RESEARCH ARTICLE

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Sustainable Uses of Daryabganj Lake in Rural Area in District K.R.Nagar (U.P.) India

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ABSTRACT

Daryabganj lake is located in Patiali tehsil of K.R.Nagar district, (which lies between 27018' north to 2802' north of latitudes and 78011' east to 79017' east of longitudes) about 47 km from the district on Aliganj road. It is 17 km away from Ganjdundwara.The usable area for various purposes is about 50 hectares although around 30 hectare is left pending in vains(non usable). The lake has semiluner shape and surrounded by Kuda, Kanar & Nagaria villages. The water depth up to 15 feet. Daryabganj Lake is a fantastic, huge, varietifull, very prosperous natural resource and is formed as a result of the changes in the burhi Ganga river basin (formally river course of Ganga) as its basin closely resemble to those of the river basin. It is situated near the residential localities and is used for bathing and washing purposes besides fishing.This lake is ancient and natural.It has vast biodiversity including different types of plankton, flora,fauna and fishes. Author has analysed the whole magnificient biodiversity including various indices present in studied some spots of lake and focused very importance of such huge biodiversity in maintaining such investigated lake (limnoecosystem) .Water supply of this lake is regulated through drainage system and rain water. The major quality of this lake to have full of water around the year by year. So it can be Sustainable used and exploited persistently as preservation of excellent biodiversity, minor irrigation for agricultural cropping, recreational activities, composite farming and aquacultural practices for many years to come. The lake is now used extensively as fish farm by the district administration and stocked with the finger lings of major carps, minor carps and exotic carps. Recently administration has decided to declare this lake as heritage biodiversity hot spot for tourism.

Key words: *Daryabganj Lake, Water Uses, District K.R.Nagar*

INTRODUCTON:

97.2 % of earth's water is locked within oceanic boundaries, which is salty and cannot be used for mankind welfare. Rest 2.8% is present in the form of fresh water. 2.2% is trapped in the polar ice, glaciers, icebergs etc. While left 0.6% is present as surface water in rivers, streams, lakes, ponds, falls, canals, ditches etc. and underground water. Moreover 0.59% is dedicated to ground water resources and .01% as surface water. India is blessed with lot of varietiful fresh water aquatic ecosystems located in different geographical regions ranging from hot & dry arid western zone , northern zone of cold & wet , eastern& central monsoon parts to wet & humid southern peninsula.

It is high time to use and reuse such valuable & vulnerable fresh water resources in every wake of human's life like drinking, domestic workings, agricultural moieties, irrigation, multifaceted farming, energy production, aqua cultural practices including fisheries an above all conservation of biodiversity. It is need of hour to lessen exploitation of such life providing natural resources so that their sustainable uses are possible for many years to come to satisfy needs of our generations.

It becomes national duty for governmental organization, NGO, s, researchers to pay much attention towards the search, survey, development and management of aquatic ecosystems which are ignored because of their remote and rural locations. Proper and systematically approach in order to survival of fresh water bodies for their sustainable uses adds much not only in interest of poor rurals engaged but also to the general well-

being to such specific areas. Thus a complete surveillance and hard planning is required to boost the conservation of domestic, hidden, inland fresh water ancient natural resources nationally and internationally.

The study of fresh water bodies of district Kanshiram Nagar forms one of the most important concepts in line of their sustainable uses. This distt. is blessed with variety of fresh water bodies. Beside Ganga River, other small rivers like kali, esan, arind, Kari, Sanger, ghumaria, neem, Boodhiganga and 30 major lakes and ponds are present.

Author purposed on such study however as he endeavored to expose and identify such hidden, interior excellent limnetic huge Daryabganj Lake. He exercised upon such lake taking its dimensions, horizons ,perspectives in context of multifold sustainable uses including conservation of biodiversity. Moreover he made analysis scientifically for Biological Varietyfullness i.e. Bio-Diversity vis-à-vis possible ways to use & utilize such lake for long journey of human civilization.

