REVIEW OF LITERATURE ON LIMNOLOGY IN INDIA
Lakes are inland water bodies. Study of lakes comes under a branch of science called Limnology. In detail, Limnology deals with the biological productivity of inland waters and the influence of physical, chemical, biological and meteorological factors on the character and quantity of biological production (Welch, 1952).

A perusal of literature shows that limnological studies in India have a brief history starting from 1920's. A bibliography of significant works done since this period till the middle of 1960 is given below.

Sewell (1927); Pruthi (1932); Ganapati (1940 a,b,c); Hora (1944); Nair (1944); Ganapati et al. (1945); Gonzalves and Joshi(1946); Alikunhi et al. (1948); Chacko and Ganapati (1950); Ganapati (1950); Ganapati et al.(1950); Alikunhi et al. (1951); Ganapati and Chacko (1951); Chacko et al. (1953); Ganapati et al. (1953); Chacko and Krishnamoorthy (1954); Chacko and Sreenivasan (1954); Ganapati (1955); Rao (1955); Singh (1955); Zafar (1955); Alikunhi (1956); Ganapati (1956); Sreenivasan (1956); Zafar (1956); Philipose (1959); Saha et al. (1959); Ganapati (1960); Singh (1960); Upadhyaya (1960); George (1962 a,b); Govind (1963); Krishnamoorty and Visweswar (1963); Ranganathan et al.(1963); Sreenivasan (1964 a,b,c,d,e); Rao and Govind (1964); Zafar (1964 a,b); Banerjea and Mandal (1965); Sreenivasan (1965 a,b); Arora (1966); George (1966); Khan and Quajjum (1966); Sitaramaiah (1966); Sreenivasan (1966 a,b); Zafar (1966).

From mid 1960's, papers started pouring in limnology from various parts
of India. Banerjea (1967) examined water and soil samples of a large number of fish ponds in various parts of the country to get an idea about the most favourable range for soil and water qualities influencing fish production. Hussainy (1967) conducted studies on the limnology and primary productivity of Vihar lake in Western Ghats and noted increase in alkalinity during warmer periods of the year and it was attributed to the photosynthetic activity of algae.


Ganapati and Sreenivasan (1968) working on the water characteristics, primary production and fisheries of Stanely reservoir, Madras, during 1947-48 noted the presence of $\text{H}_2\text{S}$ in deep water during summer.

Sreenivasan (1968 a,b) made limnological observations on two hard water lakes in Madras and two upland impoundments in Nilgiris; Vasisht (1968) made similar studies in Sukhna lake, Chandigarh.

While Vyas and Kumar (1968) studied on the phytoplankton and other algae of Indrasagar tank, Udaipur, Zafar (1968) explored thermal structure of certain freshwater bodies of Hyderabad.

Jhingran et al. (1969) reported on the methodology of reservoir fisheries in India. Seasonal trends in physico-chemical factors and plankton of fresh water pond and their role in fish culture have been discussed by George (1969).

A detailed report of the various water supply divisions of Nagpur city with emphasis on bacteriology was given by Mishra et al. (1969). The practical difficulties
encountered in effectively adhering to the recommended standards are discussed with respect to frequency of sampling and analysis of water. Narayanaswamy et al. (1969) analyzed water samples for microorganisms and salts and recorded variations in Bacteria, Fungi and Actinomycetes in different water bodies in Madras. They further concluded that no water is sterile unless it is heat sterilized.

An account of the physico-chemical and biological characters of Ramgarh lake was given by Sahai and Sinha (1969).


From a study on phosphorus cycling in soil collected from selected fish farms in India by Banerjea and Ghosh (1970) found that as the pH of the soil increases from 4.0 to 8.9, the phosphate fixation by calcium steadily increases and that by iron steadily decreases.

Khan and Siddiqui (1970) studied diurnal variations of water chemistry and plankton distribution in a eutrophic tropical pond Moat and noted large fluctuations in temperature, dissolved oxygen, carbonate and hydrogen ion concentration. Water bloom formed mainly by Microcystis aeruginosa was also observed.

Munawar (1970 a,b) investigated the limnology of three fresh water ponds for two years. The former work included discussion on the interrelationships of temperature and other physico-chemical factors: oxygen and carbon dioxide; carbon dioxide and buffer system; sodium and chlorides; organic matter and allied factors; phosphate; sulfur complexes; silicates and nitrogen complexes. The latter paper dealt with
the distribution of phytoplankton in relation to physico-chemical complexes of the ponds.

Limnological studies of seventeen man made lakes in Tamil Nadu have been done by Sreenivasan (1970). The features like edaphic characters, thermal regime, water replacement and impoundment influences on water quality, plankton, primary productivity and their overall interactions were discussed.

Saha et al. (1971) observed the diurnal and vertical variations of the physico-chemical conditions of water and soil in relation to plankton in a perennial pond, Cuttack, during 1959 to 1961.

