and around Titagudi, Tamil Nadu was carried out by Rani et al., (2002b). Studies on statistical relationship between ground water quality parameters in Nambiyar river basin was studied by Gajendran and Thamarai (2008) and found out that the parameters had high correlations coefficient. Raja et al., (2008) evaluated the physico-chemical parameters of Kaveri river. Sundarasivakumar and Ebansar (2008a,b) studied the potability of borewell water in villages around Sendurai, Ariyalur and also the water quality of drinking water ponds in villages around Sendurai, Ariyalur. Sheeja et al., (2008) carried out studies on progressive changes in the physico-chemical characteristics of the Thampraparani River (West) during its flow. Pazhanisamy and Ebansar (2008) carried out studies on mathematic prediction models on the physical characteristics and on the distribution of nutrients in lower Anaicut reservoir of Thanjavur District, Tamil Nadu. Thirugnanamoorthy and Selvaraju (2009) studied the phytoplankton diversity in relation to physico-chemical parameters of Gnanaprakasam temple pond of Chidambaram.

Arivumani and Ebansar (2011) carried out seasonal variations in pH, Nitrate and Nitrite levels of Varattuppalam reservoir of Erode District, Tamil Nadu. Jacklin Jemi and Regini Balasingh (2011) studied the physico-chemical parameters of temple
ponds of Kanyakumari district. Limnological studies of Kodaikanal lake was done by Prathap Singh and Regini Balasingh (2011) with special reference to phytoplankton diversity. Kalavathy et al., (2011) carried out water quality index of Cauvery river in Tiruchirappalli district. The study revealed that the water of the river is polluted moderately in the upstream of the city and unfit for human consumption towards the downstream. Rajiv et al., (2012) have studied the physico-chemical and microbial analysis of river waters in Western Tamil Nadu. Assessment on the characteristics of river Kodayar with reference to physico-chemical parameters was done by Sreeja and Ramalingom (2012). The study revealed that few parameters were found to be higher and preventive measures should be adopted for quality water for domestic utilization. Jenila et al., (2012) studied the water quality of ponds around Marthandam and Nagercoil town in Kanyakumari district. The findings of the study indicated that there was much deterioration in water quality of the ponds studied and that anthropogenic activities should be regulated and implemented by the local self governments. Nithya Jeniffer et al., (2012) reported the physico-chemical parameters of Theppakulam pond at Valparai, Coimbatore. Ecological investigation of water of Perumchani reservoir, Kanyakumari district was done by Deleep and Beena (2012).

Kadarshahib et al., (2012) analysed the water quality in different sampling sites of Vaigai river. The study showed that the water parameters had already exceeded the tolerable limits. Rajesh and Ramesh (2013) analysed the water pollution in the Pazhayar river at Kanyakumari district. The results revealed that the river is under very poor quality rating and appropriate steps are to be taken for pollution control. The investigators found that the water was least polluted water, compared to other reservoirs in the South western Ghats. Surface water quality monitoring for Thamirabarani river basin using Geographical Information System (GIS) was carried
out by Krishnakumar et al., (2013). The study provided a guideline for the suitability of water for domestic purposes. Amoudavel et al., (2013) studied the potability and dynamic variation in water quality of bore well samples of selected villages in Nagapattinum District, Tamil Nadu over a period of five years. Krishna Kumar and Ebanasar (2013) carried out seasonal variations in physico-chemical characteristics of Ramakkal lake in Dhammapuri, Tamil Nadu. Analysis of water quality parameters in Vembakottai water reservoir, Virudhunagar district was done by Pulugandi (2014). Nagarajan and Saravanaraja (2014) studied the seasonal variation and fish culture activities in physico-chemical and biological qualities of Thenmugum Vellode Lake in Erode District.

Many limnological studies have been conducted in water bodies of the Nilgiris district. Pioneering works were done by Rajan (1963) regarding the ecology of the fishes of the Pykara and Moyar rivers. Sreenivasan (1968) studied the limnology of tropical upland impoundments in Nilgiris. Rao et al., (1993) have analysed various physico-chemical and biological factors in the storm water channel and Ooty Lake and suggested that the dumping of the sewage into the lake affected the lake’s purification properties. Geetha et al., (1999) carried out a study on Modelling seasonal fluctuation of aquatic fauna with reference to the Environment Factors in a high altitude lake of Peninsular India (The Ootacamund lake).

Recent physico-chemical analysis works are of Sivakumar et al., (2000) in water sources of Ooty. Jaganathan and Sivakumar (2002) observed the environmental quality and productivity of the Ooty Lake. Muralidharan et al.,(2005) studied the heavy metal contamination in the fishes of selected high altitude water bodies in the Nilgiri district. Thilaga et al., (2005) studied the nutrient content of the Ooty lake with reference to pollution. Limnology and fisheries of Sandynalla reservoir was studied
by Rani Palaniswamy *et al.* (2006). Studies of pollution prevention strategies for reclamation of Ooty lake was carried out by Subramani (2012). Sumithra and Ebanasar (2013a) carried out studies on seasonal variations in dissolved oxygen, dissolved solids level in Sim’s park pond of Coonoor. Seasonal variations in ecosystem dynamics with special reference to Coliform levels of Ralliah reservoir of Nilgiris District, Tamil Nadu was carried out by Sumithra and Ebanasar (2013b). Sumithra and Ebanasar (2013c) also reported seasonal variation in phytoplankton diversity of two wetland patches of Coonoor of Nilgiris.

Even though Katteri Reservoir is the first hydroelectric projects of the Country and situated at high elevations of Nilgiri Biosphere Reserve, the thorough study on literature reveals that Saravanan et al., (2010b) reported the soil erosion mapping of the watershed. While, no studies are *hitherto* available on the water quality and ecosystem dynamics of the reservoir. With this view in mind the present investigation was planned and carried out.