MATERIALS AND METHODS:

Author thoroughly visited the lake with some rurals by transport to cover such huge lake around 80 hectare area in year 2010-2011.he noticed that 20,000 peasants residing nearby villages of lake might be beneficial on account by using lake water in irrigating their crop fields (150 hectare of land). Author with village head and peasants coordinated and met many times with district administration regarding the multifold uses, and perspectives of lake like construction of small canals joining lake to agricultural lands for irrigation, use of lower areas of lake for composite farming, modern aqua cultural practices for tremendous pisciculture, develop navigation and ecotourism. However efforts in this line had been made by author for last 3 years. He also shacked hands with NGO›s, social workers, researchers in order to maintain the prosperous status of lake.

BIOLOGICAL PARAMETERS:

Monthly water sample will be collected in special water samplers from experimental station of Daryabganj Lake. The methods were under taken for the investigation work on different aspects of biological factors as followed.

To study of the biota (plankton, flora, fauna and fishes) of the lake consisting of plant and animal communities besides fish fauna, samples were collected. It has required water samplers, hand nets and plankton nets etc. For identification purpose spectrophotometer, research, inverted and simple microscope have been employed. Regular survey was made to observe pisciculture.

Sampling and Analysis of plankton: Monthly planktonic sample, at the experimental station were collected by filtering 2 liter of water through planktonic net NO.25. Samples were preserved in 5% formaldehyde solution in labeled glass tube. In the laboratory, plankton were identified (Fritch, 1977; Tonapi, 1980; Adoni, 1985 and Sharma (1996, 2001) and counted. Zooplankton counting was done in the Sedgwick rafter counting cell (Welch, 1948) while drop count method was used for counting the phytoplankton. Also plankton samplers were used in this regard.

SAMPLING AND ANALYSIS OF MACROPHYTES:

Random monthly macrophytes from spot were collected by the help of metallic quadrate (6sq. inches). In the laboratory they got washed thoroughly under a net of water to get rid of adhering materials, separated and identified.

The biomass was reported on the basis of dry weight by drying in an oven at 80^0C.

For the Sampling and Analysis of Macro Benthic Fauna:

Samples were collected on monthly interval from the ponds. Collection was made by dredge net. The dredge material was sieved with a sieve number 44 and left material transfer to enamel tray, from here they were picked up and preserved in 5% formalin. Identification of fauna was done by using standards text.

Study of Fishes:

Methods ranging from catching by hand to the operation of small indigenously designed hand nets were adopted for fishing. Frequent survey was made at various points of lake where fishermen engaged in fishing. Identification of fishes was performed at the spot, done by author with the help of standard texts also at time to time he convinced the rural people specially fisherman to know about physico-chemical and biological parameters regarding the fish production.

1. for calculating species diversity Shannon-Weiner Index was used (1963).

$$H' = -\sum p_i \ln(p_i)$$

H' = the Shannon-Weaver Diversity Index
Pi = the relative abundance of each group of organisms
But remember that the S-W index is usually expressed as $e^{H'}$
OR H'= - ∑(Ni/N) × ln (Ni/N)
Where Ni = no. of individuals of each group/genera/species in a given sample
N = no. of individuals of all group/genera/species in a given sample.

2. Species richness index was calculated as (Margalef, 1958)
d =S-1/ ln N
Where S = no. of group/genera/species
N = no. of individuals
As per convenience for biodiversity indices data were converted in to smaller units as follows-
1. Plankton was estimated as no. /lt., converted in to no./ml.
2. Macrobenthic fauna were estimated as individual. /m^2, converted in to individual. /mm^2.
3. Macro flora were estimated as gm./m^2(dry weight). No index was determined.

GEOGRAPHICAL STUDY AND FACT FILE OF LAKE:

Daryabganj lake is located in Patiali tehsil of K.R.Nagar district, (which lies between 27018' north to 2802' north of latitudes and 78011' east to 79017' east of longitudes) about 47 km from the district on Aliganj road. It is 17 km away from Ganjdundwara.
The usable area for various purposes is about 50 hectares although around 30 hectare is left pending in veins (non usable). The lake has semi lunar shape and surrounded by Kura, Knar& Nagaria villages. The water depth up to 15 feet Daryabganj lake is a fantastic, huge ,varietiful ,very prosperous natural resource and is formed as a result of the changes in the burin Ganga river basin (formally river course of Ganga) as its basin closely resemble to those of the river basin . It is situated near the residential localities and is used for bathing and washing purposes besides fishing. This lake is ancient and natural. Water supply of this lake is regulated through drainage system and rain water.