Ecological behaviour of different forms of phytoplankton like chlorophyceae, cyanophyceae and bacillariophyceae with reference to the physico-chemical complexes of water in certain fish ponds of Hyderabad was studied by Seenayya (1971a, 1972).

Sreenivasan (1971 b) observed four shallow aquatic biotopes (Kodaikanal lake, Ooty lake, Ayyankulam pond and Odaithurai tank) for their limnological characteristics and found Ayyankulam pond as the most productive one. Further, it was concluded that klinograde oxygen curve with oxygen deficit at the bottom was characteristic of eutrophic productive waters.

Eutrophication trends in Kashmir lakes were studied by Zutshi and Vass (1971).

Problems involved with pollution of lakes and rivers in Delhi, in connection with increasing human population were discussed by Varshney (1971).

Ganapati and Amin (1972) conducted the microbiological studies of viscous scum formed at the surface of water lagoons. The study revealed that the scum was
formed of many different zoogloeae, thread like bacteria, spirilla, egg shaped cocci and bacilli along with certain biochemical components like fats and proteins.

Ganapatt and Sreenivasan (1972) commented on the energy flow of aquatic ecosystems in India.

Limnology of a seepage type impoundment, Odaithurai tank was described by Sreenivasan (1972 a). It was inferred from the study that the absence of free CO₂, high alkalinity and constant turbidity were responsible for observed low productivity. Sreenivasan (1972 b) further explored the energy transformations through primary production and fish production in some tropical fresh water impoundments and ponds.

Nayar (1972) made studies on the crustacean plankton of a fresh water tank at Pilani, Rajasthan and observed no well defined seasonal periodicity for the total zooplankton. Physico-chemical factors of the tank were also monitored regularly.

Effect of certain physico-chemical factors on the plankton of the Nangal lake was worked out by Tandon and Singh (1972) and showed that the abundance of zooplankton generally followed the phytoplankton bloom.

Seasonal periodicity of plankton in a fresh water pond in West Bengal was studied by Jana (1973). Kant and Kachroo (1973) carried out limnological studies in Kashmir lakes.

Seenayya (1973) while studying the ecology of plankton in certain fresh water ponds of Hyderabad, noted abundance of cladocerans among the zooplanktonic groups. The study also revealed that the pulses of zooplankton preceded those of phytoplankton.

Studies on nutrient exchanges between soil and water (Vijayaraghavan, 1973)
in three ponds showed that productivity of a pond need not necessarily depend upon the total nitrogen content present in the soil. The study also unveiled an inverse relationship between phosphate and nitrogen contents of the soil, and a direct relationship between phosphate and pH of the soil.

Jana (1974) observed narrow fluctuations in pH, free CO$_2$ and Cl$^-$ during a study on the diurnal rhythm of plankton in a tropical fresh water pond. The total alkalinity was found primarily due to the bicarbonates.

Studies on the hydrological conditions of a sewage pond (Ghosh et al. 1974) disclosed that the fluctuations in the productivity, bottom biota, plankton concentration and other chemical factors of the pond were mainly governed by the release of sewage effluents. Phosphorus and nitrogen content of the water and soil were found to be quite high.

Limnological features of Bhavanisagar, a tropical impoundment in Madras, were studied by Sreenivasan (1974).

Mathew (1975) described Govindgargh lake, Rewa, in terms of physico-chemical factors, plankton and primary productivity during a period from 1968-'69. Based on the results of the study suggestions were made to increase the productivity of the lake.

Mandal and Moitra (1975) carried out studies on the seasonal variations of total benthos volume and bottom soil edaphic factors in a fresh water fish pond.

Diurnal variations in physico-chemical factors at Padamsagar reservoir during pre-monsoon period of 1974 were observed by Mishra et al. (1975).
Patil et al. (1975) assessed zoo- and phytoplankton composition during pre-stabilization and stabilization of domestic waste water in a facultative pond, Mysore.

Carbon and nitrogen contents of soil collected from various reservoirs, lakes and fish ponds in Tamil Nadu were estimated by Pillai and Sreenivasan (1975). The study has revealed considerable variation in the carbon contents which was ascribed to the difference in soil temperature, vegetation, topography, soil texture and water depth.

Qualitative and quantitative studies on the seasonal fluctuations and distribution of plankton in a fresh water fish pond at Burdwa, W. Bengal, were done by Mandal (1976). Study showed highest percentages of zooplankton and phytoplankton in March and December respectively.

The physico-chemical complexes and their relationship with the macrophytes of Chilwa lake, Gorakhpur, was investigated by Sahai and Srivastava (1976).

An exploration on the limnology and primary productivity of three temple pond ecosystems in Madras state by Sreenivasan (1976) showed permanant bloom of blue-green algae in all the three ponds.

Shrivastava et al. (1977) observed the phenomenon of eutrophication in relation to changing eulittoral planktonic productivity in Parasaram lake.

Kader et al. (1978) made seasonal studies of some of the physico-chemical parameters and zooplankton in one of the experimental ponds of Madras University campus during 1973-'74. Studies revealed the complete absence of phytoplankton and the dependence of zooplankton on microbial flora and organic matter for their food, indicating an agrillotrophic nature of pond.
Khan et al. (1978) studied physico-chemical and biological characteristics of Chandtal pond.

Haniffa and Pandian (1978) assessed the morphometry, primary productivity and energy flow in a tropical pond called Idumban pond, Trichy.

Qadri and Yousuf (1978) explored the seasonal variations in the physico-chemical factors of a subtropical lake of Kashmir and noted hardness of water due to high bicarbonate content. The role of temperature and CO$_2$ in the lake water chemistry and the seasonal-spatial variation in dissolved oxygen content were discussed.

Vasisht and Sharma (1978) observed diurnal variations in a fresh water pond of Ambala city, Haryana.

Morphometry and physical features of four different basins of Dal lake, Kashmir, with special reference to temperature were assessed by Vass and Zutshi (1978) and found that irrespective of the difference in thermal behaviour, all the four basins had identical heat budgets.

Seasonal variations of physico-chemical factors and pattern of plankton in Nakhi lake, Mount Abu, Rajasthan, showed certain special characteristics (Bohra et al., 1979).

Temporal plankton succession and ecology of a tropical tank in West Bengal had been studied by Jana (1979). Correlation analyses of different parameters were also attempted.

Jyothi and Sehgal (1979) reported on the ecology of rotifers in Surinsar, a
subtropical fresh water lake in Jammu. About seventeen species of rotifers were identified.

Mollah et al. (1979) observed interaction between pond bottom soil and water qualities, and the results were discussed in the light of previous studies.

The trophic status, plankton production, macrobenthic organisms and various physico-chemical variables of two lakes of Kumaun viz., Nainital and Bhimtal have been studied by Pant et al. (1979). The study revealed higher values of total alkalinity, free carbon dioxide, nitrogen and phosphate in Nainital lake than Bhimtal lake.

Sitaramaiah (1979) examined the individual and population net efficiencies of a tropical fresh water community and found that it increased with increasing trophic levels. The assimilation and ecological efficiencies were calculated and presented for different trophic levels.

Abraham (1980) made a study on the seasonal abundance of plankton in Bhavanisagar reservoir during 1974- ’76 and observed that the littoral area of the reservoir was more productive than sublittoral and profundal areas. *Microcystis* was found to be dominant among the phytoplankton genera. A study on the seasonal fluctuations of zooplankton in Ramasamudra tank by Ayyappan and Gupta (1980) revealed a direct relationship between phytoplankton and zooplankton. Jayangoudar (1980) carried out hydrobiological studies on the Ajwa reservoir, the source of raw water supply to the Baroda water works, making suggestions for the economic purification of the water.

Kannan and Job (1980 a,b) conducted a diurnal, seasonal and depthwise study
of primary productivity and physico-chemical characteristics of Sathiar reservoir, and noted that the gross primary productivity was not limited by nutrients availability but by factors like biomass, water level changes and precipitation. The study also disclosed the eutrophic nature of the waterbody. While Khan & Zutshi (1980) studied on the primary productivity of the plankton of Nilnag lake, Kashmir, a comparative study of productivity of Bharatpur and Ramgarh lakes in Rajasthan was carried out by Mahajan et al. (1980) establishing that Bharatpur lake was eutrophic and richer in number of species. In the same paper, dynamics and management of the fish populations of the two habitats are also discussed.

Mandal (1980), on the basis of his studies of a freshwater pond at Burdwan, W. Bengal, found a seasonal abundance of plankton in relation to physico-chemical characteristics of water.

Nair and Prabhoo (1980) carried out a one year study consisting of monthly estimations of primary productivity along with limnological features and fish productivity of Neyyar reservoir of Kerala. The low fish catch noted in the reservoir was ascribed to a large population of piscivorous birds and crocodiles. In the same year metallic contents in the water and sediments of Lake Nainital were investigated by Pande and Das (1980), and their implications on public health and natural fauna were highlighted.

Rana et al. (1980) assessed the inter-relationship of CO\(_2\) with other chemical parameters in Fort Moat of Bharatpur and found that CO\(_2\) was related to dissolved oxygen, carbonate and pH.

Fluctuations of plankton density in two fresh water ponds at Janai, W.
Bengal, were observed by Sen and Sircar (1980).

Singh *et al.* (1980) worked on the seasonal and diurnal variations in the physico-chemical conditions of water and plankton in the lotic sector of Rihand reservoir, (Uttar Pradesh) to find that the greater availability of plankton in surface water during cooler temperature of night and morning hours was likely to cause upward movement of fish.