Fig. 1: Showing Uttar Pradesh, state of India

Fig. 2: Showing Distt. Kanshiramnagar: lake has shown in S-E direction denoted by sky blue color

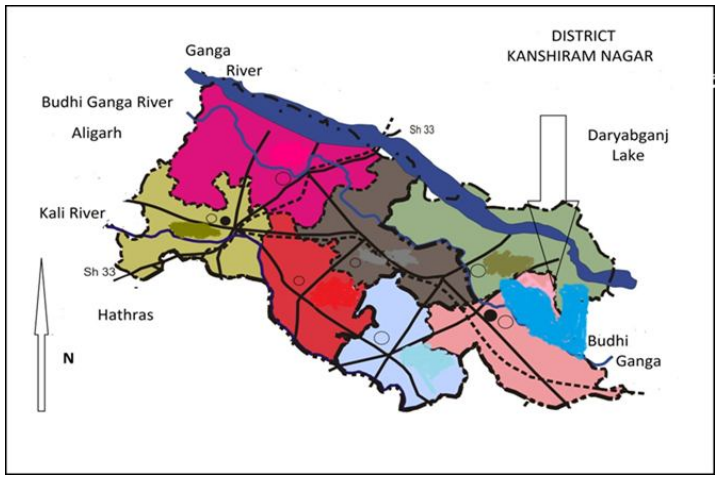
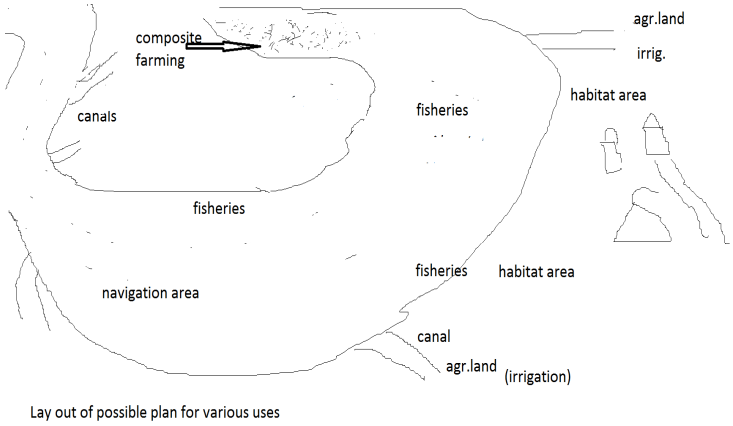


Fig. 3: Showing Distt. Kanshiramnagar: Lay our of Possible Plan for Various Uses



RESULT AND DISCUSSION:

Author had analyzed broad spectrum of biological organisms as biological variety fullness (Bio-diversity).he evaluated biodiversity both quantitatively & qualitatively including various mathematical indices. Moreover following type of biodiversity was observed in lake.

PHYTOPLANKTON:

Phytoplankton found to be separated by 3 major groups Viz. chlorophyceae, Bacillariophyceae and Myxophyceae (cynophyceae) at experiment site in lake. Total 30 genera were observed in these sites.

(A) Chlorophyceae:

Pediastrum, Closterium, Chlorella, Tetraspora, Ulothorix, Spirogyra, Volvox, Oedogonium Tetradesmus, Euglena, Eudorina, Microspora, Hydrodictyon, Heteronema, Chlamydomonas, Pandorina.

(B) Bacillariophyceae:

Nitzchia, Navicula, Diatoma, Peronia, Frustulia, Cymbella, Fragillaria, Amphora Synendra

(C) Myxophyceae (Cyanophyceae):

Oscillatoria, Spirulina, Nostoc, Anabena, Anacystis

The maximum phytoplankton was recorded during summer. However minimum population was found during rainy season. Highest peak was available in month June (19359) at studied site while minima was observed in month of October (11562).