A study by Sugunan (1980) in Nagarjuna Sagar reservoir brought to light the seasonal abundance of different phyto- and zooplanktonic group in relation to physico-chemical factor of water and the plankton utilization by fishes.

Thomas *et al.* (1980 a) estimated primary productivity of Sasthamcotta lake for six months and noted a low rate of production ranging from 0.95 gC/m$^3$/day to 3.36 gC/m$^3$/day. The above authors (1980 b) in a preliminary study on the fish fauna of the same habitat recorded 23 species of fishes belonging to 13 different families.

Zutshi *et al.* (1980) investigated the comparative limnology (morphology, thermal behaviour, physico-chemical features and biological conditions) of nine high altitude lakes of Jammu Kashmir, Himalayas. They found that the lakes were either eutrophic or in the process of rapid evolution into high trophic levels, except one.


From a study on the chemical and textural characteristics of sediments from
different depths in a subtropical pond by Mishra (1981), it was noted that concentration of nitrogen, organic matter and cation exchange capacities of sediments increased with water depth while concentration of phosphorus and hydrogen ion decreased with depth.

Pillai (1981) observed some aspects of ecology of larval *chaoborus* in Sasthamcotta lake.

Seshavatharam and Venu (1981) studied the ecology of Kolleru (Andra Pradesh), the largest fresh water lake of south India. A general survey of water chemistry and phytoplankton production was attempted in the study.

Chattopadhyay and Mandal (1982) studied the changes in chemical and biological properties of soil and water of a brackish water fish pond in response to a combined application of manure and fertilizers. It was found that artificial fertilization was more effective in increasing the production of plankton.

A comprehensive account of textural characteristics of sediments from various micro-environments of Sukhna lake was published by Chandhri and Chandra (1982). They noted that the lake sediments have polymodal distribution according to the mean size of the particles.

Studies carried out on the eutrophication of Nainital lake waters (Handa *et al.*, 1982) have revealed that in contrast to the Bhimtal lake, the nutrient elements like nitrogen, phosphorus and certain other elements were present in the lake in concentrations exceeding the acceptable limit, mainly due to the anthropogenic effect.

The limnology of a peninsular perennial tank and selected village ponds in Bangalore was studied by Rao *et al.* (1982).
Zutshi and Vass (1982) explored the biological features of Lake Dal, Srinagar, and noted that open area of the lake depicted low trophic level in terms of phytoplanktonic production. Further, the study unveiled significant spatial variation in the plankton production and therefore inferred that since the limnological features differed significantly among various basins of the lake, a single trophy cannot be applied.

Chemical composition (NO$_3^-$, available P, Ca, Na, K, Mn, Zn, CO and organic matter along with Ph, Eh) and clay content of surface sediments of a eutrophic lake, Nainital was examined by Gupta & Pant (1983). Overall negative skewness values were employed for the characterisation of the sediments. Measurement of NH$_3$-N and dissolved O$_2$ at the mud-water interface was also attempted.

A two year study of the water quality of a fresh water lake in Ballia (Uttar Pradesh) revealed that fluctuations in the physico-chemical factors were within the range conducive to high biological productivity (Singh, 1983).

Unni (1983) studied the gross primary production of a fish pond, receiving sewage and domestic laundry, and reported that the production was negative at one metre depth due to higher oxygen consumption. The paper also gives an account of thermal stratification, inter-relation of factors and plankton composition.

Vass and Zutshi (1983) studying on the energy flows, trophic evolution and ecosystem management of a Kashmir lake calculated that the conversion efficiency between primary and zooplankton was 0.7% and between the former and fish was 0.19%. The study also disclosed the dominant contribution of macrophytes (88%) in the gross primary production of the lake.
Pollution studies in Rihand reservoir by Chandra et al. (1984) revealed that the ecological conditions of the water body have become unsustainable for the growth and multiplication of plankton. The author urged for the proper treatment of effluents from the Kanoria chemicals, Renukoot, Uttar Pradesh, before let out.

Depthwise studies made in Bhavanisagar reservoir during 1974 - '77 by Gupta (1984) revealed that thermal stratification was absent but biogenic chemical stratification in respect of dissolved oxygen, pH, free CO$_2$, bicarbonate and specific conductivity was frequently observed in lentic and intermediate sectors.

An enquiry by Jayangoudar et al. (1984) on the biological and physico-chemical characters of Lake Gandhisagar water showed that the lake was subjected to artificial eutrophication and can be classified as hyper eutrophic, while Phutala tank was subjected to natural eutrophication and hence can be classified as mesotrophic. The findings were confirmed by the application of Palmer’s indices.

Khatri (1984) carried out a study on Lakhotia lake ecosystem, Rajasthan, with a discussion on the inter-relationship of various water parameters.

Saha (1984) worked on the physico-chemical conditions of Shajangi pond at Bhagalpur. The variations in different parameters have been discussed in relation to fluctuating climatic conditions.