ZOOPLANKTON:
Immediate consumer of phytoplankton as a result of quantitative analysis the Zooplankton was represented by 3 major groups viz .Rotifera, protozoa and crustacea at studied station. Total 21 genera were observed.

(A) PROTOZOA:
Amoeba, Arcella, Ceratium, Vorticella, Chilomonas, Nebella, Euglena, Paramecium, Euglypha

(B) ROTIFERA:
Keratella, Brachionus, Cephalodella, Polyarthra, Rotaria, Gastropus, Diplois

(C) CRUSTACEA:
Cyclops, Daphnia, Nauplii larva, Cypris, Monia

The maximum zooplankton was recorded during summer. However minimum population was found during rainy season. Highest peak was available in month June (14199) at studied site while minima was observed in month of December (5785) .

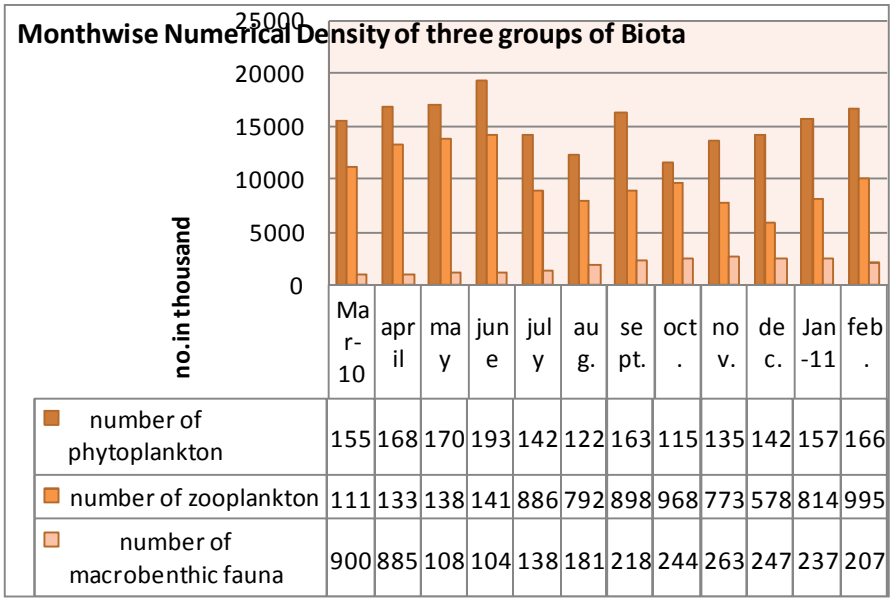
MACROBENTHIC FAUNA:
Monthly reading of Darybganj Lake showed dominance of Oligochaeta and insect in different month. The insects had common feature throughout the period of investigation with little seasonal variations certain molluscan species were also abundant there.

1. Oligochaeta:
Population density was observed from 200- 1125 in ind. /m^2, Maxima was found during April & May 2010. While minimum in Aug & Sept. 2010.
During investigation Tubifex, Nais, Lumbriculus, and Limnodrillus were observed at all the stations also Hirudinaria species was observed.

2. Mollusca:
Population density was observed from 40-80 in ind./m^2.Pila, Lymnea, Viviparae, Gyrulus were most common. Maximum of three species was observed in summer season, while minimum in rainy season.

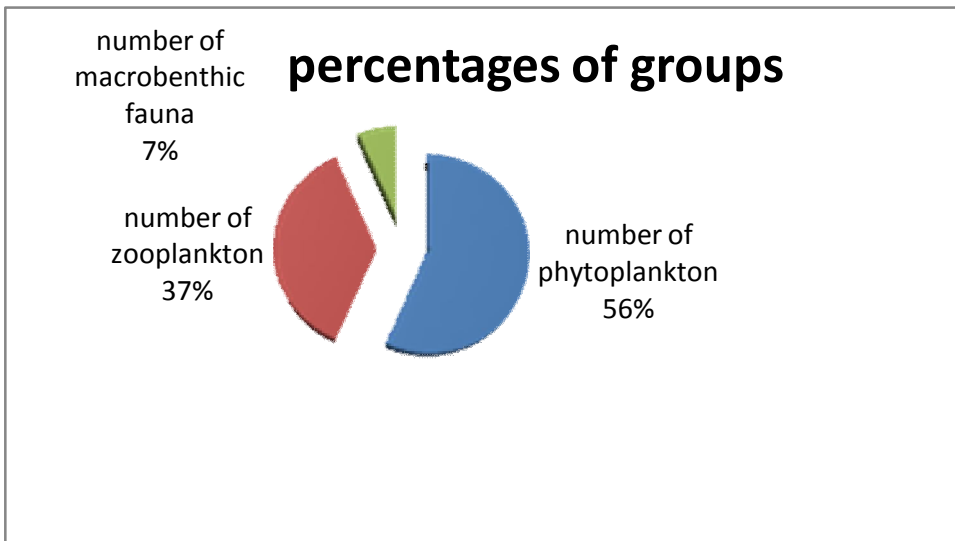
3. Insect:
Maximum density was recorded of 1550in ind. / m^2 in May 2010& minimum of 780 in ind./ m^2 august 2010. Insect larvae---Drangon fly nymph, Chironomus, tabanus, Psychoda, Simulium.(Total 14 genera of macrobenthos were identified)
(Density of three groups are shown in Plate-1& 2)

Fig. 4: Monthwise Numerical Density of three groups of Biota



	Mar-10	april	may	june	july	aug.	sept.	oct.	nov.	dec.	Jan-11	feb.
number of phytoplankton	155	168	170	193	142	122	163	115	135	142	157	166
number of zooplankton	111	133	138	141	886	792	898	968	773	578	814	995
number of macrobenthic fauna	900	885	108	104	138	181	218	244	263	247	237	207

Fig. 5: Percentage of Groups



MACROPHYTIC FLORA:

In the aquatic environment macrophytes have a great influence upon 3 groups of Weeds (flora) was identified from station.

(A) Marginal & Emergent Weeds:

Equisetum, Typha, Nitella, Wolfia, Nelumbium Apomogeton, Nymphaea, Polygonum

(B) Submerged Weeds:

Hydrilla, Utricularia, Vallisaneria, Potamogeton, Nais

(C) Floating Weeds:

Pistia, Marsilia, Lemna, Eichhornia, Azolla

Monthly biomass analysis showed thickest population of Marginal and Emergent weeds was found in Nov. 2010(7.0g/m^2) and minimum in Aug. 2010 (1.80g/m^2).Submerged weeds were highest(11.50g/m^2) during May 2010 & lowest (1.00g/m^2) in July 2010.Floating weeds high peak (15.50g/m^2) in June 2010, low peak (.95g/m^2) in Aug 2010. All weeds population showed ascending density depth rains from winter till summer.

FISH DIVERSITY:

All the main fresh water bodies of Kanshiramnagar distt. Constitute fresh water fishery. Daryabganj Lake had to have the main groups of fresh water fishes notated as follows-

1. Major Carps - Catlacatla, labeorohita, cirrhinusmrigla

2. Miner carps - Cirrhinuscirrhosa, Ambiypharyngodon, microlepis, Cirrhinusreba,

3. Cat fishes - Rita rita, Wallagoattu, Bagarius, Cavasisus, Mystus, Aor, Aorichthys

4. Feather fishes - Notopterus chitala, Notopterus notopterus.

5. Live fishes - Anabas testudineus, Channapunctatus, Hetropneustes fossilis, Clarius, Magur.

6. Mullets - Mugil

7. Eels - Anguilla bengalensis

8. Exotic and cultivate fishes - Cyprinus carpio, Cteno-pharyngodon idellus, Osphronemus, gorami lacepede, Tilapia mossaamic

Shannon-Weiner indices were determined as zooplankton> benthic fauna> phytoplankton, while numerical strength was observed in reverse way as phytoplankton> zooplankton> benthic fauna. It is due to the fact that index is largely depend upon group's individual's relative abundances i.e., Pi. for instance phytoplankton were classified in 3

groups as zooplankton & benthic fauna but each group of phytoplankton was not more relatively abundant as compare to zooplankton & benthic fauna's groups.