The relative similarity of three sectors of Getalsud reservoir in terms of qualitative planktonic composition was worked out by Singh (1984). Sorensen’s Quotient of similarity (QS) was applied.

Sukumaran et al. (1984) made observations on physico-chemical conditions
of water and plankton of two tanks in Maland region of Karnataka. The study indicated the oligotrophic nature of water body and suggested measures for enhanced production.

Studies on the limnology of a sewage polluted tank (Unni, 1984) brought to light the chemical stratification of water body and occurrence of seasonal blooming of *Microcystis*.

Bilgrami *et al.* (1985), while making a study of the limnology of thermal springs in Bihar, observed the discharge of some rare gases like Helium and Argon.

A comparative account of the variations in the plankton population of two oxbow lakes of Gandak basin in Muzaffarpur, Bihar was given by Bhowmik (1985). The study revealed that both the lakes show swampy conditions and tendency towards eutrophication.

Jindal and Vasisht (1985) conducted a two year study (1978-'80) of the physico-chemical and biological characteristics of a fresh water pond at Nabha in Patiala district (Punjab). The data obtained have been correlated with the abundance and periodicity of plankton.

Exploration of thermal fluctuations along the vertical profile of Idukki reservoir by Khatri (1985), revealed an interesting phenomenon of abnormal variations with depth, termed as "dithermolimnion".

Patil and Gouder (1985) examined abiotic and biotic conditions in a subtropical natural pond over a period of 14 months. The relationships between different factors were evaluated by partial and multiple correlation coefficients.

Qualitative and quantitative analysis of plankton with reference to
hydrological features of a freshwater tank in Bangalore (Rao, 1985), showed zooplanktonic predominance over phytoplankton throughout the year. It was inferred that the low production of plankton as a whole was due to turbidity of waters and low nutrient of both soil and water.

Unni (1985) investigated twenty four reservoirs in central India for their physical, chemical and biological features. The study revealed considerable limnological differences among different reservoirs.

Trivedi et al. (1985) explored five lakes in Kolhapur city for a period of one year for their physico-chemical and biological characteristics. The results showed that at least three lakes were highly eutrophic as apparent by very high concentration of nutrients and organic matter, while the remaining two were heading for eutrophication.

Kulgarhi reservoir in M.P. was assessed during 1968 - '72 by Dwivedi et al. (1986) for its productivity status in context of fishery management and suggested that production can be enhanced through proper management.

Thermal ecology of lake Surinsar, Jammu, was studied by Jyoti et al., (1986). Based on thermal characteristics and geographical location, the lake was classified as "subtropical-monoholomictic".

Limnological studies of a Beel ecosystem by Pathak et al., (1986) showed that nanno plankton contributed 39.5 to 81.2 % of the total standing crop of plankton and 64.7 to 90 % of the primary productivity.

Preliminary ecological studies on the freshwater lake, fox sagar, Hyderabad, by Ramakrishna (1986) demonstrated that, taking into account the benthic organisms,
aquatic insects, variation in physico-chemical factors and human interference, the condition of the lake was tending towards mesotrophic nature.

Saha and Pandit (1986) worked on the limnology of two ponds in Bhagalpur and reported about increased pollution in one of them.

Singh (1986) studied relationships between primary productivity and environmental parameters of tropical lakes. The study indicated the strong dependence of primary productivity on energy related physical parameters like temperature and secchi disc transparency than on nutrients present in the water. Seasonal variations of pH and alkalinity and their inter-relationship in Sagar lake was observed by Thakur and Bais (1986).

Nutrient level and its influence on phytoplankton were studied by Khatri (1987) during summer, monsoon and winter seasons in a shallow tropical lake, Lakhotia of Rajasthan. A positive correlation of phytoplankton with phosphate and nitrate, and a negative relationships with Bacillariophyceae and silica were noted in the study. Patil et al. (1987) observed the seasonal variations in the population of phytoplankton in a fish tank of Jabalpur for a period of one year and showed the Myxophycean dominance.

A study of the seasonal changes in nitrogen fixation in a eutrophic pond, Varanasi (Rao and Kumar, 1987) showed that algal nitrogen fixation took place under natural conditions only when heterocystous cyanobacteria were present in the pond.

In situ nitrogen fixation by the blue greens was regulated by several external factors such as light intensity, temperature and ammonium present in the pond.
A study on the limnology of an urban pond by Ramanibai and Ravichandran (1987) indicated that the pond was slightly eutrophic and supported a rich biota. The study also exposed higher influence of physical variables on biological community in comparison to that of nutrients.

Satyamohan (1987) explored two drinking water lakes of Hyderabad - Osman Sagar and Mir Alam - for their chemistry for two years and reported that higher particulate silicate occurred in Osman sagar. Another study of Satyamohan and Reddy (1987) revealed cationic composition of Osman Sagar (Ca > Mg > Na > K) and Mir Alam (Ca > Na > Mg > K) and commented on the influence of sediments on lake chemistry.