The entire fresh water ecosystem maintains their morphometry and ecophysiological status by interaction and interdependency of physio-chemical and biotic entities asylumed by them. Maintenance and homeostatis between water characterstics is pre requisite for sustainable use including aquacultural operations and conservation of biodiversity (Vishwakant, 2007).

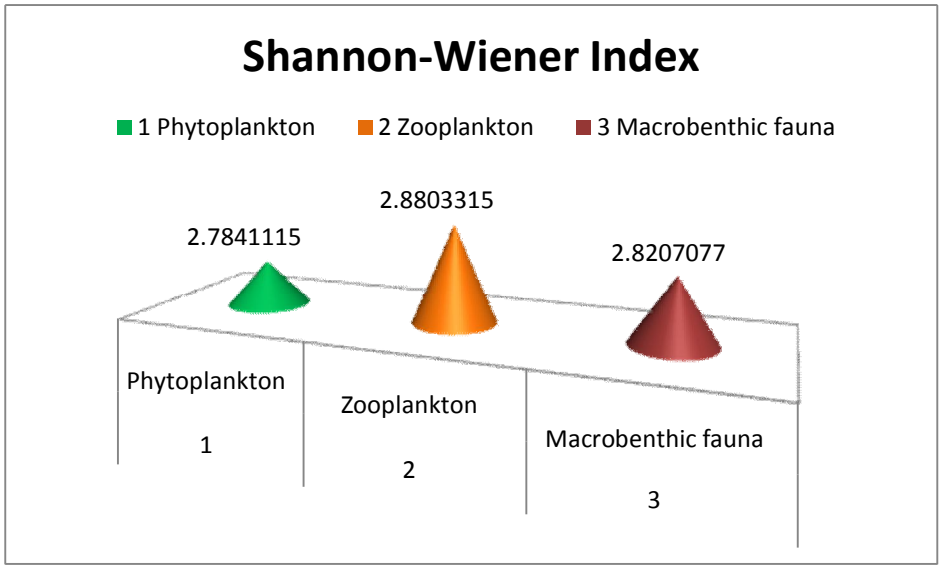
Author selected a huge lake in rural area for his study. He discussed that plankton are ancient biological organisms as have been studying for last many years as basic science research and their role in modern arena as ecobalancers in aquatic spheres. Phytoplanktons are most valuable global food-synthates because they account almost fifty percent of earth carbon fixation. They are in fact life provider to many heterotrophs. They are highly rich specifically and diversified in studied rural lake. Mathematical models are performed by author through Shannon-Weaver index of biodiversity. As they are present in all aquatic ecosystems from very primitive times through geological time scale, so they are basic biological entities. They are responsible for maintenance of fish and fisheries because largely depend on zooplankton for their food , so plankton play a great role in keeping dynamicity of such fresh water body vis-à-vis preserve limnetic system.

Plankton acts as milestone, establishers and hierrchier in water bodies. It is because of the fact that they are producer as well as nutrient equalizer. They play a magnificent role in cycling and stabilizing the different nutrients and chemicals present in water body. If there had no plankton, other large consumers which is essential, diversified component would be vanished due to non availability of food as plankton. Thus biodiversity indices be disturbed in large way and water body would be without community gathering and stratification.

Table 1: Diversity indices of biotic groups in Daryabganj Lake

S.No.	Group	Shannon-Wiener Index
1	Phytoplankton	2.7841115
2	Zooplankton	2.8803315
3	Macrobenthic fauna	2.8207077

Fig. 6: Showing the Diversity indices of biotic groups in Daryabganj Lake



Such huge biodiversity in investigated lake is very important as biological engineer in maintaining productivity of such investigated lake (limnoecosystem).Biological surveillance of communities vis-à-vis their richness and variety has become most sensitive tool in recent scenario for attrandum detecting changes in lentic spheres.(Vishwakant, 2007).on the part of plankton ,they are serving as food themselves for commercially edible fishes. Plankton study is now an essential tool in assessing suitability of an aquatic environment for fish culture (Mitra and Mohpatra, 1956; Alikunhi, 1957; Jhingran,1991.)