Variations of temperature, alkalinity and dissolved oxygen in Sagar lake were observed by Thakur and Bais (1987) and found that surface water values were always higher than the bottom water values. Inter-relationships of these parameters were also discussed.

Valecha et al. (1987a) made an attempt to classify the Lower lake of Bhopal with regard to its trophic status on the basis of compound quotients of Nygaard (1949) and factors responsible for the eutrophic process have been discussed. In another study, the same authors (1987b) explained the pattern of thermal stratification on the basis of results obtained from diurnal studies for a period of 19 months, and noted complete circulation during rainy season.

Limnology and productivity of Dighali Beel (Assam) was assessed by Yadava et al. (1987). The study dealt with physico-chemical condition of water and soil,
plankton, macrobenthos, primary productivity and photosynthetic efficiency and fish production. It was noted that a detritus food chain was operating in Beel ecosystem.

The diel variation in water quality, primary production and plankton levels in a perennial peninsular tank during four seasons of 1983-'84 were presented in the work of Ayyappan et al. (1988).

In a review article, Bhatti and Bhatti (1988) gave an account on biological indicators ranging from virus to man and discussed their significance in determining water quality, its preservation and maintenance.

Johal and Chahal (1988) surveyed the ichthyofaunal composition of Jaismund lake, Rajasthan, and discussed the causes of appearance and disappearance of some fishes from this lake.

Mishra (1988) discussed major nutrients responsible for eutrophication in lakes, their sources, management and control strategies.

Reddy and Prasad (1988) noted considerable diel variations in the concentration of ammonia during their study on nutrient status of Banjara lake, Hyderabad. The major sources of nutrient loading identified were sewage and domestic wastes that were often enhanced by rainfall.

A comparative assessment of limnological characteristics of an urban and rural pond in Varanasi was worked out by Shardendu and Ambasht (1988). It was found that urban pond was poor in dissolved oxygen and macrophytes but rich in ionic strength, biochemical and chemical oxygen demand compared to the rural pond.

Limnological study of an eutrophic deep discharge reservoir, Wagyanala, in
central India, by Unni and Patil (1988), revealed dominance of blue-green algae throughout the year.

Periodicity and abundance of plankton and physico-chemical factors of Gulariya reservoir, a 300 ha minor irrigation impoundment near Allahabad, was studied by Wishard and Mehrotra (1988) and noted that the productive potential of the reservoir was influenced more by certain physical reasons such as high flushing rate and allochthonous input.

Frequent blooming of *Microcystis* was noticed by Anitha Kumari and Aziz (1989) during a study on the limnology of Palkulangara temple pond, near Thiruvananthapuram.

A multidisciplinary team (Anon., 1989) has investigated the different aspects of management and conservation of Pookot lake ecosystem in the western ghats, Wyanad dist., Kerala. The study included physical characteristics of lake and its catchment, hydrology, sedimentation problems, physico-chemical and biological factors, soil characteristics of the catchment and vegetation survey of Pookot lake area.

Studies on various environmental parameters and zooplankton conducted in a polluted urban reservoir, Hussainsagar, Hyderabad, during 1980-'81 period by Ghosh and George (1989) revealed an almost anaerobic condition and evolution of hydrogen sulphide in the reservoir, which was ascribed to the anthropogenic eutrophication and discharge of industrial effluents.

Harikrishnan and Aziz (1989) examined the physico-chemical characteristics, primary productivity and zooplankton distribution of Neyyar reservoir,
Kerala. It was inferred that the inconsistency of the gross productivity of reservoir might be due to the irregular fluctuations in phytoplankton and low light intensity.

Mishra and Singh (1989) carried out physico-chemical analysis of certain ponds of Sitamarhi district in order to know what extent these waters were suitable for the increase of fish production.

The progressive eutrophication of lake Rangasagar was investigated by Rao and Durve (1989) through planktonic community succession and limno-chemical characteristics. However, the structure of lake basin suggested oligotrophy.

Reddy and Prasad (1989) explored the nutrient enrichment and primary productivity in Banjara lake, Hyderabad, using C\textsuperscript{14} uptake by filtration technique and acidification bubbling method.

Tripati and Pandey (1989) assessed the algal community of some polluted ponds of Kanpur and determined the trophic status using Nygaard’s indices.

Ahmed and Singh (1990) while studying the diurnal fluctuations of limnochemical parameters in a perennial freshwater pond at Dholi, Bihar, noted interesting correlation between different parameters.

Jakher et al. (1990) assessed the functioning and interaction of various environmental and biological factors in Sambhar and Didwana lakes of Rajasthan, during a period from 1984 to 1985.

Vass and Langler (1990) observed the changes in primary production and trophic status of Kashmir Oxbow lake, consequent to man made modifications in the environment. Changes in the production have been compared over the years and a shift
in trophic status of the lake, as a consequence of human pressure and land use, have been evaluated and highlighted.