The maximum limnoplankton was recorded during summer. However minimum population was found during rainy-winter season. Summer pulse because of optimum light intensity, water temperature, p^H, D.O., alkalinity and vital nutrients. Declined plankton diversity was observed in rainy season by less sun light, less photosynthesis, more turbidity with organic pollution. Optimum presence of limnoplankton leads to healthy strength and diversity of macrobenthic fauna and fishes. The quantitative dominance of phytoplankton in present lake has been chlorophyceae> bacillariophyceae> myxoohyceae as also noticed by Kant and Raina (1985) from ponds of Jammu, Nayak and Khare (1993) from Patna lake. High variety fullness of chlorophyceae in present work over other groups because of presence of plenty of nutrients as nitrates and phosphates released during decomposition of aquatic organisms (Zafar, 1964; Haque, 1991).

Importance of biota in maintaining fresh water ecosystems: maintenance of water body means balancing among different components of water bodies. Nutrients present in water body come in to it by natural inflow of water from rainfall, water cycle and nearby areas as surface-runoff, household's discharges and other man made waste materials.

Nutrients are grasped by phytoplankton as they flourished in water body. In turn they get being in taken almost by zooplankton. Small fishes ingest later ones and being ingested by larger fishes. If any change occurs in physical and chemical characters made by anthropogenic activities, it leaves land mark variation in composition and gathering of biota.

In present study author reported 30 genera of phytoplankton represented by 16 of chlorophyceae, 09 of diatoms, of 05 of myxophyceae. It was concluded by Ganpati (1960), Zafar (1964, 67), Munawar (1972), Vashisht and Sharma (1975), Singhal et al (1980) and Zutshi and Khan (1988) that nutrient plentiness, primary productivity, sewage disposal, domestic and industrial effluents and over all human dimensions result in floristic composition of phytoplankton.

Few numbers of Pediastrum, Tetraspora, Closterium, Pandorina of chlorophyceae indicated that these eurypollutic genera shown that lake is being discharged with domestic eflluents. Diatoms are microscopic (2µm-100µm in size). They occur either as unicellular or colonial forms (Wetzel 1983).

Silicates are important nutrient in fresh water body for floristic bloom of diatoms (Pearsall, 1923; Lund, 1965; Hutchinson, 1967).they are much sensitive to physic chemical condition of water. Sudden increase in diatoms following the rains indicates that the sedentary diatoms attached to aquatic vegetation substratum (Patric, 1984) were detached and brought up in the main body of water from catchment area.

Hosemanni (2002) suggested that myxophyceae were found to be higher in water bodies as compare to larger ones, it became opposite in present huge lake. Palmer (1969) noticed the presence of Anacystis, Nostoc, Anabena and Oscillatoria indicate the organic pollution and eutrophication.

Generally we take organic pollution is worse for aquatic life, however we cannot stop intrusion of chemicals and organicals with surface runoff. They play a crucial role in water cycling, rainfall and mineral circulation in biosphere. In fact these chemicals and nutrients are ZERO LEVEL producers which being trapped by phytoplankton contributing in primary productivity. Having completed their lives they and other biological organisms getting decomposed and mix with organicals & minerals and circulate with bio-geochemical cycles for thousands years to come. Thus any water body if becomes highly

contaminated by virtue of man infinite desires, that leads in making danger zone for biota present at next levels. So maintenance of water body gets out of control by hands of biota.

No clean water will be available in future if no biota is present in limnoecosystem because lake or other water body would become dumped with chemicals, toxins, redicals etc. Due to no or little possibility of biodegradation performed by biota for such harmful substances.

Zooplanktons are sacrificed edible mediators between phytoplankton and small fishes. They control overgrowth of phytoplankton. The load of pollution is reflected in the biotic community of fresh water in the form of their occurrence, abundance pattern and diversity as only living organisms in aquatic medium are capable of combating pollution (Vishwakant, 2007). Numericaly zooplanktonic summer pulse was due to high temperature, increased solar illumination, rich availability of food and nutrients (Goldman & Horne, 1983; Sharma &Patnaik, 1985) as observed in present study.