Vijayakumar and Paul (1990) worked on the physico-chemical characteristics of Bosga reservoir, Gulbarga, Karnataka, and noted the variations and correlation of different parameters.

Adholia (1991) studied phytoplankton community in relation to limno-chemistry of Mansarovar reservoir, Bhopal, and noted very high positive correlation of phytoplankton with temperature and nutrients.

Ayyappan et al. (1991) explored the limnology and microbial ecology of a peninsular tank, Bangalore. The study was dealt with morphometry, water and sediment quality, plankton, productivity and bacterial community.

Belsare (1991) discussed the biological problems and solutions of safe drinking water for tropical belt.

Bhaskaran et al. (1991) while investigating the phytoplankton productivity of few tropical ponds, noted highest productivity values in July due to high temperature and phytoplankton density.

The impact of mining on the water quality of Mayem lake, Goa, was observed by Desai (1991). The results indicated increased rate of pollution of this waterbody.

Gupta (1991) made ecological study of Sagar lake with reference to soil and cultivable fishes. Monthly variations in chemical parameters of soil and the population of cultivable fishes were recorded and statistically analysed.
A study by kaushik et al. (1991) on the phytoplankton population dynamics in relation to environmental parameters in Matsyasarobar, Gwalior, Madhya Pradesh, showed that the tank was oligotrophic with increasing nutrient concentration in summer. In another study Kaushik et al. (1991) observed the fluctuations of phytoplanktonic algae in relation to the water quality of chambal tal, Gwalior, Madhya Pradesh. The Nygaard and Palmer indices were applied to evaluate the trophic system.

Bathymetric and morphometric studies on lake ecosystems of Kumaun, Himalaya (khanka, 1991) showed that the depth of these lakes was reducing due to increased rate of erosion from the water shed and silt installation in their bottom, especially during rainy season.

Kodarkar et al. (1991) carried out a study on permanent toxic algal blooming in Lake Hussainsagar, Hyderabad, and found that the blooming had a direct correlation with pH, temperature, DO and available phospate.

Kumar and Sharma (1991) compared the physico-chemical limnology of the lakes of Udaipur, Fatehsagar and Picchola and noted almost indentical conditions.

Kumari et al. (1991) worked on ecological parameters of Basman lake of Motihari, Bihar, and found that dissolved oxygen was closely and directly related to plankton production.

Some metal pollutants in bottom sediments of a polluted tank was estimated by Mohanty et al. (1991). Pandey et al. (1991) studied the physico-chemical and biological parameters of a pond ecosystem of Purnea.
In his project report, Prakasam (1991) has described the water and sediment characteristics of Sasthamcotta lake with reference to pollution. The author has also made suggestions for maintaining the status quo of the lake. Human excreta has poised great threat to the potability of Sasthamcotta lake waters. According to Nair (1988), during rainy season large quantities of faecal matter were drained into the lake. The study by Prakasam (1991) revealed alarming number of faecal coliforms in the surface waters of the present lake.

Prakasam and Joseph (1991) studied the sediment-water interaction in Sasthamcotta lake in relation to the primary productivity and observed that the phytoplankton production was correlated with the percentage of organic matter in the sediment. The above authors (1992) also reported on oxygen, carbon dioxide and temperature cycle in Sasthamcotta lake. The study showed that the concentration of DO was higher in surface water and lower in bottom water, whereas, the free CO$_2$ registered just reverse condition. Light and dark bottle experiment for the estimation of primary productivity showed anomalous oxygen values.

Praveen et al. (1991) conducted limnological studies of upper lake Bhopal, during certain religious activities. The study showed that after the immersion of the idols, limnological characteristics of Upper lakes have changed significantly.

Hydrobiological studies on five drinking water bodies at Thiruvannamalai, Tamil Nadu, was carried out by Ramakrishna et al. (1991).

A preliminary investigation on the ecology of chironomid larvae Polypedilum indicum of Sasthamcotta lake by Johnson (1991) revealed that oxygen and carbon dioxide
concentration and the nature of substratum were the main factors which affected the
density and distribution of larvae.

Sanjeeb (1991) investigated the impact of habitation on hydrobiology of Lake
Picchola, Udaipur, and found that nutrients in the lake were higher than that of ISI
standard of potable water. The author made some suggestions for the improvement of
water quality.

Satyamohan (1991) described the limnology of a mid lake station of Lake Mir
Alam, Hyderabad.

The physico-chemical dimension of the lentic hydrosphere of Ravindra
sarovar (Gaya) was studied by Shastree et al. (1991).

Study on the biotic parameters of the Sikanderpur lake, Muzzaffarpur, Bihar,
showed that summer and post-monsoon season were the best periods for phytoplankton
growth (Singh et al., 1991)

Correlation between limno-chemistry and copepod population of Mansarovar
reservoir, Bhopal, was worked out by Adholia and Vyas (1992).