Rotifer occurrence may be seen in almost all kind of fresh waters and have attracted global attention as an indicator of water quality, particularly in pollution studies.They are excellent indicator of trophic status of water (Sledecek 1983). Moreover they being fed by invertebrate and vertebrate predators (Herzig, 1987), although this group is little as species counting but numericity is high than other two groups. *Keratella* genus was found profoundly than *Brachionus* as former ones is cosmopolitan in inland limnoecosystems. *Brachionus* was regarded as eurypollutic genus while *Keratella*as stenopollutic genera. Overall rotifers were examined as pollutophilic group. The abundance of rotifers has also been reported by Allen (1920), Micheal (1966), Mathew (1975,1977), Yousuf *et, al.*(1986) George *et, al.(*1992) and Sharma(2001). Crustaceae were examined in the 3 groups viz. cladocera, copepod and nauplii. Cladocera help in (Sharma, 2001) resurrecting the trophic history of primitive lakes, ponds and reservoirs. *Daphnia, Monia, Bosmina* represented semi-eutrophic and tropicopolitan forms. Copepods were represented by mainly Cyclops species. However eggs of copepods hatch out into minute compact active swimming larvae called Nauplii having three pair of appandages.

Macrozoobenthic fauna was represented by Annelida, Mollusca and Arthropoda (Insecta), such fauna has been an indicator of pollution and added tool for rapid evaluation of water quality besides physico-chemical and biological analysis. They depend largely on decaying organic matter settled on the bottom mud as organic detritus. In present study was Oligochaeta found as dominant group of total benthic fauna. Oligochaeta have been widely used as indicator of pollution. They can resist even high pollution load. However *Nais* &*Tubifex* genus were observed in less quantity as they had examined having directly proportional with pollution and had more dilution effect. D.O. had been in optimum amount throughout the study. However D.O. had inverse relation with such two species, means they present in O_2 depleted water as noticed by Reddy & Roy (1987) and Gupta &Sharma (2005) William (1980), Bais et al (1992). However domestic sewage sludge, increase in decaying organic matter in the mud bottom provide an ideal medium for feeding, growth, burrowing (Singh et al, 2002), richness, composition, survival, fecundity, reproduction, some absence of predators of Oligochaeta. Mollusca was represented by mainly *Pila, Lymnea, Viviparae* and *Gyrulus. Gyrulus* was found associated with moderately polluted water body (Myslinki and Ginsburg, 1977; Saksena &Kulkarni, 1982; Gupta & Sharma, 2005). However in present study such pollutophilic genus was present in feeble count showing that the Daryabganj lake was no so polluted to check proliferation of biodiversity. In Insects *Chironomus* &*Tabanus* were present in less amount as they were also pollutophilic genera, while Coleopteran dragon fly , may fly, nymphs were oserved in high quantity because they were examined as pollutophobic groups.(Gupta &Sharma, 2005 ;Vishwakant, 2007). Thus macrozoobenthic fauna was found in great extent in maintaining the limnoecosystem.

On the part of Macrophytes , they were observed in high proportion in summer because of the fact that richment of nitrates and phosphates .thus macrophytes act as harmfull biota as weeds as they gradual shrinked the lake's area as they spreaded over the lake in

high proportion, along with other complications like low transparency, reduced D.O., high CO_2, clogging of water channels lowered entertainmental and recreational sustainable values of fresh water lake and also sometimes the level of O_2 depletes so that it can lead to fish mortality (Tamot& Sharma, 2006).

Conclusion:

The major quality of this miraculous lake to have full of water around the year, so it can be Sustainable used and exploited persistently as preservation of excellent biodiversity, minor irrigation for agricultural cropping, recreational activities, composite farming and aqua cultural practices for many years to come.

By exclusive efforts of Author, Environmentalists and local people government administration declared recently this lake as heritage biodiversity hot spot as well as eco-tourist place. Also was given status of fish farm stocked with fingerlings of major , minor and exotic carps so that supply of fish seed could transport to various places where pisciculture were going on.

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