Ahmed and Alireza (1992) made an attempt to correlate the fluctuations in
population density of surface zooplankton with some selected physico-chemical parameters
of Nathsagar, Paithan (Maharashtra).

Akhtar et al. (1992) studied abiotic features of two interconnected lakes of
Srinagar and inferred that greater habitational influence, encroachments and consequent
nutrient enrichment seem to be the major factors contributing towards the trophic level
of these lakes.
Aneja and Singh (1992) compared physico-chemical environment between Water hyacinth infested and uninfested area of a shallow pond. The results showed that calcium hardness, free CO$_2$, phosphate, sulphate content, biochemical oxygen demand (BOD) and chemical oxygen demand (COD) were higher whereas temperature, pH, dissolved oxygen and nitrate content were lower under Waterhyacinth cover.

A study on the species diversity of zooplankton in Kashmir waters by Balkhi et al. (1992) revealed that least species diversity was obtained in water bodies with very little or no plant communities in them.

Gupta et al. (1992) examined primary productivity and zooplankton of a shallow pond of southern Rajasthan and suggested that production could be increased by the use of fertilizers.


The biota and productivity of Gandhisagar reservoir were assessed by Kartha and Rao (1992). Langer and Vass (1992) observed the physico-chemical behaviour and primary production of Naranbagh lake, Kashmir and found that production increased significantly from winter months and attained maximum values during summer-autumn period.

A study by Mishra et al. (1992) on phytoplanktonic communities in relation to environmental conditions of lentic waters at Gwalior (M.P.) revealed that the water quality at cotton mill waste water pond was severely deteriorated.

Pandey et al. (1992) used species diversity indices (Shannon and Weaver’s
equation) to plankton community to identify the pollution in fish ponds at Pune, Maharashtra.

Parmar et al. (1992) carried out an assessment of quality of drinking water standard and its purification system of Bhavanagar city (Gujarat, India) in respect of certain physico-chemical and bacteriological parameters. The study revealed that all the tested constituents were within the permissible limits.

Rao and Durve (1992) observed the fluctuations of zooplanktonic assemblages in a eutrophic lake Rangasagar, Udaipur, in the year 1984-'85 and found no predator-prey relationship among various groups.

An account on the abiotic environment of Wular lake, Kashmir, was given by Sarwar et al. (1992).

Based on an extensive survey and monitoring programme, Tiwana (1992), reported about urgent need for water quality improvement programmes throughout the country.

Changes in the physical and chemical limnology of Lake Mansbal, Kashmir, from 1976 to 1988 were assessed by Yousuf et al. (1992) and concluded that the lake was gradually passing towards the eutrophic state.

A study on the ecology of polluted waters of Kashmir (Barinambal basin of Dal lake) by Yousuf and Parveen (1992) showed that the plankton community of Barinambal area has been affected by change in the physico-chemical limnology as a result of introduction of large quantities of untreated municipal sewage.

Rao et al. (1993) worked on seasonal dynamics of physico-chemical factors
in a tropical high altitude lake (Ooty lake, Nilgiri) in relation to phytoplankton. The paper
gave an account of the occurrence, abundance and seasonal succession of phytoplankton
and microbial population in relation to physico-chemical characteristics.

From the average values of various physical, chemical and biological
parameters an arbitrary composite trophic index for four ponds in Kaira district, Gujarat,
was prepared by Rana and Kumar (1993).

From the review of literature it can be seen that upto 1960 limnological
studies in India were quite meagre.

From 1960's onwards a real spurt in limnological studies has been observed.
During this period water bodies including farms, tanks, ponds, lakes and rivers were
extensively probed for their hydrobiological characteristics like planktonic composition
and abundance, seasonal variation in physico-chemical parameters, primary production and
fishery potential.

In 1970's notable innovations in Indian limnology were made. Emphasis was
given to interactions between abiotic environment and biota, primary productivity and
energy flow in aquatic systems. Studies were also reported on benthic fauna and
sediment characteristics. The assessment of "eutrophication" and pollution aspects due
to various reasons like effluent discharge, sewage dumping and human settlement were
also initiated.

Research on freshwater eco-biology showed further advancement in 1980's.
It included the pollution assessment, estimation of heavy metal composition of water and
sediment, vertical or depth wise stratification of physico-chemical parameters,
comparative trophic status study of different water bodies and inter-relationships between
different parameters. Besides, the application of statistical tools for data analysis,
preparation of mathematical models, use of components and remote sensing techniques
have provided new dimensions to the investigations.

The literature review shows that majority of the Indian fresh water lakes have
been scanned in detail for their various eco-biological characteristics. These scientific
explorations have enabled to highlight the importance of aquatic habitats as rich
resources.

However, it may be mentioned that studies relating to the complex reactions
like sediment-water interactions and productivity are scanty. Similarly, lake
Sasthamcotta, the biggest fresh water lake of Kerala has not been subjected to detailed
eco-biological investigations.